A preliminary look at smaller geographic units, 1855–1890

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CORRECTIONS

page/line	the correct line
p. 28 l. 28-29	The mutual decline of marriage frequency and the rise of marriage age ...
p. 31 l. 19	(Graph 1, Map 2)
p. 32 l. 35	... to a family curve which...
p. 44 l. 17	..., Hälsinglands Östra, low fertility ...
p. 49 l. 27	... Uppsala provinces is that it lay ...
p. 54 l. 36	... with a low nuptiality ...
p. 56 l. 18	... as rapid as anywhere else, ...
p. 76 l. 23	... of late and less frequent marriage...
p. 135 l. 8	... Dedham, Massachusetts ...

The Fertility Transition in Sweden: A Preliminary Look at Smaller Geographic Units, 1855-1890.

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THE FERTILITY TRANSITION IN SWEDEN:

A preliminary look at smaller geographic units, 1855–1890

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ABSTRACT

The Fertility Transition in Sweden: A Preliminary Look at Smaller Geographic Units, 1855-1890

This is an analysis of the evidence on fertility in the rural deaneries (typically 3-7 parishes) and härader (typically 1-5 parishes) of several provinces in central Sweden, primarily in the years 1855-1890. Certain deaneries are singled out, in the year 1855, as suspected foci of early family-limitation behavior, chiefly by virtue of the relatively low total fertility at any given level of nuptuality, and, by deduction, low marital fertility in these deaneries. Analysis of data on age-specific marital fertility from some of these same deaneries in the year 1890 also indicates that these deaneries, and the härader they contain, were the primary foci of the early advent of family-limitation behavior in rural central Sweden in the years 1855-1890. Yet these vital areas were structurally dissimilar, and the usual indices of population pressure and of sharply declining infant mortality correlate with reduced fertility in only one subset of these areas - a cluster located on the border between Västmanland and Uppsala provinces. What does appear to correlate with the advent of family limitation in all these areas, however, is that they, virtually alone in the provinces studied, seem to have been characterized by a weakened, varied, and to some degree secularized religious climate in preliminary data supplied by Margareta Larsson, Stockholm University. If true, this fact suggests very strongly that cultural change was a vital factor in preparing the way for the advent of family limitation in Sweden. This essentially confirms the hypothesis of John Knodel (Population Studies, 1977) that cultural change was a, and perhaps the only, universal and necessary element in the fertility transition. Recent unpublished research on the fertility transition in several other European countries by Lesthaeghe and Wilson further confirms the view that secularization, as part of a wider process of cultural innovation, was the universal, necessary and, in their view, possibly sufficient condition for the fertility transition in western society. But further work with these weak and contingent Swedish statistics is needed.

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Kenneth A Lockridge

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THE FERTILITY TRANSITION IN CENTRAL SWEDEN: A PRELIMINARY LOOK AT SMALLER GEOGRAPHIC UNITS, 1855-1890.

I

The study of the Fertility Transition in Sweden: The Middle-Level Aggregate Data Introduced

The aggregate demographic data for Sweden during the period of social modernization, circa 1749-1940, are among the best in the world. Around the turn of the century it was common for Swedish researchers to use these statistics in analyses of virtually all the demographic problems researchers are interested in today.¹ But by the time of the Second World War, these data fell into disuse. Only recently has their use been revived. Erland Hofsten, Eva Bernhardt, John Knodel, and Carl Mosk, among others, have used these statistics on the national and provincial levels to describe and to begin to analyze the fertility transition in Sweden, which occurred largely between 1890 and 1930.² Knodel, in particular, offers a very suggestive argument, using Swedish with other European and with Asian data on fertility, that the breakthrough of a modern age-structure of marital fertility resulting from the widespread adoption of family limitation practices in these years was, in Sweden as elsewhere, in part a process of cultural innovation. This thesis explains why demographers have been unable to find a single underlying structural crisis behind the adoption of parity-specific fertility control in the western world, and it offers a greater hope for the adoption of this cultural innovation in Asia and elsewhere today. Mosk, in turn, seeks to find a social process which, both in Sweden and the west and in Japan and the east, was preliminary to the massive adoption of family limitation. Knodel and Mosk do not necessarily conflict, as both are seeking more subtle and flexible definitions of the cultural and material contexts of social change in

which the fertility transition in the west took place.

But the problem in deepening and extending such work, in Sweden at least, is that the provincial-level demographic statistics do not permit a more refined analysis. In the first place, there are only 24 provinces (län) in Sweden (see Map 1). The northern-most four of these, Jämtland, Västernorrland, Västerbotten and Norrbotten provinces, did not participate in the major phase of the demographic transition. These provinces experienced the phenomenon later, in the 1920's, 30's, and 40's, which raises questions about their inclusion in any analysis. The remaining 20 provinces are divided into two major demographic regions, "West Sweden", characterized by relatively low nuptiality, late marriages, high fertility, few illegitimate births, low mortality and high out-migration and "East Sweden", relatively the opposite in all of these respects. The problems here are, first, that within each of these two regions the range of demographic variation between provinces is not great, and, secondly that, both in pre-transition demographic characteristics and above all in the timing and intensity of virtually all social and demographic changes during the period of the fertility transition, these two regions are rather similar. On an absolute scale, then, these two regions are internally relatively homogenous, and during the fertility transition they do not always differ very much at all from one another. Finally, at least four of these 20 southern provinces, Kopparberg, Örebro, Östergötland, and Kalmar, are divided down the middle between the "West" and "East" regions, making their aggregate statistics an amalgam of the two and matching their behavior even more closely to the national average. In sum, on the provincial level, particularly in this southern half of Sweden where most people lived and where the major fertility transition took place, there is not much variation to work with. Sixteen provinces which sometimes differ little from one another within the two main East-West regions, regions which themselves seem to have had roughly similar experiences of the fertility transition, are not the stuff of dazzling further analysis³. The main reason for the lack of variation between provinces within regions, incidentally, seems to be that most provinces are so large, inclusive, and internally diverse. Each might be said to be a summary of many of the varieties of human demographic behavior found in Sweden during the fertility transition, and as a result each province tends to resemble other provinces within its region and to a degree many in both regions tend to resemble the national average.

The recent response to the inscrutability of the provincial statistics has been to leap immediately to the level of individual behavior, through studies of the population of particular parishes (församlingar). Some excellent work has been done in recent years.⁴

Swedish researchers are talented, and the records, above all the house-examination records (husförhörslängder), which give an annual census of each parish, are of unmatched quality. But so far only ten or fifteen of the several thousand parishes in Sweden have been studied and of these few have been analyzed as far forward in time as the vital period of the fertility transition between 1890 and 1930. Further, the different researchers do not always use the same methods, and indeed there is presently no agreement on which measures of family limitation are reliable, so results from these parishes are not always comparable nor is their meaning always clear. Finally, setting each parish in its larger context by means of the provincial aggregate statistics is virtually impossible, as the provinces are too large and too internally diverse to offer a meaningful context. At the present time, parish studies are provocative but little more.

A project now underway at Uppsala University aims to study a carefully selected sample of parishes by uniform methods well into the twentieth century, supplementing statistical analyses with a thorough use of the qualitative sources.⁵ But this will take time and, first in selecting its parishes, and later in testing hypotheses generated there, this project will have to depend on a middle level of Swedish aggregate statistics which has gone virtually untouched since 1940, and which neither Hofsten, Bernhardt, Knodel, nor Mosk have analyzed. These are the statistics for lesser geographic units within the provinces of Sweden. These statistics may in fact offer more than the supporting context which the Uppsala parish-study project seeks; they may offer the quickest way into the details of the fertility transition in Sweden.

From 1749 until 1859, the first national statistical service in Sweden, known as the Tabellverk, required every parish priest to prepare statistical summaries of births and deaths in his parish once a year. Every five years a statistical summary of the age structure, civil status, occupational distribution, economic condition and net migration of the parish population was submitted as well. These tables were then added together to describe all the parishes in a deanery (prosteri; typically made up of 3-7 parishes) and the deanery tables were later added together on the diocesan, provincial, and national levels. Rural and urban areas were kept separate in the tables on all levels. After 1859, the Tabellverk was replaced by the current Statistical Central Bureau (SCB), which gathered or amalgamated data variously on the parish, pastorat (an ecclesiastical unit smaller than a deanery), härad (civil district usually smaller than a deanery, typically with 1-6 parishes) and on the provincial and national levels. Data below the provincial level were seldom published in the decennial censuses, such as those of

1880, 1890, and so on, but the statistical tables on the parish, pastorat, and härad levels were kept in SCB's archive, and early researchers into Swedish demographic behavior published much of the härad data for the period 1880-1940 as part of a series of early analyses of social and demographic changes in Sweden.⁶

The demographic variables on the deanery level, as these are assembled in the Tabellverk from 1749 to 1859, are far from ideal, particularly where fertility is concerned. Only total, not marital, age-specific fertility is available. The level but not the age-structure of illegitimate fertility is given. Neither marriage age nor marriage frequency is given nor can these be deduced from these records without a sea of virtually untestable assumptions. The only "nuptiality" variable is the proportion of all women over age 15 who are married, and this, alas, blends together marriage frequency, marriage age, and a minor effect related to the tendency of men to die early and leave widows, which also decreases the proportion of women over 15 who are married.⁷ The published data for the härad of the post-1860 period, originally gathered or assembled by SCB and published by later researchers, is little better where these fertility-related variables are concerned. Though some kind of marital fertility variable is often printed, these usually express marital fertility only per 1000 population, and do so without good information on the age-sex structure of the population. Published data on marriage age and frequency do not appear to improve significantly in the SCB period. Social and economic variables do, however, increase considerably over what is available for the pre-1860 deaneries, and hitherto unpublished archival data held by the SCB permit the reconstruction of marital fertility by age on the härad and deanery levels. Yet the accuracy of all variables before 1885 has been questioned repeatedly, largely because up to this date both Tabellverk and its successor, the Statistical Central Bureau, relied on local priests to gather and to amalgamate these statistics.⁸

Still, these statistics for such smaller geographic units as the deanery and, after 1860, the härad, are currently the only device available for a widespread and detailed analysis of the fertility transition in Sweden. The data should be used. As the use of this data proceeds, some of the fertility-related variables in the Tabellverk can be "cleaned up" and, with research into the assumptions involved, more precise variables, such as marital age-specific fertilities or marriage frequency or marriage age can be synthesized for this early period. After 1860, increasing recourse can be had to the more precise information on fertility, and eventually to data on marriage frequency and age, contained in the unpublished census schedules in the archive of the Statistical

Central Bureau in Stockholm. Actual use of the local data as it now exists will begin the process of refining or seeking better variables, and will also provide the best test of its reliability. One test already exists, in the brilliant work on infant mortality in nineteenth-century Sweden begun by Jan Sundin and now being completed by Anders Brändström.⁹ The clarity of the picture of evolving regional variations in infant mortality which they have evolved from the deanery statistics in the Tabellverk, and their ability to use parish studies and qualitative sources to confirm and to explain this picture, says volumes for the fundamental accuracy of the data gathered in this source. Because fertility is a more complex phenomenon and the variables less precise, it will be hard to achieve similar clarity in the initial picture of fertility change provided by the statistics for the various Swedish deaneries, but Sundin's and Brändström's work at least shows no reason to expect massive distorting errors in the Tabellverk data, where the worst distortions should occur. Presumably the published and unpublished data for local units collected by the SCB after 1860 are still more reliable.

This study will begin the evaluation of the data on fertility in these lesser geographic units. It was undertaken in 1977 at the behest of the Demographic Database in Umeå and in co-operation with the Uppsala project on the fertility transition in Sweden.¹⁰ Specifically, it uses the crude variables relating to fertility found, before 1860, in the deaneries as recorded in the Tabellverk and, after 1860, in these same deaneries (reconstructed from data on smaller units) and in the häradar which are within or overlap with these deaneries, as recorded in the published and archival statistics gathered by the Statistical Central Bureau. The goal is to offer a preliminary picture of the early stages of the fertility transition in central Sweden. The analysis begins with total, but not marital fertility, in the form of the Total Fertility Rate, an age-specific-fertility based, age-pyramid-adjusted measure of the total number of children 1000 women are likely to have in a lifetime, and a crude "nuptiality" variable, namely the proportion of all women over 15 who are married, and brings in background statistics on illegitimacy, infant mortality, social structure and welfare, all drawn from the over 50 deaneries in Värmland, Örebro, Uppsala, Västmanland, Kopparberg and Gävleborg provinces in central Sweden (Map 1), in the years 1805-6 and most particularly 1855-6.¹¹ These data are supplemented with the same or very similar variables, plus marital fertility and marital age-specific fertility data rescued from the archives of the SCB, for the reconstructed equivalents of the roughly 25 of these deaneries which were found in Västmanland, Kopparberg, and Gävleborg provinces, and for the approximately 45 häradar which were partly or entirely contained within these

deaneries, for the years 1889-90.¹² Only rural areas are considered. Once rural fertility patterns in central Sweden 1855-1890 are delineated by the use of the demographic data, the related social and economic variables for the same areas and times will be drawn into the analysis.

The chief aim, then, is to examine the potential diffusion of family limitation, in the sense of parity-specific fertility control, into these rural areas during the early stages of the fertility transition in central Sweden, an area which itself has long been considered to be the initial locus of the massive conversion to a modern fertility regime in Sweden.¹³ But the larger aim is to use these and other rough-and-ready local statistics, with as few further assumptions as possible, to comment on the larger structure of the entire fertility transition in Sweden. With due modesty, even these crude variables from a few localities speak very persuasively in their way of that transition.¹⁴ With further refinement of the variables, these middle-level statistics may offer an equally fruitful avenue to understanding the fertility transition, alongside the further parish studies of the Uppsala project.

II

Low Total Fertility Per Unit Nuptuality in 1855: An Early Indicator of the Fertility Transition in Central Sweden?

The first goal is to find in the statistics some way of separating out the various fertility regimes within the six provinces in central Sweden studied in 1805-6 and in 1855-6, well before the great breakthrough of family limitation after 1890, and to identify among these regimes that regime and the particular geographic areas associated with it, where large proportions of families may have adopted family limitation at this early stage. These initial "suspected" family-limitation areas, if they are in the three of the six provinces for which later data has been processed for this analysis, can then be tested against the known age-specific marital fertility data for the same areas in 1889-90. This later data will tend to reject or to confirm the hypothesis that the early breakthrough of family-limitation into rural areas, occurred precisely in the areas where such an event is suspected from the earlier data. Statistical correlates of the event can then be examined.

The method chosen is to graph the Total Fertility Rate against the crude nuptiality rate (percentage of all women over 15 who are

married) for the 50-odd deaneries of Värmland, Örebro, Uppsala, Västmanland, Kopparberg and Gävleborgs provinces in 1805-6 and in 1855-6, using the data in Tabellverket (Graphs 1, 2). The reasons for graphing these two variables are both theoretical and practical. The "theory" is as follows: The first strategy, conscious or unconscious, by which fertility and so population growth were reduced in nineteenth-century Sweden was a sharp reduction in nuptiality throughout most areas of the country. Women married less frequently than and at a later age than previously, and by some estimates this decline in nuptiality accounts for most of the decline in total fertility in Sweden in the years 1805-1870.¹⁵ This associated decline in nuptiality and in total fertility emerges clearly within each of the demographic regimes, or regions, presented in Graph 2, for the years 1855-6. The argument here is that, already by 1855-6, certain deaneries, probably in geographic sub-clusters, should stand out by reason of their declining and/or relatively low fertility per unit nuptiality. That is to say, whether or not these deaneries participated in the growing trend to lower nuptiality and to the associated lower total fertility, at any given level of nuptiality they should show a distinctly lower level of total fertility than all other deaneries at the same level of nuptiality. The crude deduction in such cases must be that some cause or causes independent of the effects of nuptiality is acting there to lower total fertility. The early advent of family limitation is one such potential cause which might lie behind a low total fertility per unit nuptiality.

A more refined argument would point out that, if rates of illegitimate fertility are nearly the same across all deaneries studied in 1855-6, as in fact they are, then the differences in total fertility per unit nuptiality graphed for these years will be essentially equivalent to relative marital fertility. For only low nuptiality, low illegitimacy, or low marital fertility can explain low total fertilities; and when total fertilities per unit nuptiality are low and when this cannot be explained by low illegitimate fertilities, the deduction is that low marital fertility is the explanation. One would expect then, where illegitimacy is constant that the deaneries marked by the lowest total fertilities per unit nuptiality would show the lowest marital fertilities of all deaneries. In such a case, certainly, wherever the absolute levels of total fertility in the deaneries characterized by low total fertility per unit nuptiality are at least as low as the lowest absolute total fertilities achieved in deaneries where low nuptiality is the apparent cause of low absolute total fertility, then the deduction is very clearly that the former deaneries have achieved their equally low or lower absolute total fertilities by means of the lowest absolute rates of marital fertility

in central Sweden in 1855-6, and indeed by rates of marital fertility distinctly lower than in the areas where low nuptiality is the apparent cause of similarly low rates of total fertility. That is, when illegitimate fertility is constant, deaneries where the lowest absolute levels of total fertility are not associated with correspondingly low levels of nuptiality can only have achieved their low absolute total fertility by means of the lowest marital fertilities in the sample and by distinctly lower marital fertilities than elsewhere. And any deaneries which have the lowest total fertilities per unit nuptiality and have the lowest marital fertilities in central Sweden, marital fertilities distinctly lower than in areas characterized by low nuptiality, are automatically potential localities for the early advent of family-limitation behavior in central Sweden. Finally, if infant mortality is also constant, as it is here, this possible determinant of low marital fertility is ruled out and family limitation is made a more plausible cause in these crucial areas.

This is not to say that such predicted family-limitation localities never had recourse to lower nuptiality as a preceding or simultaneous fertility-reduction strategy alongside potential family limitation, though it would be expected that the earlier any hypothetical family-limitation behavior began in a locality, the less recourse to low nuptiality as a parallel and conscious fertility-limitation strategy would be required. Nor is it to predict that in other areas, where nuptiality was extremely low and appears substantially to have reduced total fertility, family limitation behavior was totally absent. The two strategies are not totally independent of one another, though, as will be seen, they are to a detectable degree independent. It is only to say that certain localities should appear in 1855, by reason of a low total fertility per unit nuptiality and a total fertility at least as low as any elsewhere in the area, hence, by deduction, by reason of uniquely low marital fertilities, to be prime candidates as the foci of the most intense early family-limitation efforts. Such behavior had to start spreading to rural areas somewhere, before it became epidemic IN rural Sweden shortly after 1890. Given the available data, in theory such areas would be the most suspect. The evidence will show that this set of theoretical assumptions is very probably true.

Finally, in actual practice, by 1855-6 the graph of the total Fertility Rate versus crude nuptiality simply gives the clearest picture of the various fertility regimes in central Sweden prior to the massive breakthrough of family limitation. No other variables in the Tabellverk and specifically not infant-mortality-related variables, provide the same degree of separation or of explanation where variations in total fertility are concerned as does crude nuptiality. (The specific values for all relevant variables are given in

Table 1.) 16

What the resulting graphs of the Total Fertility Rate versus crude nuptiality actually show, in embryo in 1805-6 (Graph 1) and in great clarity in 1855-6 (Graph 2), is the emergence of three distinct demographic regimes each corresponding to a geographically consistent set, or in the third case to two or three sub-clusters, of deaneries in central Sweden. These three regimes, and regions, differed not so much with respect to the overall relationship between fertility and nuptiality, which by 1855 had become significant within each region, but differed most, rather, with respect to the average levels of total fertility which prevailed at any given level of nuptiality. Two of these regions, a "west" region and an "east" region, conform very well to the two primary demographic regions in Sweden as identified by Gustav Sundbärg already in 1910.¹⁷ Basically, relative to the "west" region deaneries, the deaneries of the "east" region show a distinctly lower total fertility per unit nuptiality, a fact which Sundbärg would have led us to expect but which still requires explanation. A third regime, actually made up of two or three clusters of deaneries located geographically within the east region, is characterized by the lowest total fertilities per unit nuptiality, and by some of the lowest absolute total fertilities, in central Sweden in 1855 (Graph 2). It is here if anywhere that one would expect that family limitation had made its breakthrough. For these regional differences in fertility per unit nuptiality, and above all the extremely low fertilities per unit nuptiality in the third region, cannot be explained by progressively lower rates of illegitimate fertility in each region. Illegitimate fertility was essentially constant across all three regions. (See Table 1, and discussion, below). Therefore, these regional differences in total fertility per unit nuptiality in 1855 can only stem from progressively lower average rates of marital fertility in each successive region, with the lowest average rate of marital fertility lying in the "region three" identified on the graph. Indeed, the low absolute levels of total fertility which prevailed in region three, which included the lowest total fertility rates in central Sweden in 1855 and were consistently at least as low as the levels achieved by the areas which had the lowest nuptiality rates (Graph 2), can only be explained by the deduction that the deaneries in this third region had the lowest absolute rates of marital fertility in central Sweden at the time, and distinctly lower rates than in the areas where a nuptiality strategy seems to have prevailed. What other deaneries had achieved largely through lower nuptiality, the deaneries of region three had evidently achieved and surpassed chiefly through the lowest marital fertilities encountered in the area at mid-century.

Graphs 1 and 2, then, present the evolving relationship between the Total Fertility Rate and nuptiality in central Sweden between 1805 and in 1855. A careful description of the patterns which emerge across these two graphs follows, in the course of which the conclusions just announced will be derived and summarized before the argument is developed further. Readers who are willing to take these conclusions for granted should skip ahead to the recapitulation on page 29.

The first impression from studying the graph of fertility versus nuptiality in central Sweden in 1805 (Graph 1), and what will become more obvious in retrospect, is that the range of variation in both fertility and nuptiality was then so little. Thus, the Total Fertility Rate (excluding outlying values discussed below) runs from 3550 children per 1000 women-lifetimes in Hälsinglands Östra deanery in Gävleborg province, to 5200 in Wisnum deanery in Örebro province. Nuptiality ranges (outlying cases aside) from 47.75% of all women over 15 married, in Gilberga deanery in Värmland to 54.75%, again in Wisnum deanery in Örebro province. (The outlying values, higher fertility in Nora deanery in Värmland, lower nuptiality in Fellingsbro deanery in Örebro, and higher nuptiality in Örbyhus in Uppsala province, are all associated with odd structures in the original statistics, and it appears that these may be the result of the famous inaccuracy of tired rural deans as they added parish figures together to get statistics for each deanery). Removing the suspect outliers, in fact, and removing also Wisnums (Örebro province) and Norrbärke (Kopparberg), leaves all but these five deaneries clustered into a Total Fertility range of 3550-4800 and into a nuptiality range of 47.75% to 54.50%. Any relationship between the two variables is obscured by this clustering of their values. Nor is any relationship presumed. What the picture seems to offer is a portrait of "natural" fertility as it existed in Sweden in 1805, with an average level of circa 4250 which is potentially consistent with true natural fertility (the absence of conscious limitation), and a picture of the "natural" nuptiality level which characterized Sweden prior to the sharp decline in marriage frequency and the well-known rise in marriage age later in the nineteenth century.¹⁸ It does not appear that the existing differences in nuptiality explain much if any of the narrow range of differences in total fertility, nor would they be expected to at this early date. A half-dozen other factors, such as variations in illegitimate fertility, in infant mortality and/or breast feeding practices, in age-differences between spouses, in marriage durations, and in nutrition might explain the existing difference between a Total Fertility Rate of 3550 and one of 4800. Such variations are characteristic of pre-modern demographic regimes.

Yet already in 1805 certain geographic patterns begin to

emerge (Graph 1). In general the deaneries of Värmland and of some or all of Örebro province (as presented on Graph 1 and listed in Table 1), i.e. the two geographically adjoining provinces west of the others in the analysis, show a mild relationship between fertility and nuptiality. Among the deaneries of these two provinces there is a discernable tendency for lower nuptialities to be associated with lower fertilities. The line of the relationship runs from Wisnum (Örebro), in the upper right of the graph, down to Nordmark and Gillberga (Värmland) in the lower left. It can also be seen that while in general the deaneries of these two provinces show lower nuptiality levels, they also show higher fertilities at any given level of nuptiality, and absolutely, than the deaneries of Uppsala, Västmanland, Kopparberg and Gävleborg provinces, also on the graph. A similar loose but detectable relationship between nuptiality and fertility can be seen across two geographic clusters of deaneries within these remaining four provinces, to wit Åsunda, Trögd, Södra Fjerdhundra, Ulleråker, Sala and Hedemora deaneries in Uppsala, Västmanland, and Kopparberg provinces, and Hälsinglands Östra, Västra Nedre, Västra Övre, and Norra deaneries in Gävleborg province (Graph 1, Map 2). But what is noteworthy in these latter areas is the remarkably low fertility they show at any given nuptiality level compared with all other deaneries. These sketchy patterns emerge far more clearly in 1855 (Graph 2) and at this point it becomes possible truly to separate out and to discuss the different fertility regimes in central Sweden before 1890.

Between 1805 and 1855 a great deal has occurred. While in a few deaneries nuptiality levels have remained at or even above their older levels, by 1855 nuptiality levels in most deaneries have fallen, reaching a new low of 43.33% in the case of Kil deanery in Värmland. The maintenance of high levels of nuptiality in some deaneries, combined with this general decline to new lows in most, has vastly extended downward the range of variation in nuptiality behavior by 1855. Similarly, while in Värmland and in Nora, Edsberg and Wisnum deaneries in western Örebro, total fertility has actually risen to an average of circa 5000, and has maintained its old maximum of 5300, in general fertility has declined elsewhere, reaching a new low of circa 3000 in Trögd deanery in Uppsala province. In the case of fertility as well, then, the continuation of high levels in some deaneries together with a general decline to new lows in the others has vastly extended the range of behavior. The result of this extension of the range of variation in both variables, itself probably caused largely by a decline in nuptiality which drew fertility down with it but also caused by lower fertilities per unit nuptiality due to local declines in the level of marital fertility, is a vast clarification of three differing fertility regimes corresponding

to three separate geographic regions, the last a double or triple region geographically, all of which had been seen in embryo in 1805.

To begin with the west region marked on Graph 2, by 1855-6 these deaneries, to wit virtually all of Värmland province, and Nora, Edsberg and Wisnum deaneries in adjoining western Örebro province, now show a definite relationship between nuptiality and the total fertility rate, as indeed does each of the three separate regions which emerges in 1855. Whether or not the decline in average nuptiality rates in this western region of central Sweden from circa 50% in 1805 to circa 47% (and note that the gross nuptiality measure used here tends greatly to understate the actual magnitude of the decline in marriage frequency among younger cohorts) in 1855 was a conscious effort to lower fertility, this decline was certainly associated with distinctly lower total fertility in the deaneries where it was most marked. As, for example, in Kil, where nuptiality fell from circa 49% to circa 43% and total fertility declined from circa 4700 to circa 4150, or in neighboring (see Map 2) Nors and Nyed deaneries, where nuptiality fell from an average of approximately 49.50% nearly to 45% and where total fertility on the average declined from circa 4650 to 4400. It was the associated declines in nuptiality and in fertility in these particular deaneries, all geographically clustered around the northern end of Lake Vänern, between 1805 and 1855, which created the overall relationship between nuptiality and fertility in Värmland and western Örebro visible in 1855. Kil, Nors, and Nyed moved down to join neighboring Gillberga at the bottom end of this relationship, while in the peripheral areas of Värmland and west Örebro, such as Nordmark and Jösse-Fryksdal-Älvdal deaneries in Värmland and Wisnum, Nora, and Edsberg deaneries in western Örebro province, the declines in nuptiality were generally less or were virtually nonexistent and were if anything associated with an increase in fertility (Graph 2). These latter areas in the western region were left behind at relatively high levels of nuptiality and of fertility, and constituted the top end of the relationship which emerges in 1855.

What is most noteworthy about this western region, however, is that while by 1855 it, like the remaining two regions on Graph 2, showed a clear relationship between nuptiality and fertility, in the western region there was still an unusually high level of fertility per unit nuptiality and so a high level of fertility in general (Graph 2). This tendency could be seen in embryo in 1805 but was far more prominent by 1855. The failure of fertility per unit nuptiality to decline at all in most western deaneries between 1805 and 1855, the actual increase in fertility per unit nuptiality in such areas as Nordmark and Jösse-Fryksdal-Älvdal, in Värmland, and in Wisnum, Nora, and Edsberg, in Örebro, and the simultaneous decline in

fertility per unit nuptiality in many deaneries outside the west region, made the high fertility per unit nuptiality of the west region quite distinct by 1855. Even in such western deaneries as Nors and Nyed, where nuptialities as low as 45.50% were associated with total fertilities as low as 4400, fertility per unit nuptiality was still far higher than in such eastern deaneries as Vestre Rekarne in Västmanland or Waksala in Uppsala province, in the next region to be discussed, where the same levels of nuptiality prevailed but where fertilities were in the 3525 range (Graph 2). Or, similarly, while in Nordmark and Nora, in the western region, nuptialities of 48% were found alongside fertilities near 5150, to the east in Örbyhus and in Köping, where similar levels of nuptiality existed, fertilities were down in the 3800 range. Plainly, whatever forces other than nuptiality had operated to reduce fertility, these other forces had had little impact in Värmland and western Örebro compared with their impact in Västmanland, Uppsala, Kopparberg, and other provinces to the east. The western region might, therefore, be considered as a region where by 1855, only the force of lower nuptiality had acted to reduce a "natural" fertility which would otherwise still have hovered above the 5000 range. That is, save for the extremely low nuptialities in some deaneries in this region, and save for the generally lower nuptialities throughout this region, there seems to have been a relative absence of those strong restraining factors, conscious or unconscious, which by 1855 were producing distinctly lower fertilities per unit nuptiality elsewhere in central Sweden. (This does not mean, however, that even with the maximum conceivable nuptiality rate, fertility in the west region would have been totally without restraint. Many factors, such as poorer nutrition, greater age differences between spouses, and shorter marriage durations, and perhaps also some conscious factors, might still have held this "natural" fertility in the west region below the maximum known true natural fertilities of 7000-8000, even had nuptiality not declined here.)¹⁹

Whatever the exact nature of the fertility regime in these western deaneries, the important question is probably not why total fertilities per unit nuptiality and total fertilities in general were higher in this western region, or whether, with the impact of lower nuptiality subtracted, these higher fertilities represented true natural fertility in any sense, but rather why by 1855 fertility per unit nuptiality and total fertility had come to be so much lower in the bulk of the remaining deaneries to the east (Graph 2). In answering this question, it is important to emphasize that the decline in fertility per unit nuptiality in eastern areas and the related decline in average total fertility levels there (attenuated only slightly by the opposite effects of rising nuptiality from west to

east are probably caused by a decline in the levels of marital fertility in these same areas.

Thus, the western region which emerges in 1855 with the highest level of fertility per unit nuptiality is geographically a part of the "West Sweden" identified by Gustav Sundbärg early in the twentieth century (Map 1), and its characteristics, especially a tendency to lower nuptiality, due both to fewer and to later marriages, and yet to higher total fertility, are precisely those Sundbärg identified as characteristic of "West Sweden".²⁰ Sundbärg also observed that illegitimate fertility throughout West Sweden tended to be lower than elsewhere in Sweden, which means that the unusually high total fertility here is almost certainly attributable to higher marital fertility than in areas which Sundbärg labelled "East Sweden", and which include our Uppsala, Västmanland, Kopparberg, and Gävleborg provinces. In all of Sundbärg's "East Sweden", by contrast, a generally lower total fertility included a relatively larger component of illegitimate fertility, which, when subtracted from the lower total fertility in this region, implied on the average an even lower marital fertility in East than in West Sweden. In sum, the differences in total fertilities between Sundbärg's West Sweden (higher) and East Sweden (lower) are even more pronounced where marital fertilities are concerned.

The actual data on illegitimacy from Tabellverk used here indicate no significant differences in illegitimacy rates between the particular parts of Sundbärg's West Sweden which are sampled here, and are the western region identified on Graph 2, and the particular parts of his East Sweden which are sampled here and are the remaining points on the same graph (see Graph 2, Table 1). In 1855 illegitimacy ranged from 7 to 13% of all live births in the deaneries of Värmland and western Örebro (a range which, incidentally, is not large enough to create and which does not correlate strongly with the range of differences in total fertility within this region). In the deaneries of Uppsala, Västmanland, Kopparberg, and Gävleborg provinces to the east, which are the remaining points on Graph 2, illegitimacy ranged similarly from 8 to 12% (and here too, save for the Rättvik-Leksand-Mora area, where illegitimacy rates of circa 3% mean that the total fertility figures for these areas slightly understate marital fertilities here relative to other areas, and save for Hälsinglands Vestre Övre deanery, where an illegitimacy rate of 14.5% creates a mild opposite effect, internal variations in the illegitimacy rate between these eastern deaneries have little to do with internal variations in total fertility within this region). But this still means that, since the particular western deaneries included in this analysis have illegitimacy rates essentially identical with the other, eastern, deaneries in the analysis, the higher total fertility

for the west region seen in Graph 2 accurately represents the relative marital fertility of that part of central Sweden in 1855. Conversely, again given the constancy of illegitimate fertility across all areas sampled here, the deaneries to the east of the western region in Graph 2 had on the average distinctly lower marital fertilities than the western region deaneries sampled here, in the proportions represented by the differences in total fertility presented in Graph 2. This lower eastern marital fertility almost certainly explains why the total fertilities per unit nuptiality and (despite the countervailing impact of generally higher nuptialities) in general the total fertilities, are progressively lower from west to east. (The same circumstances are found faintly within the data for 1805 (see Table 1). There is, of course, a widespread increase in illegitimacy rates from 1805 to 1855 in all regions graphed as in Sweden in general (Table 1) but the net effect here is simply that Graph 2 slightly understates the general decline in marital as opposed to total fertility from 1805 to 1855. Of further significance is the fact that infant mortality is also essentially constant across all regions on Graph 2, (see Table 1), which indicates very strongly that this factor is not involved in the implied lower marital fertilities in the regions further east of Värmland-Örebro.)²¹

The real issue, then, is why by 1855 total fertilities per unit nuptiality, to a degree total fertilities in general, and by deduction marital fertilities were on the average so much lower in the bulk of the remaining deaneries, located to the east of Värmland and western Örebro. For, leaving aside for the moment a third "region" of deaneries geographically located within this eastern region, where still lower fertilities per unit nuptiality had been achieved, the fact is that by 1855 the mass of deaneries in eastern Örebro, Västmanland, Kopparberg, and Gävleborg provinces formed a geographically contiguous "east region" where, while internally much the same link between declining nuptiality and declining fertility had emerged as had by then evolved in the deaneries of Värmland and western Örebro, at any given level of nuptiality the total and by deduction the marital fertility was far lower than in the deaneries of the western region.

This development, so palpable in Graph 2, is summarized in Table 1 in statistical form, and the details of its emergence between 1805 and 1855 can quickly be outlined. Two tendencies which emerged between 1805 and 1855 had helped this east region demographic regime emerge more clearly. First, within this "east region", as denoted on Graph 2 by the broad band of values proceeding upward and to the right from Waksala and Vestre-Rekarne to Vester-Dal and Hagunda, in certain deaneries, such as Håbo and Norrunda in Uppsala province and Vestre-Rekarne

and Munktorp in Västmanland, nuptiality rates fell from circa 53% in 1805 to roughly 47% in 1855 while simultaneously total fertility rates declined from circa 4300 in 1805 to 3600 in 1855. This contrasts with such generally more northerly deaneries within the region, such as Gästrikland and Gävle in Gävleborg province and Vester-Dal in Kopparberg, plus Hagunda to the south in Uppsala, where nuptiality remained around 53% and fertility stayed at its former level of circa 4300. The result, albeit at slightly higher average levels of nuptiality and lower average levels of fertility, was that the eastern region now showed much the same relationship between nuptiality and fertility which had been embryonic in the west region in 1805 and had definitely emerged there by 1855. Throughout central Sweden then, and even within a third region found within the eastern deaneries included in the analysis and discussed below, there was now a firm relationship between nuptiality and total fertility. This is no surprise.

But at the same time, by 1855 in the east region the relationship between declining nuptiality and declining total fertility existed within a region which had a distinctly lower level of fertility per unit nuptiality than its western neighbor. This, too, was already embryonic in 1805, but it, too, had emerged much more strongly by 1855. This happened both because fertilities per unit nuptiality actually increased, as noted, in a few of the deaneries in the west region, and also because fertilities per unit nuptiality in an number of east region deaneries where this figure had previously been relatively high, most notably in adjoining Köping and Vestre-Fernebo in Västmanland, and possibly in Norbärke in Kopparberg province, fell distinctly between 1805 and 1855. (A similar event moved Wisnum deanery in eastern Örebro out of the west and into the east region by 1855). The result was a clarification of the earlier, embryonic tendency of the eastern region to achieve lower total fertilities per unit nuptiality, generally lower total fertilities and, by deduction, lower marital fertilities. By 1855 total fertilities per unit nuptiality in the eastern region were circa 81.5, as against over 100 units fertility per unit nuptiality in the western region. This phenomenon is implicit in Sundbärg's identification of the larger "East Sweden" of which this eastern region is a part, characterized by an unusually low total fertility with respect to its higher nuptiality rates, a low total fertility apparently caused by low marital fertility. The graph for 1855 simply presents this phenomenon in its most dramatic form and time.

What, then, were the "device or "devices", if conscious they were, which had enabled Sundbärg's East Sweden and specifically the eastern region among the deaneries represented on Graph 2, to achieve distinctly low fertility per unit nuptiality and by deduction

low marital fertility above all in 1855? This question can only be answered by first describing still a third region, or rather three sub-clusters of deaneries geographically speaking, which simultaneously emerged from within the general eastern area described by eastern Örebro, Uppsala, Västmanland, Kopparberg and Gävleborg provinces. This is the "region three" identified by underlining on Graph 1 and found on Graph 2 along the line proceeding upward and to the right from Sala and Trögd to Hälsinglands Norra and Vestre Nedre deaneries. Geographically, this third "region" actually includes at least two areas: First, an area made up of the contiguous deaneries of Trögd, Åsunda, Lagunda and Håbo (plus slightly removed Ulleråker) in Uppsala province, Södre Fjerdhundra and Sala, in Västmanland, and, in a half-detached fashion, Hedemora deanery in Kopparberg province, which might be counted as a separate area, and finally, the adjoining Hälsinglands Norra, Östra, and Vestre Nedre deaneries which constitute most of the landscape known as Hälsingland in northern Gävleborg province (Map 2). Here the entire analytical picture moves precisely one step further, for here by 1855 total fertilities per unit nuptiality, in many cases total fertilities, and, by deduction from the constancy of illegitimate fertility, marital fertilities, were lower still!

In this "region three", as elsewhere, the intensifying relationship between declining nuptiality and declining fertility in certain deaneries had created, by 1855, a distinct overall relationship between these two variables within this as within the other regions graphed. Thus, in Sala and in Trögd, nuptiality fell from circa 53% in 1805 to circa 47.50% in 1855 and total fertility from circa 3750 in 1805 to circa 3150 in 1855, placing these deaneries at far lower nuptiality and fertility levels than such deaneries as Hedemora, where between 1805 and 1855 there was little decline in either variable. At the same time, the remarkably low fertility per unit nuptiality, already faintly embryonic in this third region in 1805, was greatly enhanced when nearly all the deaneries save Hedemora and Hälsinglands Östra lowered their fertilities per unit nuptiality between 1805 and 1855. The result by 1855 was a regional figure of roughly 69 units total fertility per unit nuptiality, as against 81.5 in the eastern region. This figure, then, best represents the emergence by 1855 of a third region, a sort of doubly or triply clustered sub-region, where the emerging relationship between nuptiality and fertility found everywhere is augmented, as in the eastern region in general but far more so, by relatively low fertilities per unit nuptiality, in this case the lowest fertilities per unit nuptiality of all! Here, too, the near-constant level of illegitimacy in the whole sample indicates that lower marital fertilities lay behind the consistently low total fertilities

per-unit-nuptiality and largely explain the generally lower total fertilities in region three. Indeed, the deaneries in region three include the very lowest and are consistently among the lowest total fertilities found in the broad areas of central Sweden sampled. Since the absolutely low total fertilities here cannot have been achieved by lower nuptiality alone, as fertilities here are generally lower than nuptiality levels would seem to explain, and since these low total fertilities cannot have been attained through low rates of illegitimate fertility, as these are essentially constant across the whole sample, the deduction is that by and large the deaneries of region three had distinctly the lowest absolute marital fertilities in central Sweden in 1855. What, then was extra device, or devices, outside the influences of nuptiality, which this third region enjoyed in turn over the eastern region? How did it achieve such relatively low rates of marital fertility? This question might well be answered before the narrative returns to the "east region" and even to the "west region", for in truth, they are probably less significant and more complex cases than this third region.

In sum, the graph of the relationship between nuptiality and fertility in central Sweden in 1855 is, despite the weakness of the original data gathering and assembly process, despite the "dirty" variables used, and despite taking only two explicit variables to describe a complex demographic situation, most revealing of the demographic forces at work on fertility in Sweden in the period at the beginning of the fertility transition. Everywhere by 1855 a relationship had been established between lower nuptiality rates and lower total fertilities. This is no surprise to students of Swedish demography. The mutual decline of marriage age frequency and the rise of marriage in mid-nineteenth century Sweden is well known and, both on the national level and among the deaneries studied here, declines in total "nuptiality" of the order found in these statistics can mathematically explain a good deal of the decline in total fertility found in the same statistics. But what is more surprising is the delineation, within this overall relationship, of three distinct geographic regions where, for reason or reasons unknown, each subsequent region has achieved lower total fertility per unit nuptiality, to a degree (despite rising nuptiality across these regions) lower total fertility in general, and by deduction, lower marital fertility than the preceding region. These differences in fertility patterns are, furthermore, not explained by differences in infant mortality in the three regions on Graph 2, as infant mortality (dead under 1 year of age) averaged 13% of children born in the west, east, and third regions delineated in 1855 (see data in Table 1). The regional phenomenon found here requires other explanation, and surely the lowest fertilities per unit nuptiality and marital fertilities

found in the third region, a double or triple region never described or predicted by Sundbärg, might hold the key to the beginnings of the fertility transition in Sweden. Sheer logic poses the question. If the east region had some device or devices which enabled it to achieve lower fertilities per unit nuptiality than the west region, what extra device must the third region have had to achieve a further distinct lowering of fertility per unit nuptiality, and of marital fertility, over that in the east region? If family limitation had broken through at all to rural areas in central Sweden by 1855 it must have done so in this remarkable third region.

III

Confirming Indicators of the Fertility Transition in Central Sweden: Other Evidence in the 1805-1855 Data; the Åsunda study; Age-Specific Marital Fertility in 1890

The suspicion that the third region identified in 1855, is, by reason of its relatively low fertility per unit nuptiality and by reason of its low marital fertility, the most likely candidate as the location of the early breakthrough of family limitation into rural areas in central Sweden, is in fact confirmed by other evidence. Some of this evidence is drawn from the Tabellverk data for 1805 and 1855, or from local studies done in this area, but most of it comes in the form of data on marital age-specific fertility for 1890, found in the archive of the Statistical Central Bureau in Stockholm.

The first fact of note is that the lower levels of fertility per-unit-nuptiality found in the third region were largely the product of the years after 1805, as one would expect if arriving family limitation practices were the cause. In 1805 the total fertilities per unit nuptiality were: region three (circa) 77, east region 85.5, west region 89. In 1855 the approximate figures were region three 69, east region 81.5 and west region 102. A number of factors could explain the rise in this index in the western region which contributed to the greater differences in fertility per unit nuptiality in 1855. Of primary interest for now is the sharp decline in fertility per unit nuptiality in the third region by 1855, a downward deviation from the general level of 77-89 prevailing in central Sweden in 1805, at a rate of decline and to a level which was not approximated even in the eastern region. In the eastern region, in fact, the average decline from 85.5 to 81.5 was only marginally significant, and

occurred because certain deaneries within this eastern region, deaneries which physically adjoined deaneries in the third region, showed declines in fertility per unit nuptiality - though in no case did these bordering deaneries fall below 73 units fertility per unit nuptiality. Clearly, something happened in the third region between 1805 and 1855 which took it well below the range of 77-89 units of total fertility per unit nuptiality prevailing in 1805, to a figure of 69, a figure which by itself would have doubled the range of fertilities per unit nuptiality over the range which had existed fifty years before. This figure was, in 1855, far lower than the level which could be found elsewhere in central Sweden.

Not only was the timing of the main decline in fertility per unit nuptiality provocative, to one interested in the advent of family limitation, but this decline was associated with unprecedentedly low levels of marital fertility. The decline in fertility per unit nuptiality from 1805 to 1855 was most marked in seven deaneries. In all of these, Södra Fjerdhundra, Trögd, Åsunda, Ulleråker, Lagunda, Håbo and Hälsinglands Norra, this index had fallen from above 77 in 1805 to below 69 in 1855, largely explaining the decline in fertility per unit nuptiality in the third region over this period. (Associated with these were several "spill-over" deaneries geographically adjoining the center of activity in Västmanland and Uppsala provinces, such as Waksala, Dom, Munktorp and Västres Fernebo, which largely explain the over-all decline in fertility per unit nuptiality in the eastern region, from 85.5 in 1805 to 81.5 in 1855.) The significant thing about these seven deaneries is not only that they showed the most rapid rates of decline in fertility per unit nuptiality, in most of these cases to unprecedentedly low levels and in the cases of Lagunda and Håbo, to rather low levels, but that these were seven of the only eight deaneries in 1855 to achieve absolute total fertilities below 3520 (the other was Sala, where fertility per unit nuptiality was already low in 1805). In 1805, none of the 50-odd deaneries had been below a total fertility of 3520. By 1855, it was precisely where fertility per unit nuptiality had declined most rapidly and to previously unheard of levels that this unprecedentedly low level of total fertility had been reached. And it had not been reached by reductions in illegitimate fertility, which rose over this period, but by reductions in marital fertility. Thus, there is an almost perfect association between the cores of the decline in fertility per unit nuptiality between 1805 and 1855 and an implied decline in marital fertility to unprecedentedly low levels.

Finally, the total fertility of circa 3000 reached by one of these seven deaneries, Trögd, in Uppsala province, is so low as to be close to the point at which natural fertility, in the sense of fertility not consciously restrained, ceases to exist and family limitation must be

deduced from the sheer low level of total fertility.²² This is particularly true in a situation where, as in all seven of these deaneries and most notably in Trögd, illegitimate fertility is near 10% of the total and rising, implying that low and falling marital fertility definitely lies behind the low total fertility in these deaneries. The strong impression from the sudden advent of the low fertility per unit nuptiality and low total and marital fertilities here is that family limitation could have been the extra device behind the special fertility patterns encountered in region three in 1855.

It is interesting to note, in this respect, that the deaneries in and near region three actually sort themselves out into two groups, where the trend of fertility per unit nuptiality and of total fertility is concerned (Graph 2). In some of these deaneries, such as Hälsinglands Östra and adjoining Hälsinglands Vestra Övre and Nedre, in the north, and in Hedemora and adjoining Sala deaneries to the south, both fertility per unit nuptiality and total, and by implication marital, fertility were already relatively the lowest in central Sweden in 1805 but did not decline further from 1805 to 1855 (Graph 1, Map 1). In the other deaneries, to a degree in Södra Fjerdhundra but most notably in adjoining Åsunda, Trögd and Håbo in Uppsala province, to an extent in Ulleråker and Lagunda just to the east, and up in Hälsinglands Norra deanery far to the north, the declines in both indexes by 1855 were dramatic. In the key cases, leaving out Ulleråker and Lagunda, these indexes fell from 78 to 66 units fertility per unit nuptiality and from circa 4100 to circa 3300 total fertility. It appears that the "extra device" enjoyed by third region areas as a whole, possibly family limitation, made headway first in the Hälsinglands Öster-Vester area and in the Hedemora-Sala area, but that between 1805 and 1855 these areas were surpassed by the region around Södra Fjerdhundra, Åsunda, Trögds and Håbo, and by Hälsinglands Norra. The theoretical implications of this pattern will be explored later.

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The suspicion that family limitation was the "extra device" common to the deaneries in region three, and perhaps found in a few east region deaneries geographically adjoining them, is further confirmed by a dissertation on Åsunda by John Rogers and Ingrid Eriksson.²³ These scholars studied two cohorts of women in Åsunda härad, which is virtually coterminous with Åsunda deanery, one cohort aged 20 years in 1824-5-6, and another which was 20 in 1854-5-6. In 1855, the first cohort was thus fifty years old and no longer

producing children, while the second cohort was only 20 and had scarcely begun to have children. It might be said, therefore, that the data from Tabellverk in 1855, used in the present study, falls precisely between the first and second cohorts. Rogers and Eriksson were able to apply a number of tests for the presence of family limitation to the individual-level data on the two cohorts from Åsunda. They concluded that the practice of family limitation may have begun among the farmers' wives within the cohort married shortly after 1825, and was definitely, even intensively practiced among the farmers' wives within the cohort married immediately after 1855. While the rural laborers known as statare probably did not practice family limitation at any time during the nineteenth century in Åsunda, there is some indication in the data on "other landless" persons, a group twice as large as the statare and which, with the farmers, made up nearly two-thirds of each of the cohorts studied, that these "other" landless families may also have begun to apply family limitation by the time of the second cohort.

Rogers and Eriksson provide age-specific marital fertility data for each social group within each cohort. This data can be employed in a test of the absence or presence of family limitation as indicated in age-specific marital fertility data, developed by Anseley Coale and James Trussell.²⁴ Their computer program executes this comparison by fitting to the observed age-specific marital fertility curve in a given area, a modelled curve which falls within a spectrum of model parameters in which a model natural fertility curve based on known data is set equal to zero and a model family limitation marital fertility curve based on known data is set equal to one. The chief characteristic which distinguishes the latter parameter from the former is the relatively low fertility among older groups of married women, as a result of the particular impact of parity-dependent fertility control on fertility in these age groups. The value of the actual modelled curve fitted to the observed data can range below 0 or above 1, but in essence it represents the nearest possible stage in the model's overall progression from a natural to a family limitation curve with can be fitted to the observed data (see Graph 2 in Appendix 1 for an example). In general such "m" values, as these fitted model curves are expressed, by themselves alone are reliable indicators of the presence of family-limitation only when the value for the model curve fitted is close to +.400 or when a long time series of m values progresses steadily from low to ever higher values, always approaching the "family-limitation" model value of 1. A measure of the goodness of fit of a given model curve to a given set of observed age-specific marital fertility values is also included, to wit the mean square error, or mse of the regression by which the modelled m curve is fitted.

Coale and Trussell suggest that an mse of .005 indicates a "mediocre" fit, and of course an mse of .000 is a perfect fit. Other problems with Coale and Trussell's "m", especially as it applies to Swedish data, will be discussed elsewhere;²⁵ but in general these do not apply to the Åsunda data.

Applying Coale and Trussell's "m" to the marital fertility curves for the Åsunda cohorts yields results which generally confirm and much strengthen Rogers and Eriksson's conclusions. The fitted m value for the farm families in cohort I, fertile circa 1825-1855, is .209, a value which alone is not sufficient to indicate the presence of family limitation. The m value for "all landless", however, is .257/mse .002, and, when the statare are removed from this group, the value rises above .300. This value begins to approach the level (.400) at which m alone might reliably indicate the presence of family limitation, and it largely explains why the m value for the first cohort as a whole was as high as .297/mse .0006. The measurements for the next cohort tend to confirm this hint that family planning may have begun as much among the non-statare landless as among the farmers of cohort one. Within cohort two, whose children were born circa 1855-85, the age-specific fertility curve for farmers' wives is assigned a model m value of .865. The mse of .0256 is almost certainly a result of the small sample size, and, with the other evidence in Rogers and Eriksson's dissertation, this figure is a powerful indication of the arrival of family limitation among the farmers of Åsunda.²⁶ By reflection backwards, it suggests that the m value of .209 for the farmers of cohort one may have caught the beginnings of this phenomenon. At the same time, however, "all landless" in cohort two show an m value of .392/mse .001, and non-statare landless are above .400. This suggests that the values close to .300 for "all landless" and "non-statare landless" in the earlier cohort likewise caught the beginning of a real if ultimately weaker trend to family limitation somewhere in the lower levels of society. The net result of both trends is an m value of .447/.0008 for all members of the second cohort in Åsunda.

Thus, among our third region areas suspected of family limitation by virtue of their low and in most cases falling fertility per unit nuptiality, and low and sometimes sharply declining total and marital fertilities, Åsunda stands as a strong indication that family limitation was indeed the extra device which uniquely characterized this region and which, in conjunction with the wider trend to low nuptiality, drove its fertility to new lows by 1855. Total cohort m figures of near .300/.0006 for women married after 1825, and of .447/.0008 for women married after 1855 suggest a definite trend to a significant degree of family limitation, a trend which would in theory produce an estimated m value for the women

captured in the cross-sectional data from Tabellverk for 1855 of something over .350. As part of a trend, then, and given the supporting evidence from the Tabellverk, such a value would definitely be an indication of family limitation.

Åsunda further suggests a mechanism by which family limitation might have arrived in the middle of the nineteenth century, namely a beginning both among the substantial peasant farmers of the region and among the non-statare landless before 1855, which after this was brought to full culmination among the farmers long before spreading more widely throughout the society. Rogers and Erikson suggest that the fear that their families would lose social position if they divided their estates among too many children motivated the farmers to have fewer children. What motivated persons of landless status, however, remains to be seen, and must have been quite other than that which motivated the farmers. Furthermore, there was not necessarily always an economic logic in whether or not a group adopted the new practice. In the case of the statare, who did not, economic "logic" argued as much in favor of as against family limitation. One explanation is simply that the statare were culturally resistant to change for reasons beyond the logic of economics.

Was Åsunda typical of region three? In 1855, there is no way to tell, as no other localities in these parts of Sweden have been studied in such detail. But there is a hint in another, an indirect statistical measure which can be applied to the aggregate statistical data available from Tabellverk in 1855, that Åsunda was typical and that family limitation was indeed the extra device which distinguished all the deaneries of this third region. Comparison of the age-specific marital fertility curves with the age-specific fertility curves for all women in the härader of Västmanland, Kopparberg and Gävleborg provinces in 1890 reveals that, beyond a certain point, changes in the shape of the age-specific marital fertility curve in the direction which Coale and Trussell say indicate family limitation (primarily a disproportionate decrease in fertility among women 40-44 and 45-49) generally entailed a parallel set of changes in the age-specific fertility curve for all women. Thus, in this 1890 data, in five of six cases where the modelled m value for a local age-specific marital fertility curve is over .350, the age-specific marital fertility curve of total fertility (i.e., all women) is over .350 in a spectrum of values where the age-specific fertility curve for all Swedish women in 1805 is set equal to 0 and the age-specific fertility curve for all Swedish women in 1935 is set equal to 1. The important point about this latter, parallel measure, is this: In the 1855 data from Tabellverk, where only the age-specific fertility curve for all Swedish women in each deanery is available, the same

mathematical expression of this curve in all the deaneries studied yields similarly positive values only for Trögd, Arboga, Vestre-Fernebo, Hedemora, and Hälsinglands Östra deaneries. Three of these five deaneries are in region three, on Graph 2, and a fourth, Arboga, is as near as can be to the border from the east region to region three (see Graph 2). Even in the 1890 data, this indicator using the age curve of total fertility was not an exclusive measure, in that not all areas with high m values also showed clearly positive values in this measure of the age-specific curve of total fertility. But in 1890 all areas over .350 were also areas with m values over .350. So it is provocative, to say the least, that in 1855 four of the five areas where this new measure is over .350 were in or very near region three, hence were already suspected of having a significant degree of family limitation. Here is a further suggestion that Åsunda may not have been alone in the region three identified in 1855 in showing potentially significant m values and hence the possible presence of family limitation. The positive value for the age-specific total fertility curve for Vestre-Fernebo in this 1855 test is, however, less reassuring, as here no other evidence available indicates the presence of a significant degree of family limitation.²⁷

This same measure of the shape of the age-specific fertility curve for all women was, incidentally, consistently negative in the 1890 test data whenever m values for the age-specific marital fertility curve were below .100. When applied to the deaneries in 1855, this measure of the age-specific total fertility curve gave consistently negative values only in Värmland and western Örebro. This is the west region on Graph 2, where by virtue of the relatively high fertilities per unit nuptiality family limitation is least expected. In sum, this highly contingent measure using the shape of the age-specific total fertility curve, which did register positively with some high m values and negatively with all low m values in the test data for 1890, in 1855 does single out as possible high m areas in four of five cases deaneries already suspected of family limitation by reason of their low fertility per unit nuptiality and does identify as potential low- m areas in nearly all cases deaneries already suspected to be free of family limitation by virtue of their high fertility per unit nuptiality. The measure widely confirms the evidence on Graph 2.

*

By 1890, the list of deaneries singled out by a low fertility-nuptiality ratio has changed little, at least as far as the three

provinces sampled in 1890, Västmanland, Kopparberg and Gävleborg, are concerned (Graph 2-a). A ratio of 66 or fewer units total fertility to 1 unit nuptiality is found in Sala-Södra Fjerdhundra, in Hedemora, in marginal Mora, and in Hälsinglands Norra deaneries. These deaneries are in 1890 joined at or below this low ratio of fertility to nuptiality by an "Arboga" deanery which was already near the border to the eastern region in 1855 and which, in the 1890 sample, is biased toward low-fertility areas near cities. They are also joined by Vestra Rekarne, a deanery whose small size as sampled both in 1855 and in 1890 (as sampled, it is largely Kung Karl's parish in Västmanland) makes its statistical behavior unreliable. Less explicable is the appearance of Köping deanery in Västmanland precisely at the border of 66 units fertility per unit nuptiality in 1890. Further, Hälsinglands Vestre Nedre and above all Hälsinglands Östra deaneries do not show low ratios of fertility to nuptiality in 1890, as they did in 1855, because of a dramatic subsequent rise in fertility there. Nonetheless, Sala-Söda Fjerdhundra, Hedemora, and some parts of northern Gävleborg province (i.e. Hälsingland), and to some degree other nearby areas in the case of Västmanland and Kopparberg provinces (i.e. Arboga, Vestra-Fernebo, Dom, Mora and Stora Tuna deaneries, as on Graph 2-a) still seem in 1890 by this crude measure to be the likely primary and peripheral foci of family limitation in Västmanland, Kopparberg and Gävleborg provinces. Gävle, Norrbärke, Vester-Dal, Rättvik and Leksand still have the highest fertility-nuptiality ratios and so are still least to be suspected of family-limitation behavior. The measure is in this sense consistent across time but is indeed very crude. By 1890 the continued and increasingly geographically irregular rise in illegitimate fertility makes total fertility less reflective of local variations in marital fertility, making the total fertility-nuptiality correlation less reflective of marital fertility behavior. Instead of leaping from the 1855 data on total fertility per unit nuptiality to the equivalent data for 1890, then, it seems more appropriate to compare the 1855 data on total fertility per unit nuptiality (Graph 2) to the much more specific Statistical Central Bureau data on age-specific marital fertility available for 1890.

The data on marital age-specific fertility for the reconstructed deaneries and for their constituent häradar in Västmanland, Kopparberg and Gävleborg provinces in 1889-90 confirm in detail the list of suspected family-limitation areas for these provinces evolved from the 1855 data (Graph 2), and leave little doubt that the phenomenon at hand was family limitation. So far, as noted, only these three of the six original provinces have been processed, as it takes time to aggregate two sets of original census tally sheets, one on the age-distribution of women in each parish and

another on the age and civil status of mothers in each pastorat, into härader and into close fascimiles of the 1855 deaneries in the region. Only data for 1889-90 have been processed, furthermore, because after 1890 the tally sheets become less specific and further sets of sources from the SCB archives must be used. Still, the results, in terms of testing the age-specific marital fertility curves for the härader and deaneries of these three provinces in 1889-90 by means of Coale and Trussell's m , are most dramatic. ²⁸

In these three provinces, the highest m values on the deanery level in 1890 are in "Arboga", a reconstituted version of Arboga deanery biassed toward areas nearest to cities, where $m = .421/mse = .017$, in Sala, $.335/.013$, in Hälsinglands Östra, $.341/.002$, in Hälsinglands Norra, $.325/.007$, in Hedemora, $.268/.002$, in Mora, $.247/.003$, and in Södra Fjerdhundra, $.241/.009$ (see Table 2). These values and fits will be refined shortly, but for now the significant point is that the deaneries in these three provinces which in 1855 were in or near region three on Graph 2, to wit Sala and Södra Fjerdhundra, Hedemora, and Hälsinglands Östra and Hälsinglands Norra, all of which were within region three, and Arboga and Mora, which were two of the four east region deaneries closest to region three, are the only deaneries where in 1890 m values are over .200! The only real inconsistency is that Hälsinglands Vestra Nedre deanery, which in 1855 was in region three, does not show a comparable m value in 1890. (Less importantly, geographically adjoining Hälsinglands Vestra Övre, which in 1855 was relatively near or perhaps on the east region border closest to region three, and Dom and Munktorps deaneries in Västmanland, which in 1855 were also near the east region border close to region three, (as this border is defined on Graph 2) do not show 1890 m values in this .241-.421 range. This is not surprising, however, since once the case of "Arboga", where the bias of the later data almost surely explains the high m value in 1890, is removed, of all the areas on the east region border near region three in 1855 (Graph 2) only Mora has by 1890 been elevated to the group where m values are .241 to .421, and Mora barely makes this distinction with an m value of .247.) Otherwise, it is hard to imagine a better match of the indirect evidence of family limitation behavior in 1855 with the direct measure for 1890.

The range of 1890 m values for the seven deaneries - "Arboga", Sala, Hälsinglands Östra and Norra, Hedemora, Mora and Södra Fjerdhundra - where both the 1855 and the 1890 measures indicate family limitation is from .241 to .421. Significantly, of the next "layer" of areas, which might from the 1855 evidence still have been suspected of a degree of family limitation, to wit Hälsinglands Vestra Nedre, found in the east region on Graph 2, and Hälsinglands

Vestra Övre, Dom Munktorp, Stora Tuna, Vestra Fernebo, Rättvik and Gästrikland deaneries, all in the eastern region just behind Arboga and Mora but still close to the border to region three (Graph 2), and all of which also geographically adjoin at least one of the seven deaneries where all measures now indicate family limitation, all save Munktorp (.107) show 1890 m values ranging from .127 to .192 and are in turn the only deaneries in this range of values (Table 2). Finally, the remaining deaneries in Västmanland, Kopparberg and Gävleborg provinces, to wit Munktorp, Köping, Vestra Rekarne, Norra Fjerdhundra, Leksand, Norrbärke, Vester-Dal and Gävle, all scattered elsewhere within the east region on the graph for 1855 (Graph 2), show in 1890 m values ranging from below zero to .119. Among these Norrbärke and Vester-Dal, in Kopparberg province, which geographically adjoin Värmland and western Örebro (Map 2), showed m values very near to zero, as would be expected of areas which adjoined the west region both geographically and in the graph of suspected family-limitation areas in 1855 (Graph 2). Thus, the map of suspected family-limitation and non-family-limitation areas sketched out in Graph 2 for 1855 is fully confirmed by the map of m values within the three provinces tested in 1890. Table 3 summarizes the correlation between the two measures more precisely, using slightly different categorizations.

Some discussion of each of the seven deaneries in Västmanland, Kopparberg and Gävleborg provinces where both in 1855 and in 1890 family limitation is most suspected, is in order. Both the m values and fits for these deaneries in 1890 and the same values for the particular geographic sub-units most involved in the phenomenon at hand, i.e. for the härader within these deaneries, can be refined considerably by use of the 1890 data. What emerges is that, while the 1890 m values for these deaneries are not extremely high, at .241 to .421, with fits (mse) which are sometimes worse than mediocre, and while these values like nearly all the m values for 1890 are probably inflated by the disorting effects of bridal pregnancy (see Appendix I), the particular härader which are found within or overlap these deaneries show as high or higher and often considerably more reliable m values, and are essentially the only härader in these three provinces of which this is true. Thus, the evidence of m values for the härader in 1890 confirms that parts of these seven deaneries were indeed the primary locations of the early adoption of family limitation in these three provinces.

The Västmanland data are the most difficult to focus, and further work will be needed here. What seems clear is that there are two centers of probable family limitation in this province. The first, and possibly least significant, is focussed on Arboga deanery in general but most particularly on the "Arboga" deanery reconstituted

for 1890 and then unavoidably weighted toward parishes closest to the small cities of Arboga and Köping. This "urban" bias, plus the likely presence of bridal pregnancy as well, somewhat inflates the m value here, and bridal pregnancy also helps explain the miserable fit of the model m curve selected (.421/.017). Bridal pregnancy, in Sweden, is found most commonly among women in the 20-24 age group.²⁴ Because pregnant brides are at risk only a short time before having children, bridal pregnancy raises fertility among married women aged 20-24 disproportionately compared to fertilities in older age groups of married women. This disproportionate fertility leads Coale and Trussell's program to fit to such data a model with a sharp drop-off in fertility from younger to older ages. Such a drop-off, in the overall model, is supposedly found only in family limitation situations, and so the modelled m curve yields a high m value even though in this case the likely cause is not family limitation, which disproportionately reduces fertility among older married women, but bridal pregnancy, which disproportionately raises fertility among younger married women. This is a common problem in the Swedish data. But if women 20-24 are taken out of the regression process by which the modelled m curves are fitted, and women 45-49 (usually left out of the regression on Coale and Trussell's advice, since fertility in this group is so volatile) are substituted, the result is substantially to remove the influence of bridal pregnancy and this yields a lower but more reliable m value. Frequently, the mean square error is also reduced, though the volatile fertility of married women 45-49 may keep this function high. Running the m program in this fashion over groups 2-6 (25-29, 30-34, 35-39, 40-44, 45-49) instead of groups 1-5 (20-24, 25-29, 30-34, 35-39, 40-44) of married women yields a corrected m value of Arboga deanery relatively free of the influence of bridal pregnancy. The result is to reduce the m value to a more plausible .309 though the fit is but little improved at .016. The reason for this in turn, however, is the extraordinarily high fertility. (.042 versus a modelled .009) of women age 45-49 in "Arboga", a good example of how fertility in ages 45-49 tends to cause bad fits and which Coale and Trussell recommend should ordinarily be left out of the regressions. In this case, this cannot be done, as group 1 has been dropped to eliminate the even worse distortion caused by bridal pregnancy. But reducing group 6 (44-49) fertility merely to the .025 average level for Västmanland in 1890 results in a final m value for Arboga of circa .350 and a fit of .008. With the low fertility per unit nuptiality in the entire deanery in 1855, this final m value and hypothetical fit for the admittedly more urban "deanery" of 1890 still suggests the presence of some degree of family limitation in the area later nineteenth century. Further confirmation may be

found in the marital fertility rate (TFR for married women only) which, at 5765, was the lowest found in any deanery studied in 1890.

But the Arboga puzzle yields no more than this, as it is the only case of a deanery which is smaller than the härader in the area; far from being disaggregable into härader, Arboga deanery occupies the southern portions of larger Åkerbo härader, whose 1890 m value of .165/.008 is not revealing. Still, the refined m values and extraordinarily low marital fertility for "Arboga" deanery in 1890 are suggestive of a degree of family limitation at least in the urbanized "Arboga" of 1890. Too far removed from the Sala - Södra Fjerdhundra area to be considered a "spill-over" from that phenomenon, "Arboga" must be considered a somewhat separate early focus of family limitation in Västmanland.

The primary locus of family limitation in this province, however, seems to have been in the Sala - Södra Fjerdhundra area to the east, on the border between Västmanland and Uppsala provinces. But here the phenomenon is even harder to focus. The m values for these two deaneries, at .335/.013 and .241/.009 respectively, are inflated by bridal pregnancy (again, see appendix I), which also explains the bad fits of these model m-value curves to the observed data on age-specific marital fertility in these areas. The härader which go into these two deaneries naturally share this problem. Thus, the m values for Yttre-Tjurbo (.291/.015) and Övre-Tjurbo (.355/.015) härader, which largely co-incide with Sala deanery, and of Torstuna (.345/.016) and Simtuna (.188/.008) härader, which are virtually synonymous with Södra Fjerdhundra deanery, are all potentially inflated and may fit badly because of the distortion caused by bridal pregnancy, as all show unusually high fertility among married women 20-24 (see Table 2). Yet equally plainly, something is going on in this area. In the case of Yttre-Tjurbo and Simtuna, removing the distorting effect of bridal pregnancy by putting groups 2-6 of married women into the regression (as was done with "Arboga") actually increases m values to .420 and .256, respectively, though because of the volatility of fertility in group 6 (women 45-49) fits do not improve.³⁰ Furthermore, Simtuna and Övre-Tjurbo härader have, at 6488 and 6466, the lowest marital fertility rates of all the härader in Västmanland province, where otherwise this rate averages circa 7000. (Only "Arboga" deanery, the unique case of a deanery smaller than a härader, had, at 5765, a lower marital fertility rate in Västmanland in 1890.) In Torstuna härader, on the other hand, putting groups 2-6 in the regression in place of the usual 1-5, lowers the m value to .039/.005, and a marital fertility rate here of 7921 casts further doubt on the presence of family limitation in this particular härader within the Sala - Södra Fjerdhundra area. While family limitation behavior does not have to be associated with

unusually low marital fertility rates, it is seldom found associated with a rate of nearly 8000. ³¹ In sum, Yttre Tjurbo and Övre Tjurbo härad, in Sala deanery, and Simtuna härad in Södra Fjerdhundra deanery, rather than Torstuna härad, also in Södra Fjerdhundra deanery, would seem to be the most likely centers of the phenomenon here.

But even the Sala - Södra Fjerdhundra areas must in turn be considered secondary to what was probably the primary early center of family limitation in this area just north of Lake Mälaren in central Sweden. Namely, the deaneries of Åsunda, Trögd, Lagunda, Ulleråker and Håbo immediately to the southeast of Södra Fjerdhundra in Uppsala province (Map 2). Low fertilities per unit nuptiality and total fertilities approaching 3000 in 1855 leave little doubt, even in the absence of 1890 m and marital fertility data, which have not yet been processed, that here was the heart of the early adoption of family limitation in central Sweden. The overall m value of .447/.0008 for the Åsunda cohort married shortly after 1855 must surely have been higher still for the later cohorts which will be captured once the cross-sectional data for Uppsala province in 1890 have been analyzed. A well fitted value between .500 and .700, even with the effects of bridal pregnancy removed if this proves necessary, would be a reasonable prediction for Åsunda in 1890. What one will get in Trögd can only be imagined. Marital fertility rates below 5000 should be common in this cluster of deaneries in southwestern Uppland, as the area of Sweden essentially synonymous with Uppsala province is popularly called, in 1890. In this perspective, even Sala - Södra Fjerdhundra was only a "spill-over" from this adjoining region.

In this perspective, too, it may not be accidental that Torstuna härad, in Södra Fjerdhundra deanery, where in 1890 the evidence of family limitation is the weakest in the Sala - Södra Fjerdhundra complex, geographically adjoins Hagunda deanery in Uppsala province, where in 1855 the total fertility per unit nuptiality and overall total fertility were the highest in this adjoining province (Map 3, Table 1). The Torstuna - Hagunda area seems to define a sub-region very near the heart of the probable family limitation phenomenon in southeastern Västmanland and southwestern Uppsala province where, from all the evidence, family limitation had made relatively little progress in the 1855-1890 period. North of Torstuna - Hagunda, too, until one reaches the Hedemora and Hälsingland areas, the deanery statistics for 1855 and the deanery and härad m figures for 1890 indicate a relative absence of family limitation behavior (Table 1, Map 2; Table 2, Map 3). Back to the west of the evident center of family limitation activity in Västmanland - Uppsala, however, in such Västmanland deaneries as Dom, Vestra

Fernebo, Munktorp and Köping, the evidence is more ambiguous (Map 3, Table 2). The m values on the deanery level are consistently lower here, as are the härad m values (which fall toward zero once bridal pregnancy is removed), and marital fertilities are somewhat higher here than in the Sala - Södra Fjerdhunda area. At the same time, these deaneries and constituent härader in south-central Västmanland are a bridge between known centers of family-limitation in Sala - Södra Fjerdhundra - Uppsala to the east and in "Arboga" deanery to the west, so here, as in all areas bordering known centers of family limitation, it would not be at all surprising to find individual parishes where family limitation was widely practiced. Data for units as large as deaneries and härader never gives a precise picture of a phenomenon, and this was never more true in all respects than with the evidence of family limitation in Västmanland in 1890.

To the north, in Kopparberg province, Hedemora deanery, $m = .268/.200$, was at heart Hedemora härad, where the m value in 1890 was .479 and the mean square error, with bridal pregnancy apparently less common, was .003. Marital fertility in this härad was 6544 as against a provincial average over 7000. This perhaps does not compare with the expected 1890 values for the Uppland deaneries, but it is clearer evidence of family limitation than was found in Sala - Södra Fjerdhundra in 1890. Hedemora härad was only one of a cluster of härader, not all of which fell into Hedemora deanery, where m values peaked and marital fertilities were relatively low. Thus, the phenomenon found to the south in Uppsala province and in Sala - Södra Fjerdhundra in Västmanland seems to have tapered off through Torstuna, Våla (Våla (.098/.004), and Folkare (.158/.003) härader, the latter in Kopparberg province and all found immediately to the north of the Sala - Södra Fjerdhundra - Uppland focus before mounting again in Hedemora härad and in neighboring Husby, Säter, and Stora Skedevi härader, also in Kopparberg (Map 3). In these latter three härader, bridal pregnancy and marginal sample sizes play havoc with m values and with mean square errors, but the trend of both raw (groups 1-5 in the regression) and corrected (groups 2-6) m values is in the .200-.400 range. Marital fertilities here ranged from 6452 in Säter through 6068 in Husby to 5303 in Stora Skedevi and were, excluding Övre-Tjurbo härad in Södra Fjerdhundra deanery at 6436 and "Arboga" deanery at 5765, the lowest marital fertilities in Västmanland, Kopparberg or Gävleborg provinces in 1890 (see Map 3, Table 2).

Here as elsewhere, individual parishes in the härader surrounding Hedemora, Husby, Säter and Stora Skedevi, such as Folkare, Gamla Norberg, Söderbärke, Stora Tuna, Vika and Ovensjö, surely participated in the "Hedemora" phenomenon, raising m

figures in these adjoining härad into the .150-.250 range through a process which was probably not accidental. Farther to the north, in Kopparbergs- och -Aspeboda and in Svärdsjö härad there may be hints of a secondary center of family limitation activity, though in Kopparberg- och -Aspeboda this may be an artifact of m values inflated by bridal pregnancy (Map 3; Table 2). On the deanery level, Säter, Stora Skedevi, Torsång (too small otherwise to be included here but clearly part of the core of the Hedemora phenomenon), Stora Tuna, Vika, Kopparberg- och Aspeboda, Sundborn and Svärdsjö härad are all lumped into Stora Tuna deanery, which helps explain the m value of .177/.002 in this deanery, since it thereby includes part of the core "Hedemora" phenomenon and much of its periphery along with areas relatively unaffected. Similarly, Hedemora härad itself, Husby and peripheral Folkare (.158/.003) are the härad which go into Hedemora deanery and which explain its initial m value of "only" .268/.002.

In sum, the low fertility per unit nuptiality in Hedemora deanery both in 1805 and in 1855, the relatively high m value for this deanery in 1890, the m value of .479/.003 for Hedemora härad within this deanery, the generally high if unstable m values and relatively low marital fertilities in adjoining Säter, Stora Skedevi and Husby härad, and the further peripheral phenomenon seen on the map and largely captured in Stora Tuna deanery, at .177/.002, all point to the presence of some degree of early family limitation centering in the Hedemora area.

Mora deanery, still farther north and west in Kopparberg provinces, at $m = .247/mse = .0026$, a case of a marginal phenomenon. The somewhat low fertility per unit nuptiality in this deanery in 1855, in this case partly achieved by low illegitimacy but also partly by low marital fertility, put it on the border between the third and east regions in this respect. The marital fertilities in this area in 1890, at circa 6900 versus of 7500 immediately to the west and east (see Map 3, Table 2) suggest the possibility of a degree of family limitation here. But it is difficult to assign much significance to an m of .247, even with a fit of .0026, or to a marital fertility of 6900. This is a case where a few parishes, presumably nearest to towns, or a particular social group, could account for the entire phenomenon. On the härad level the sample sizes become too small to allow a more detailed portrait of events within this large and underpopulated deanery. One can only wonder how such a precocious phenomenon as family limitation, otherwise found here in relatively more cosmopolitan locations, could have come to so distant and underdeveloped an area.

Hälsinglands Östra deanery in Gävleborg province appears at first to be, like Mora, a borderline phenomenon. Its position on the

graph for 1855 was barely within the third region of lowest fertilities per unit nuptiality, and while its 1890 m value of .341/.002 is more impressive, its 1890 marital fertility rate was 7500! But this populous deanery along the city-studied and rapidly developing coast of central Sweden can be broken down into significant härad-level samples, and here the results are quite surprising. For within this deanery is Hanebo härad, with an 1890 m value of .450 and a mean square error of .001. Hanebo may in fact explain the m value for nearby Svärdsjö in Kopparberg province to the southwest, at .268/.007, and the Hanebo phenomenon appears to spill over into Norrala härad to the east within Hälsinglands Östra deanery, at .297/.006. The same phenomenon reaches farther north into Hälsinglands Norra deanery, as will be seen. What is extraordinary is the high level of marital fertility in most of these areas in 1890, among which the circa 7500 for Hanebo is typical (see Table 2). In 1855 not only had the deanery within which Hanebo is found, Hälsinglands Östra, had low fertility per unit nuptiality, it had also a relatively low total and by deduction marital fertility, the former then being 3800. But by 1890 the total fertility for Hälsinglands Östra deanery was 4738 and the marital fertility rate 7540, both well above the then existing averages for central Sweden. Hanebo härad was very likely a part of this sharp increase in fertility within the deanery, as witness its marital fertility of circa 7500 in 1890.

In theory, of course, family limitation, such as is indicated by the m value of .450/.001 for this härad in 1890, can be found associated with high marital fertilities, even with marital fertilities as high as 7500. This peculiarity could have come about in the Hanebo area because, perhaps as a result of immigration into the areas the section of the population not practicing family limitation had an astronomically high marital fertility. Or, it could have come about because those who practiced family limitation began to do so only in panic, late in their fertile spans and after having many children, thus raising m values without significantly lowering overall marital fertility. Or, the same result could have been achieved if the target family size had grown from 4-5 children to 6-7 children, and this target had to be achieved before the deliberate application of family limitation was undertaken, late in life. Deliberate use of birth control to space out the earlier children within this process would further delay the application of family limitation until very late in the woman's fertility span. Some version of this high-target-size and/or spacing behavior is thought to be one typical stage in the early phases of the breakthrough of the idea of family planning in areas where people still prefer, where conditions permit, large families.³² Conditions in Hälsingland did improve from 1855 to

1890, and this may have permitted the restoration of a larger target size.³³ Whatever was going on in Hanebo in 1890, it was not the typical pattern found in Uppsala, Västmanland and Kopparberg provinces, where the highest m values were consistently associated with the lowest marital fertilities.

This same form of family limitation behavior seems also to have prevailed immediately to the north in Hälsinglands Norra deanery (.325/.007). Here, the center of activity was evidently Forsa härad (.454/.003) along the coast to the north of Hanebo. To debatable degrees, this phenomenon appears to have spilled over into neighboring härader, such as Delsbo (.370/.008) to the west and still farther inland into Järvsjö härad (.434/.01), though methodological considerations suggest that the latter two figures are somewhat inflated, among other things by bridal pregnancy (see Map 3, Table 2 and Appendix I). Here, as in Hälsinglands Östra deanery immediately to the south, total and evidently marital fertilities had risen considerably from 1855 to 1890. Thus, total fertility rose from 3423 to 4276 in Hälsinglands Norra deanery as a whole. The result was a marital fertility well over 7000 in the deanery, and figures as high as 7108 in Forsa härad and 8109 in Järvsjö härad. So by 1890, in this part of Hälsingland as well, the evidence of family limitation was associated with average to high marital fertility.

Methodological problems with the m measure, the disaggregation of the data into härader, and a consideration of the actual marital fertility rate have introduced complexities into this survey of the potential family limitation areas in central Sweden in the period 1855-1890. Yet the coincidence of suspected family limitation areas in 1855 with high m areas in 1890 is not challenged, but rather is given a clearer definition as a result of this close examination of the 1890 data. Thus, beneath the relatively high but uncertain m values for Sala and Södra Fjerdhundra deaneries lay härader, to wit Yttre-Tjurbo and Simtuna, whose m values seemed to be in the .200-.400 range even with the potentially inflating effects of bridal pregnancy removed, and härader, to wit Övre-Tjurbo and Simtuna, with the lowest marital fertilities of all the härader in Västmanland. The proximity of these härader to regions of Uppsala province where fertility per unit nuptiality and total fertility had fallen drastically and in some cases to unprecedented levels already by 1855, and where in one case, Åsunda, the m value is known to be over .447 in the period shortly after 1855, leaves little doubt that the evidence of family limitation in these neighboring areas of Västmanland both in 1855 and in 1890 is a reliable reflection of a wider event. In Hedemora härad, to the north, the m value of .479, a mean square error of .003 unaffected by bridal

pregnancy, marginal sample size or other distortions, and a marital fertility of circa 6500 stand at the core of a geographic cluster of four significant härader. In neighboring Säter, Stora Skedevi and Husby härader, whatever the distortions caused in generally high m values by bridal pregnancy and marginal sample sizes, the uniformly low marital fertility rates, such as 6068 in Husby and 5305 in Stora Skedevi further reinforce the total pattern begun by the detection of low fertility per unit nuptiality in Hedemora deanery in 1855 and leave little doubt that the entire Hedemora area was a second center of the early breakthrough of family limitation into rural areas in central Sweden. To the north (leaving aside Mora) was a third focus, also anticipated in the data for 1855, seated chiefly in Hanebo (.450/.001) and Forsa (.454/.003) härader. These m values likewise show no serious distortions from bridal pregnancy, sample size, marriage age, or other identifiable source, a fact less true of nearby Norrala, Delsbo, Järvsjö and other associated härader. In this case, however, despite low total fertilities per unit nuptiality and relatively low overall total and marital fertilities both in 1805 and in 1855, the Hälsingland deaneries and härader which showed high m values in 1890 also showed in 1890 marital fertilities which ranged from only slightly below to well above the central Swedish average of 7000. Somehow in this area what appears to have been family limitation behavior had come to be associated, possibly within the same sub-population, with high rates of marital fertility. But this is a plausible alternate form of the early stages of family limitation so the high marital fertility alone need not disqualify these areas in Hälsingland from consideration.

It is, however, not guaranteed that a significant proportion of the population in Sala, Södra Fjerdhundra or "Arboga" deaneries or in Hedemora, Hanebo or Forsa härader actually practiced family limitation in 1805, in 1855, or in 1890. Relatively low fertilities per unit nuptiality and low overall and marital fertilities in these areas in 1805 and 1855, raw and corrected m values in the .250-.500 range in 1890, often with decent fits, and, in 1890 in Västmanland and Kopparberg provinces, a consistent association of high m values with the lowest recorded marital fertilities in these provinces, create only a strong probability. There are forces other than conscious family limitation which can produce low fertilities per unit nuptiality and can reduce total fertilities to the 3500 range and lower marital fertilities accordingly. Some of these factors, which included bad nutrition, short marriage duration, and large age differences between spouses, can also lower fertility most radically among older women, creating an age-specific marital fertility curve which yields high m values - though perhaps not as high as the .400-.500 in Hedemora härad. ³⁴ Moreover, such unconscious forces

influencing fertility and even age-specific fertility can assume the consistent regional clusterings and the slopes downward from geographic foci of intensity which are found in the case of the phenomena at hand. All this is unlikely, but it is theoretically possible.

Confirmation must ultimately come from studies like that in Åsunda, conducted for härader in Västmanland, Kopparberg and Gävleborg provinces, studies which show increasing and significant m values, with confirmatory individual-level measures of family limitation behavior, for these selected areas in the period 1855-1890. The SCB data for the remaining three provinces, Uppsala, Värmland and Örebro, for 1890 must be processed to complete the aggregate fertility trends in these areas. SCB data on age-specific marital fertility for 1910 should also be processed to complete a series of aggregate statistical values for 1805, 1855, 1890 and 1910, for all six provinces. A trend starting with the suspicions created in the 1855 data, re-enforced by local studies such as that in Åsunda, and confirmed by refined m values in the .300-.500 range in 1890 and well above this in 1910, would establish the early advent of family limitation in the particular areas selected by this analysis. At the same time, some common sense is called for. There is little doubt that some rural areas, and in retrospect most probably some areas in the Lake Mälaren area of central Sweden, must have begun practicing family limitation on a significant scale before its massive breakthrough in Sweden in the years 1890-1930. Whatever these areas were, in Västmanland, Kopparberg, and Gävleborg provinces, they must on the basis of all the evidence have been among the localities so strongly singled out for suspicion here. Strong suspicion also falls on Åsunda, Trögd, Lagunda, Ulleråker and Håbo deaneries in Uppsala province. The statistics may mislead in some, but surely not in all these cases.

Finally, it is important to emphasize once again that specific parishes elsewhere, in other härader and other deaneries, will surely reveal evidence of the early advent of family limitation practices, in some instances very strong evidence. Logic demands that this must be so, even though these parishes were too few strongly to affect the aggregate data for the larger units of which they were parts. Similarly, the deaneries and härader singled out here must have contained parishes where the practice of family limitation was negligible before 1890. That, too, is only to be expected.

IV

Structural and Dynamic Correlates of Family Limitation Behavior in Central Sweden in 1890

The diversity of the areas singled out here is striking. The history, or timing, of the advent of family limitation behavior seems to have varied considerably between the Sala - Södra-Fjerdhundra - Uppland area, the Hedemora area and the Hälsinglands Östra and Norra area. Structurally, these three foci of suspected family limitation were as different from one another in their economies as any three areas in Sweden could have been. Dynamically, there is no indication of an economic trend, such as population pressure (or, conversely, of radical economic progress), common to all these areas. Where the best evidence of such pressure exists in the sample, as it does in large areas of Västmanland, it does not even correlate specifically with suspected family limitation behavior in that province, but rather only with reduced total fertility in general, whether this was achieved by reduced marital fertility or by reduced nuptiality. Nor does drastically declining infant mortality provide a common background to all these suspected family limitation areas, since such a decline was not found in all the vital areas; and in the provinces where sharply declining infant mortality was most marked it does not correlate consistently with family-limitation behavior in specific or with reduced fertility in general. At first glance, then, no single structural or dynamic explanation seems to fit the particular areas singled out here. Nor does any such an economic or demographic dynamic, even within any one of the three provinces sampled where it might best apply, do more than single out lower fertility deaneries and häradar in general rather than suspected family-limitation localities in specific. One could hardly appear to be farther from an explanation of the early advent of family limitation behavior across all three provinces or even within any one province.

Consider first the possible timing of the advent of family limitation in each of these areas. Hedemora and Hälsinglands Östra deaneries showed the lowest fertilities and the lowest fertilites per unit nuptiality in central Sweden already in 1805. Hedemora, like the Swedish island of Gotland, in the Baltic, was known even in the 1700's as a center of the lowest marital fertility rates in Sweden. In the case of Gotland, one study of individual behavior claims to have detected an early form of family limitation among the farmers of Alskog parish in the mid 1700's.³⁵ If Hedemora was similar, it, and

perhaps Hälsinglands Östra deanery, would have to be labelled a first stage in the adoption of family limitation in Sweden. Sala occupies a position similar to but weaker than Hedemora in this respect. Arboga's position is uncertain.

From 1805 to 1855 a second stage seems to manifest itself in Hälsinglands Norra and above all in the Sala - Södra Fjerdhundra - Åsunda - Trögd etc area, where fertilities per unit nuptiality and total and marital fertilities fell rapidly and to unheard-of low figures. Given the known rate of illegitimate fertility, the total fertility of 3000-plus in Trögd in 1855 corresponds to marital fertility of circa 5000. Why did these areas tumble so rapidly after 1805 into what, from the evidence of the dissertation on Åsunda härad and the 1890 m figures for Sala and Södra Fjerdhundra, was indeed the widespread use of family limitation among certain if not all social groups? Rogers and Eriksson suggest that population growth and rural proletarianization after 1805 influenced the farmers in Åsunda to protect themselves from division of their holdings and consequent proletarianization for their families by adopting family limitation.³⁶ Yet it is also inescapable that this area was only one among many in central Sweden experiencing such pressures, and that not all of these made the same move to family limitation between 1805 and 1855. Some nearby deaneries under similar pressure lowered nuptiality, as to a degree did the vital deaneries in question, but these other deaneries seem not to have taken that further distinct step toward family limitation taken by the vital deaneries in the Västmanland-Uppland area. What is unique about this area on the border of Västmanland and Uppsala provinces that it lay nearest the metropolis of Stockholm, where secular, liberal ideals were advancing rapidly to preminence, and so was exposed to new conceptions of human life and human behavior. "Adjustment" to internal social change may have gone hand-in-hand with a special "proneness-to-innovation" on the part of the farmers, as opposed to the statare, in this area and may also have gone hand-in-hand with the exposure to "innovation" in the form of new ideas about acceptable behavior and about the life style which smaller families could entail, an exposure implicit in the special location of this area near to Stockholm. Regardless, the process here may have been rather different from that which occurred in such older areas as Gotland and Hedemora.

This still leaves unexplained, however, the evidence that Hälsinglands Norra deanery, far to the north, may also have moved significantly toward family limitation between 1805 and 1855. The final stage, in central Sweden before 1890, is the peculiar resurgence of marital fertility in both Hälsinglands Östra and in Hälsinglands Norra deaneries between 1855 and 1890, a phenomenon

which might be explained either through the in-migration of high fertility families, or by an increase in job opportunities in these areas after 1855 which led families in both deaneries to raise their target family size.

The suspicion, then, based on the very different histories of the evolving evidence of family limitation in these areas is that not only different timing but accordingly different social structures and possibly dynamics were involved in each case. Preliminary analysis of the structural data from each deanery, in the Tabellverk, to 1860, and from each härad in Västmanland, Kopparberg and Gävleborg provinces in the SCB statistics available thereafter, shows that the respective areas in which family limitation seems to have begun appear always to have been very different in structural character. The Västmanland-Uppland area where family limitation is suspected was an area of large, capitalistic agricultural entities with labor hired from among the landless. The Hedemora area was characterized by small, independent landholdings, while the Hanebo-Forsa area in Hälsingland was a mixed agricultural-forest-industrial society. Surely it is not easy to find a single structural explanation of the adoption of family limitation, evidently at widely varying points in time, in these localities which seem to have gone over early to a significant degree of family limitation. Conversely, in the local aggregate statistics one can find other deaneries and, later, härader, which structurally resemble one or another of these three types of society in every vital detail, but where the 1805 and 1855 data and the 1890 m values and 1890 marital fertilities give no hint of the early existence of family limitation or, often, of any effort to lower total fertility.³⁷ In the main features of their structures, then, these areas appear to have little in common nor are they in any sense unique.

Nor does there appear to be a common and unique dynamic which links these areas beneath their obvious structural dissimilarities and beneath the fact that structurally each shares features with other localities within its respective province. For example, and while this is a question which could be posed in many ways, the arrival of "capitalist enterprise" does not seem to explain the timing and advent of early family limitation practices in these diverse areas. True, in the Västmanland-Uppland area, commercialization and extreme proletarianization within the old estate-based agriculture do precede and accompany the evidence of increasing resort to family limitation after 1805. But there is no evidence of any such sudden infusion of "capitalist enterprise" in the Hedemora area, save in the sense that profit as well as sustenance was long a motive here as in many areas. And in Hälsingland, the evidence of family-limitation behavior and low marital fertilities in

1805 clearly precedes the arrival of the timber industry after 1855. Marital fertility in Hälsingland actually rose after this industry arrived. Further, the particular pace of economic development within each of these respective areas was shared by certain other deaneries and härader in each case, yet these other localities show no comparable evidence of family-limitation behavior nor in some cases even of a total fertility reduced by means of radically reduced nuptiality. (In a certain sense, however, as will be seen below, a "capitalist" or related mentality, nor accessible through the economic statistics, may have been one aspect of a common and nearly unique attitudinal situation in these crucial localities.)

Another hypothesis would suggest that some sort of population pressure on the particular resources available in each of these respective areas, might have been common to all these areas and unusually intense in them alone. Population pressure, or "overcrowding", like "capitalist enterprise", is a concept susceptible of many statistical definitions none of which may fully capture the views of the people in the vital or in other localities. Still, as well as the concept can be operationalized here, there seems to be no substance to the hypothesis either in terms of a measurable strain on local resources or in terms of local perceptions. Population-pressure variables were associated with reduced fertilities in Västmanland but only in sharply lesser degrees in Kopparberg and Gävleborg. And even in Västmanland, where available measures of actual or perceived "overcrowding" correlate best with reduced fertility, they correlate only with a total fertility reduced by any means, whether by family limitation or by the older strategy of reduced nuptiality. So, population pressure in no case explains the common and unique evidence of family-limitation behavior in the vital areas studied.

Thus, in 1855 the total fertility rate in the deaneries in Västmanland and to a far lesser degree in Kopparberg provinces and in Gästrikland and Gävle deaneries in southern Gävleborg province, correlated inversely with the proportion of the population in each deanery which, "in the absence of their own resources, are entirely supported by public or private welfare" (see Graph 3).³⁸ Areas with only around 1% of the population supported by welfare included Gästrikland and Gävle deaneries in Gävleborg province and Vester-Dal and Leksand deaneries in northern Kopparberg (see Map 3). These deaneries showed four of the five highest total fertility rates in 1855, and their total fertility rates averaged over 4400. Up at the top of the welfare spectrum, Sala and Södra Fjerdhundra, where by far the highest proportion of the population needed welfare, nearly 5% of the population, showed the lowest total fertilities in the Västmanland-Kopparberg-Gästrikland-Gävle area, at below 3500.

But, again, it is not suspected family planning alone, as in Sala or Södra Fjerdhundra, which is associated with reduced fertility and with poverty. Just behind Sala and Södra Fjerdhundra at the top of the scale comes, yes, Arboga, but right next to it are Dom and Vestre Rekarne deaneries, at nearly 4% on welfare and total fertilities only slightly above 3500. What is significant here is that in Dom and in Vestre-Rekarne deaneries, fertilities per unit nuptiality were generally higher, and later *m* values generally far lower, than in Sala and Södra Fjerdhundra. These facts, plus the unusually low nuptiality rates in Dom and above all in Vestre-Rakarne deaneries in 1855 (see Graph 2, Table 1), suggest that the low total fertilities achieved in these particular high poverty deaneries were not the product so much of family limitation as of drastically reduced nuptiality. Thus, a high proportion on welfare is associated both with a significant degree of family limitation as one means to reduced fertility, as in Sala and Södra Fjerdhundra, and also with a more emphatic reliance on low nuptiality as a means to reduced fertility as (even to a degree in Sala but) most clearly in Dom and Vestre Rekarne deaneries. This patterns occurs again and again in correlations which have been used to test for population pressure in 1855 and 1890. It implies that, whatever the "proportion on welfare" explains, and it does suggest a population-versus-resources mechanism of some kind, probably real and certainly perceived, this variable explains reduced fertility by whatever deliberate means. In Västmanland, then, these crude data do no provide an adequate explanation of the unique phenomenon of family limitation which seems to be found in Sala and in Södra Fjerdhundra. Why, under the pressure of population versus resources, some deaneries augmented or replaced low nuptiality with family limitation while others, with similar population pressure on resources and, it might be added, generally similar occupational distributions, responded primarily with reduced nuptiality, is a mystery beyond the power of this data to explain.

Moreover, as noted, the correlation between "proportion on welfare" and reduced total fertility by any conscious means, does not, as indicated in Graph 3, apply equally to all the provinces studied. It works somewhat in Kopparberg - plus Gästrikland-and-Gävle, but even in Kopparberg province, for example, the deaneries with the lowest and highest total fertilities, Hedemora and Norrbärke, differ little in their proportions on welfare and in fact Hedemora's proportion on welfare is lower. Here, "proportion on welfare" cannot entirely explain reduced fertility by any means, and far less by means of family limitation. "Proportion on welfare" simply does not do very well in explaining variations in fertility in Kopparberg province. This is even more true in the Hälsingland

deaneries in Gävleborg province, where a range of fertilitates from Hälsinglands Norra at 3423 to Hälsinglands Vestre Övre at 3911 are all found on the same level of circa 1% of the population on welfare. Plainly, no correlation is found in Hälsingland, and other causes of the variations in fertility in 1855 must be sought here. Much of the lack of strong correlation in Kopparberg and Gävleborg provinces may be related to the fact that levels of perceived population pressure here, as measured by the proportion on welfare, are so low.

These same points can be seen at a later time in Graph 4, which relates the cultivated land per 100 inhabitants in 1905 (as close to 1890 as could be obtained) to the total fertility rate in 1890, in the härader of Västmanland, Kopparberg and Gävleborg provinces.³⁹ There is, leaving aside Skinnskatteberg and Snefringe, which lie geographically on the border with Örebro province, a loose relationship between a low amount of cultivated land per 100 inhabitants and low total fertility in the härader of Västmanland circa 1890. Here as previously, the pressure of population on resources may be related to reduced fertility in this area. But the cluster of härader within Västmanland which have low amounts of cultivated land per inhabitant and low total fertilities, includes not only härader associated with family limitation, such as Åkerbo, in which Arboga deanery is found, and Övre-Tjurbo and Simtuna, which go into Sala and Södra Fjerdhundra deaneries, but also Våla and Vagnsbro härader, which in 1890 had m values below .100 and had the lowest nuptiality rates among the härader of Västmanland.⁴⁰ Once again, then, the measure of population pressure which seems to apply in Västmanland does not discriminate well between family limitation and relatively pure nuptiality-strategy areas. It simply singles out all härader which went for lower fertility by either means. Once again, too, other structural statistics show no obvious difference between Åkerbo, Övre-Tjurbo, and Simtuna, on the one hand, and Våla-Vagnsbro on the other, which would readily explain their different routes to lower fertility - save for the most obvious difference of all. The former härader are closest to Lake Mälaren and are part of its rich culture and excellent access to communications with Stockholm. Våla and Vagnsbro, where the ratios of cultivated land per inhabitant are similar and are similarly associated with low total fertilities, are relatively "backwoods" areas within Västmanland. Could it be that communications hold one key to why the more cosmopolitan areas shifted to family limitation while these backwoods areas held with the more traditional nuptiality strategy, which arrived on a massive scale early in the nineteenth century but was nonetheless accepted by parents and priests, the traditional social authorities in rural Sweden?

As Graph 4 further shows, the loose relationship in 1890 between a possible shortage of cultivated land and low total fertility by whatever means the latter was reached, does not hold for Kopparberg or Gävleborg provinces. In the former, if any relationship is visible at all (see Graph 4), it is a tendency for fertility to decrease as cultivated land increases, reaching the lowest total fertilities where cultivated land per inhabitant is greatest. In Gävleborg province, the relationship is if anything U-shaped, though, admittedly, no relationship would be expected here since in this province cultivated land is least of all the relevant resource against which to measure population pressure.

While many complex explanations of these phenomena are possible, it is especially difficult to propose that in Kopparberg and even in Gävleborg province there was the same degree of pressure of population on resources which may have occurred in Västmanland, because in 1855 (see Graph 3) and in 1890 (in Sundbärg's published data cited here below) measures of perceived poverty which are independent of the type of pressure or the type of resources, indicate lower perceived levels of poverty in Kopparberg and in Gävleborg than in Västmanland. Thus, in Kopparberg and in Gävleborg provinces in 1890, the "proportion unable to support themselves on their own resources", a later measure of perceived poverty, indicates that the proportion remained low in Kopparberg and in Gävleborg provinces as late as 1890 and, as earlier, probably for this reason this measure of perceived poverty failed to correlate with reduced fertility in general or with family limitation in particular within these provinces ⁴¹

So variations in fertility and the evident adoption of family limitation in some districts of Kopparberg and Gävleborg provinces cannot easily be explained in terms of population pressure as in Västmanland. These graphs, then, are ways of expressing the relative statistical inexplicability of the phenomenon of family limitation as detected here. Low fertility can sometimes be "explained" by measures of population pressure, as in Västmanland, but not why some pressured areas went to family limitation while others stayed with a low nuptiality strategy. And in Kopparberg and Gävleborg there is no firm evidence that population pressure of any sort, real or perceived, lay behind lower fertility whether this was achieved by family limitation or by low nuptiality.

The early arrival of family limitation in central Sweden is thus something of a statistical puzzle. Across all provinces the localities which began family planning had varying structural and particularly economic features, while within each province, these areas often shared their features with localities which, while they may or may not have controlled nuptiality or illegitimacy to reduce fertility, nonetheless do not appear to have gone over significantly to family

limitation. Within provinces population pressure (in Västmanland) or differing and often unclear mechanisms (in Kopparberg and Gävleborg) often lump together areas which appear to have achieved lower fertility by control of nuptiality (and, in the case of the Leksand area, by means of control of illegitimate fertility - see Table 1, Graph 4) with areas which had shifted toward a distinct reliance on family limitation. Beyond the usual background of long-term increased net fertility (births over deaths) and so population increase, and beyond increasing illegitimacy, both backgrounds shared by nearly all localities studied here, and found previously in history without resulting in family limitation, it is impossible in this preliminary analysis to find across all provinces widely common structural or dynamic factors which uniquely single out these areas where family limitation appears to have begun. Even within provinces it is impossible to find structural or dynamic factors which uniquely single out these areas. These are different ways of expressing what is essentially the same statistical dilemma.

One underlying explanation which is distantly but not necessarily related to the local economic structures or to population pressure is the argument that sharp declines in infant mortality produced the realization that, because fewer infants would die, fewer needed to be born. Presumably, until this realization dawned, the decline in infant mortality would also have raised the prospect of eventual population pressure regardless of the immediate economic situation and, assuming a rapid shift to effective limitation, would have raised the spectre of overpopulation without actual consequences in terms of the pressure of population against resources in this area. Such an underlying mechanism could explain the decline in fertility in many areas, and possibly even the early advent of family limitation in the structurally dissimilar areas detected here, without necessarily creating a reflection in the form of actual relationships between statistical indices of overcrowding on the one hand and fertility on the other. And indeed there was a sharp decline in infant mortality in Sweden between 1815 and 1855, from circa 21% to circa 14% of infants born live who died within one year, a decline not surpassed until, between 1901 and 1911, the same index declined from 9.9% to 7.3% in the short space of ten years. Some of the deaneries where infant mortality declined most sharply were found in Uppsala and Västmanland and a few were located in Kopparberg and Gävleborgs provinces. The difficulty here is that the decline in infant mortality from 1805 to 1855, as measured in the deaneries of these provinces, does not correlate either with a low total fertility rate in 1855 or with the rate of decline in total fertility from 1805 to 1855. As Graphs 5 and 6 demonstrate, there is simply no relationship between these variables

at all (raw figures for infant mortality are in Table 1)

Thus, in Graphs 5 and 6, the sharp decline in infant mortality, from circa 22% to circa 13%, a 40% drop, in the Sala-Södra Fjerdhundra-Åsunda-Trögd-Ulleråker-Lagunda-Håbo area, and in Arboga, is in both cases definitely associated with rapid rates of decline in total fertility between 1805 and 1855 and with low absolute levels of total fertility in 1855. But one problem is that similar levels and rates of decline in infant mortality in Waksala, Norunda and Köping deaneries, for example, are associated with rapid declines in total fertility, and in some cases relatively low levels of total fertility, in areas where the evidence for family limitation is weak and where lowered nuptiality seems to have been the chief path taken to lower fertility (see Graphs 6, 5, 2, Tables 1, 2). Further, many deaneries on Graphs 5 and 6, such as geographically contiguous Norunda, Hagunda, Norra Fjerdhundra and Gästrikland, or contiguous Vestra Fernebo and Norrbärke (Map 2), where initial levels as high and rates of decline in infant mortality has rapid as anywhere else, from circa 22% to circa 13%, a 40% decline from 1805 to 1855, show negligible rates of decline or indeed actual increases in total fertility and above average levels of total fertility in 1855! A second major problem is the fact that, in some deaneries, such as Hälsinglands Norra and Vestre Rekarne, negligible or quite modest declines in infant mortality did not preclude rapid rates of decline in total fertility to levels well below the average, whether by means probably including significant family limitation, as in Hälsinglands Norra, or by means largely of nuptiality, as in Vestre Rekarne. Similarly, whether in 1805 or in 1855, Hedemora deanery enjoyed relatively low total and marital fertilities despite the fact that infant mortality here did not decline significantly. It might be said that in Hälsinglands Norra and in Hedemora infant mortality had already declined by 1805, as levels in these deaneries were then only 14.43% and 15.22% respectively, and that an earlier decline in infant mortality explains the lower fertilities here. But the evidence of recent research is that infant mortalities in these areas never were in the 20-25% + range encountered elsewhere, which indicates that there was no earlier decline in infant mortality in these areas. Further, such an hypothesis fails to explain why many other deaneries in Gävleborg or Kopparberg provinces, which also had relatively low rates of infant mortality in 1805, failed to achieve or to move toward low total fertilities by 1805 or 1855. Except as part of a very complex explanation in some areas, then, a rapid decline in infant mortality from 22% to 13% does not seem to be a necessary or a sufficient condition either for family limitation in specific or for lower fertility in general during the early stages of the fertility transition in Sweden.

Of course, the family limitation phenomena in the Sala - Södra Fjerdhundra - Southwestern Uppsala province area is explained by and large by the combination of a sharp decline in infant mortality with an area where all indices point to population pressure within a capitalistic agricultural environment which had little room for further divisions of holdings or, after 1870 or so, for further development of new agricultural land. But, even here, what is "explained" is not so much family limitation in specific but reduced total fertility in general, as most indices of population pressure or of declining infant mortality trend to correlate with areas in Västmanland or in Uppland with low and/or falling total fertility, whether achieved more through lower nuptiality or more through family limitation. In this sense, only proximity to Stockholm seems to explain the decision of more persons specifically in the Sala - Södra Fjerdhundra - Uppland area to choose family limitation. And what combination of factors explains the evidence of early family limitation in the Hedemora area, where few if any of these structural or dynamic background factors obtained? Or, if Hedemora is to be treated as an outlier, like Gotland, a place historically "peculiar" and so not truly a part of the nineteenth-century conversion to family limitation in rural Sweden, then how is the evidence of family limitation to be explained in the relevant härader in Hälsingland, which were likewise different from the Västmanland -Uppsala focus and from Hedemora in most of these structural and dynamic respects? Indeed, beyond the general crude rate of population growth and growing rate of illegitimacy, and an infant mortality rate already at or falling toward 13-15% all factors widely shared by areas where not even fertility decline much less family limitation had set in, these three centers of early family limitation had very little in common. Yet all very probably began a significant degree of family limitation by 1855 and certainly by 1890 and they were unique in central Sweden in this respect. Again, common and unique structural and dynamic factors seem simply not to exist, even when declining infant mortality is considered as part of a total picture.

V

Family Limitation as a Cultural Innovation: Current Theory, Swedish Evidence and Reflections

It is possible that a sophisticated multivariate analysis might produce a common and unique statistical event in the Västmanland -

Uppsala area, in Hedemora, and in the key areas in Hälsingland, but at the moment this does not seem likely. The statistical dilemma in this preliminary data may have to be accepted as a reflection of reality. This should come as no surprise, as it has been the experience of all researchers studying the fertility transition in western society. Beyond generally rising population, a phenomenon itself known previously in history (and sometimes even this is absent), no single structural or dynamic statistical pattern has been found consistently to explain the advent of family limitation behavior in Western society. There seem at best to have been different structural situations in different regions, and these situations are not always unique to family limitation areas within each region and thus are not always sufficient even regionally to explain the phenomenon.

It is this dilemma which led first Ansley Coale and then John Knodel to re-examine the total evidence of the fertility transition in a bold and provocative way.⁴² Knodel concluded that, while there were various background factors and various structural situations, old and new, which prompted various groups in various localities to begin the practice of family limitation on an increasing, irreversible, and finally unprecedented scale, the chief common factor may have been the acceptance of the idea of family limitation in all these areas as part of a process of cultural innovation. Thus, the idea of family limitation became widely available as part of the general process of secularization and changed social ideals which took place, in western society, in the nineteenth century. Different groups came to this idea out of different structurally created and also out of different personally perceived needs, depending also on their degree of contact with such new ideas, on their propensity to adopt such a new idea and model of human behavior and of human society, and depending also on the ease with which local traditions could be replaced with such new concepts. As these early areas for various reasons adopted the new behavior of family limitation, associated with a new world-view, the idea of limitation gained momentum until, likewise for varying reasons but with increasing speed it was adopted and so shaped behavior in the entire society. So runs Knodel's hypothesis. In Sweden, this latter stage of the process took place largely between 1890 and 1930.

Significantly, the only consistent correlation found between any available variable for nineteenth-century Swedish society and the three major early family limitation areas identified here, strongly supports Knodel's hypothesis. Preliminary research by Margareta Larsson, of the Department of Sociology at Stockholm University, reveals one cultural factor common to all of the areas here identified with the early advent of family limitation in

Sweden.⁴³ On the initial religious map of the härad of nineteenth-century Sweden which Ms. Larsson had constructed independently for her studies of pre-family-limitation demographic behavior in Sweden, in this case using chiefly literary sources, the key härad identified here - Simtuna, Övre-Tjurbo, Åkerbo (which includes most of Arboga deanery), Hedemora - Husby etc., Hanebo and Forsa - all emerge as areas not dominated either by a strict version of the old Swedish state religion, as was for example the Leksand - Rättvik area, or by any of the various revivalist sects of the nineteenth century. These crucial härad are characterized on her map by the presence of a weakened, liberalized version of the old state religion, with only a minor and diverse admixture of the new sectarian religions. Ms. Larsson had independently labelled these areas as "mixed and relatively secularized." In such areas, a weakened old and diversified new religion meant that neither the state church nor a single, powerful and, in terms of sexual behavior, conservative new sect, effectively enforced the traditional ban on family limitation nor always maintained effectively the injunctions to marry less or later which traditional authorities in many areas had implicitly endorsed as population growth had mounted in Sweden.⁴⁴ Such a religious climate left increasing room for the advent of secular ideas in all of these areas, precisely where the new, secular idea of an individually determined family limitation for personal and often material goals seems in fact to have broken through.

More remains to be done in defining "secularization" and reliable statistical measures do not exist, but this correlation of the literary sources on secularization with the evidence of family limitation is interesting. Even more significant is the fact that, in localities where Ms Larsson's literary and statistical sources indicate that the old Swedish State Church was still very strong, such as the area centering on Leksand härad and including parts of Orsa, Rättvik, Gagnef, Malung and Nås härad, the evidence of family limitation is the weakest within the three provinces studied to 1890 (Map 3, Graph 2, Table 2). Indeed, in Leksand härad and in the härad to the southwest of Leksand low *m* values and high marital fertilities in 1890 are virtually prohibitive evidence against the early presence of family limitation. Thus, the statement that the areas most suspected of family limitation appear from the literary sources to have been relatively secularized, in the meaning given above, is followed by a much stronger statement that clearly non-secularized areas show virtually no sign of family limitation on the basis of the evidence gathered here. Where the old church was strong, family limitation did not occur. In the middle ranges of both variables, of course, no further correlation can be seen nor, given the uncertainties of both variables in this range, can be expected.

There are two other localities in these three provinces, to wit in and around Sundborn and Ockelbo härader in Kopparberg and Gävleborg, and in adjoining Stora Tuna and Grangärde härader in southwestern Kopparberg, where Ms. Larsson's initial measure of secularization does not correlate with signs of family limitation and where both total and marital fertilities were high. This can probably be explained in terms of the absence here of any of the various possible structural motives for reduced fertility in these areas. It would thus appear that one of the various old or new structural motivations for reduced fertility had to exist in an area, together with a relatively weak, diversified, secularized religious climate, for a group or an area to go over to family-limitation behavior. Nonetheless, the possible role of a secularized religious climate in helping explain what happened in Sala - Södra Fjerdhundra, in Hedemora, and in the Hanebo - Forsa areas in Hälsingland, and the strong evidence against family limitation on the religious end of the cultural scale, fits in nicely with Knodel's hypothesis that the adoption of family limitation behavior was in part a process of cultural innovation. This was presumably a process which gained momentum with time.

What happened after 1890, in central as in all of Sweden nonetheless needs further clarification. How does one go from such early areas as Hedemora and Hälsingland, the latter with its peculiar resurgence in marital fertility by 1890, and from the evident population crisis in the Sala - Södra Fjerdhundra - southwestern Uppsala area, all areas where the cultural climate possibly favored such an innovation as family limitation, to the sudden and massive breakthrough of the idea of family limitation in virtually all areas of Sweden between 1890 and 1930? The explanation is surely not so simple as the "various structural causes plus a growing momentum for the innovation of family limitation as part of a general climate of cultural change and secularization" which Knodel's hypothesis and the evidence here might indicate. At any rate some comments might be useful in embellishment to this hypothesis.

One curious thing is the evident failure just prior to 1890 of new deaneries or härader to join the early family limitation areas identified already in 1855 and confirmed in 1890. How can it be that the deaneries suspected of family limitation in 1855 are the only deaneries where in 1890 m values were over .220 and include the only härader where in 1890 m values were over .300 and where in 1890 marital fertility rates were below the relatively modest level of 6500? Why are there no new family-limitation areas by 1890? Further, even within the deaneries singled out in 1855, m values may already have been nearly as high in 1855 as they were in 1890. The evidence, for example, of the cohorts in Åsunda and of the shape of the age-specific total fertility curves in Hälsinglands Östra,

Hedemora and Arboga in 1855 (see page 29) suggests that already in 1855 m values in much of "region three" were in the .200-.500 range. Why are there not higher m values thirty-five years later, in 1890, when still no m value in Västmanland, Kopparberg or Gävleborg, at any rate, much surpasses .500? Once begun, the adoption of family limitation tends to go very rapidly, and thirty-five years is ample time for deaneries whose m values had been near 0 in 1855 to have achieved values above .220 by 1890 and abundant time for deaneries whose m values may have been .200-.500 already in 1855, to have reached m values well over .500 by 1890.⁴⁵ Yet none did. Only the areas already suspected of family limitation as early as 1855 showed m values above .200 in 1890, and as late as 1890 none of those tested was above $m = .500$. In this perspective, too, the lowest marital fertility achieved by 1890, at circa 5300, was not very low for areas which seem to have entered the fertility transition thirty-five years earlier. By 1925, thirty-five years later, marital fertility rates in these same localities would be below 3500. The curious impression is that things moved very slowly, where family limitation is concerned, between 1855 and 1890.

Yet things did not stand still. What did happen just before 1890 is that in nearly every deanery in Västmanland, Kopparberg and Gävleborg provinces total fertility rose. This rise was most dramatic in Hälsingland, where as has already been observed, it was if anything sometimes sharpest in the härad where the evidence of family limitation was strongest. In Gävleborg province as a whole, the total fertility rate rose from circa 3950 in 1855 to circa 4600 in 1890, and this rise occurred in all six deaneries there. In Västmanland and Kopparberg provinces the rise is less marked, from circa 4100 in 1855 to circa 4500 in 1890, but it is found in every deanery in these provinces as well, save for Norra Fjerdhundra, Hedemora, Leksand, Norrbärke and Vester-Dal, where total fertility was virtually unchanged. In these latter two provinces, unlike Gävleborg, the rise in total fertility was, however, not strong in areas suspected of family limitation behavior, as witness Hedemora. The causes of this general increase in total fertility are not certain. As has been suggested, in Hälsingland one cause may have been larger target family sizes among married persons who previously practiced family limitation with lower target family sizes. Here and elsewhere, a general rise in the rate of illegitimate fertility from circa 10% to circa 15% of all births could explain part but mathematically cannot explain all of the nearly 10% rise in total fertility from 1855 to 1890. A general if slight increase in the frequency of marriage and decline in the age at marriage occurred in central as in all of Sweden after 1870; and this in turn may explain a significant part of the higher total fertility by 1890. (This higher

total fertility may have been augmented, in terms of its impact on population growth, by a continuing decline in infant mortality, which in these three provinces fell from circa 14% in 1855 to circa 11% by 1890, not nearly the rate of decline which had obtained from 1815 to 1855 but a continuing decline nonetheless.)⁴⁶

It is difficult to know how to interpret this rising fertility as a whole, which seems to have been found throughout much of what Sundbärg identified as "East Sweden", to wit in Västmanland, in parts of Kopparberg, in Gävleborg, Stockholm and Södermanland and to a less degree in Uppsala province, between 1855 and 1890. What is clear is that between 1855 and 1890 much of this region, which traditionally had achieved lower total fertilities than "West Sweden" or "North Sweden" (see Map 1) despite traditionally higher nuptialities, suddenly found its total fertilities rising nearly to the levels found in the other regions of Sweden.⁴⁷ It appears that in part this rise could have been a result of better times. In the first place, between 1805 and 1855, the reduction of nuptiality in East as in West Sweden had, with other devices relatively peculiar to this region, procured lower total fertilities here. Thus, total fertilities had by 1855 fallen from circa 4500 nearly to 4000 in Västmanland and in Kopparberg provinces, thereby declining almost to the 3800 level which had existed since 1805 in Gävleborg province. Possibly this early reduction in fertility by 1855, plus migration to the cities and improving economic opportunities thereafter, led to a further release in the controls on illegitimacy, and to a release in the controls on nuptiality so characteristic of the nineteenth century, and led, in the case of marital fertility, to higher target sizes where planned families were concerned, and these changes explain the impressively general rise in total fertility in much of East Sweden from 1855 to 1890. At the same time, there is research which interprets this same evidence as a sign of a social breakdown. Here in East Sweden, as in much of the country at this time, illegitimate fertility continued to rise to unprecedented levels, and simultaneously parental, communal and religious controls over marriage weakened on an ever wider front, and young people began to marry when and as they wished.⁴⁸ While where religion is concerned such an erosion of control was possibly earliest and most marked in the suspected family-limitation localities studied here, it was also a general trend, and indeed, among the areas studied, only in the Leksand area did the old control of the state church over sexual behavior in general and over illegitimacy in particular maintain its full vigor in the period 1855-90. Such a national trend to loosening social and religious controls may particularly have threatened the relatively recent and weak but no means insignificant controls on nuptiality in East Sweden. The result may have been a rise in nuptiality, a renewed rise in total fertility and a revived threat of a population crisis in East Sweden by 1890. A further possible result of these

loosening controls may also have been, albeit later than in the early family-limitation areas studied here, a slowly increasing openness to more modern imperatives where sexual behavior was concerned, in a region where, thanks to the nearness of Stockholm and of Uppsala, such imperatives were most accessible. Some such sequence of events may explain why East Sweden, already so precocious in both consciously and unconsciously reducing its fertility up to 1855, experienced a resurgence in total fertility thereafter to 1890 and then definitively after 1890 assumed the leadership of the massive break-through of family limitation in Sweden between 1890 and 1930.⁴⁹ By 1890, other controls had failed widely throughout East Sweden.

Yet, while it would therefore be wrong to say that nothing much seems to have happened in the three provinces most under study and in the larger East Sweden of which they were a part, between 1855 and 1890, the fact remains that everywhere in Sweden from 1890 to 1930 events were by comparison startling. All the varied forms of fertility limitation and specifically of family limitation encapsuled in the earlier data together constitute a mere "Phase One" in the Swedish fertility transition, a phase which, insofar as detectable evidence of family limitation was concerned, affected only a few localities and which seems to have progressed relatively little toward high *m* values and low marital fertilities by 1890. Between 1890 and 1930 a "Phase Two" saw such stunning progress of family limitation in virtually all parts of Sweden south of Norrland that *m* values for the whole population rose from below .200 in 1890 to over .800 in 1930 and marital fertility rates fell below 3500. In this major part of Sweden, local variations in circumstance served only to create minor variations in the time at which each locality, province, or region entered the transition and in the level of marital fertility it had achieved by 1930. Even "backward" areas in West Sweden quickly followed Uppsala, Västmanland and the entire Lake Mälaren area into the fertility transition and these areas as well achieved drastically lower marital fertilities by the 1930's. By the 1950's even northern Sweden, where the delay had been significant, had joined the rest of the country on the other side of the fertility transition.⁵⁰ Beside this change, all that had happened before seemed slow and minor.

There is a sort of paradox in the data. In "Phase One" of the fertility transition, lasting up to 1890, the very variety of the circumstances which accompanied the early advent of family limitation seems to preclude a single structural crisis as an explanation. What structural crisis could Hedemora, Sala - Södra Fjerdhundra, Hanebo and Forsa possibly have had in common and experience uniquely in the years between 1750 and 1890? What they

had in common, rather, was probably various structural situations which provided various motivations to family limitation, plus a precociously intense climate of diversity and secularization in which new ideas were more easily accessible, at least to certain groups. Lesser versions of this combination of events probably prevailed in adjoining areas to varying degrees. In "Phase Two" of the fertility transition, from 1890 to 1930 and beyond, the very speed and universality of the transition seems to rule out a single structural explanation. What could all the immensely varied localities of Sweden south of Norrland possibly have had in common precisely in the years 1890-1930? What is more likely is that what they in turn had in common, beyond the growing population which itself was soon no longer to be an absolute precondition, was a variety of structural circumstances which provided various motives for family limitation, together with, after 1890 (and partly as a result of the initial breakthroughs of family limitation in Phase One areas), a vastly accelerated secularization. In this new climate ideas of material progress and female emancipation, to name just two examples, were spread by magazines and carried by the railroads to the very farthest corners of the country. With this climate came the ideal of the small family and the knowledge of how to achieve it. In both phases of the fertility transition, then it would appear inescapable that cultural circumstances and ultimately cultural change played a vital role.

Curiously it was in 1894, as good a year as any from which to date the true advent of the fertility transition in Sweden, that the Swedish State Church ceased after more than two centuries annually and publicly to examine every person in Sweden on his or her reading ability, understanding of churchly texts, and knowledge of the hustavla, the order of obedience owed to the traditional church, community and state.⁵¹ It was just at this time that the mass of the Swedish people abandoned fatalistic acceptance of "natural" fertility and, having already largely abandoned the traditional method of reducing total fertility by limiting illegitimate births, also abandoned the relatively traditional practice of reducing total fertility by ever stricter familial and communal controls on nuptiality. These older methods, strongest in the areas where the Swedish church was still old-fashioned and strict or where the new sectarian religions could to buttress popular morality, such as in Rättvik, or in Våla and Vagnsbro, respectively, soon ceased to hold sway.⁵² Even the practice of using family planning chiefly to space rather than to limit children, if this had been common at all, obviously likewise went under. All these practices virtually disappeared in the tide of reduced fertility resulting from the massive adoption of the modern practice of family limitation in

early twentieth century Sweden. Personal, secular ideals triumphed over traditional authorities in a vast cultural sea-change which paid little respect to local circumstances.

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Many reflections concerning these findings will occur to anyone familiar with the literature of the fertility transition, a literature which can be traced back through John Knodel's synthesis of 1977, into the 1950's and indeed earlier. Multivariate processing of the data included in Table 1, while it will discard some of the variation crucial to the discoveries made in the course of this analysis, and while it will probably confirm the main lines of the analysis, may nonetheless give rise to further demurrals.⁵³ Some of these qualifications will surely be powerful caveats to the conclusions offered here, yet these conclusions also have a certain resilience.

For example, it is possible that the early family limitation areas tentatively identified here are not correctly labelled and that, for example, an extremely long period of breast-feeding somehow explains both the low marital fertility and, more implausibly, the high *m* values found in these areas. (The final section of this paper will develop the relevance of breastfeeding to fertility levels in the "east region" identified in Graph 2 and will discuss the problems which this practice, were it even more intensive in "region three", could pose for the conclusion that family limitation began in this third region as early as 1855.) Attributing the vital phenomenon identified here to breast feeding would lead toward the conclusion that family limitation had not spread significantly to a single rural area, potential outliers such as Hedemora possibly excepted, before 1890, after which that behavior suddenly spread like wildfire through all of rural Sweden in the years 1894-1928. Yet this conclusion, in turn, would mean that, in rural Sweden, modern family limitation was a phenomenon which arose so very suddenly that it could not have had more than fleeting structural correlates, rather on the order of the advent of blue jeans in eastern Europe between 1950 and 1975. It seems more likely, however, that family limitation rather than uniquely prolonged breast-feeding explains the uniquely low marital fertilities and uniquely high *m* values in the localities identified as region three on Graph 1 and that these localities did in fact lead in the advent of family-limitation practices in central Sweden.

To select another potential problem, what if all the "family limitation" areas identified here, even assuming they were properly

identified as such, were outliers, i.e. were freakish areas on the presumed Gotland-Hedemora model, where local culture had long favored low marital fertility? Do these areas then say anything about the great fertility transition in Sweden after 1890? Or, what if both Hedemora and Hälsingland were such outliers? Then the evidence of declining infant mortality and population pressure in the Södra Fjerdhundra - southwestern Uppland area would become more central. Or, speculatively, such a process of "overcrowding" might even have taken place in the Hedemora area as well, to judge from the admittedly faint evidence of Graphs 3 and 4, linking this area with the Västmanland - Uppland area in a dominant dynamic, possibly earlier in the former area than the latter, of declining infant mortality, population pressure, and possibly the early stages of both proletarianization and "capitalism".

There are problems with such notions, however. Hälsingland is not obviously either an outlier or, even before 1806, a population crisis area of the later order of southern Västmanland - Uppland, and so the evidence of family limitation here would have to be explained in some other way. Further, in Västmanland - Uppland (as in Hedemora) any such "crisis" seems equally to lead to lower nuptiality and to family limitation strategies, and so population pressure does not explain family limitation in specific. The most that can be said is that such queries lead to a thoughtful re-examination of the importance of declining infant mortality and of population pressure. Under such a model, population pressure could have been the vital if not the universal dynamic which led most localities to seek reduced fertility by what ever means. By pushing certain of them hardest of all, it could have led certain of these in turn, where the traditional culture was also weakest and possibly where people also saw best what was to be gained from such new behaviors, massively to go over to family limitation. Yet in the end the fact would remain that persons in some areas, such as, elsewhere, Gotland and such as, in the sample, either Hedemora or Hälsingland may have been, still appear to have adopted family limitation for other reasons, and not all such family-limitation areas where truly persuasive evidence of population pressure is missing can be dismissed as "outliers". Further, after this "spark" of "overcrowding" was struck in some areas, partly because of the spark itself but more because of the further march of the secular cultural climate which had evidently made early family limitation possible both here and elsewhere, that new behavior soon acquired a momentum of its own clearly independent, save in minor details of timing, of the structure or dynamic of the remaining localities to which it spread. No other interpretation would be consistent with the overall evidence of the fertility transition in Sweden. The

overwhelming trend of the evidence is that breaking the crust of the old culture was a, and perhaps the, necessary and eventually even also a sufficient condition for the fertility transition in Sweden.

Strong confirmation of the necessary role of secularization in the specific sense encountered in the early family limitation areas identified in central Sweden, and later throughout most of Sweden, to wit a declining or liberalized state Church and a relative diversity or absence of new sects which might have revived its injunctions regarding sexual behavior, is found in an as yet unpublished monograph by Ron Lesthaeghe and Chris Wilson, of the Vrije Universiteit, Brussels.⁵⁴ In this paper, after a massive statistical survey of the correlates of fertility in the nineteenth century in several other European countries, Lesthaeghe and Wilson offer two conclusions. First, they suggest that areas which have evolved away from a familial, labor intensive mode of production are more likely to experience an early advent of family-limitation. This characteristic may or may not describe all the vital areas isolated in central Sweden as early foci of family-limitation behavior, and it encounters the problem that a non-familial, market-and-mobility oriented labor system was also found in localities in the sample where no significant degree of family-limitation behavior was found before 1890. But then, this result is the more contingent of the two conclusions offered. What is more relevant is the authors' claim, far more strongly substantiated by their analysis, that "secularization" was a necessary and a sufficient feature both of areas where family limitation behavior began early and of the process as a whole.

Their measure of secularization is different from the one used by Margareta Larsson, which is based on bishops' visitation records and on related religious sources. Lesthaeghe and Wilson use instead the proportion voting socialist in the elections of the nineteenth and early twentieth centuries, a measure not available in Sweden as significant socialist voting arose only after 1911. But this rather imaginative variable correlates as well, controlling for other variables, with measures of the advent of family limitation as does the initial measure of secularization used in Sweden; and the interpretation of this result is precisely the same as the interpretation of the secularization data used in the present study, i.e. that the traditional moral order represented by the state church, and sometimes revived by newer sects, had to be broken before the new value system which both permitted and encouraged family limitation could assert itself. Lesthaeghe and Wilson specifically underline the fact that this cultural event was often independent of the pace or nature of economic development. On the basis of this

evidence they affirm that secularization best explains the variations in the timing of the arrival of family limitation behavior in several European societies, even in the presence of all other relevant variables, and they conclude that it was therefore a necessary and even a sufficient condition of the fertility transition in western society. These conclusions are precisely the conclusions reached in this study.

The conclusions reached here and the nearly identical conclusions of Lesthaeghe and Wilson strongly support the hypothesis offered by John Knodel in his article in Population Studies, 1977, referred to throughout this paper. All three sources now suggest definitively that the advent of family limitation in western, and implicitly in all societies, can best be seen in terms of a variety of old and new structural and cultural stimuli urging fertility control upon persons who, as a result of a larger process of cultural innovation, begin to find that the specific concept of family limitation is both culturally compelling and culturally acceptable. The traditional culture, led by the religious authorities in the case of Sweden and evidently elsewhere in western Europe, has lost its power to compel allegiance, and so lost its ability to displace or to oppose a view in which rational, self-interested young persons decide for themselves to limit fertility within marriage for a variety of secular motives. In such a context, the new behavior of family limitation is in a specific sense a cultural or attitudinal innovation, and is of course a part of a larger process of such innovations which may be only distantly if at all related to the specifics, presence, or absence of economic development save in the sense that a generalized expectation of secular progress may be a part of the new cultural climate. It appears, then, that we may have been looking for thirty years for the cause of family limitation in a single structural change or set of changes, and failed to find it, because what we have been studying has been so fundamentally a cultural event or series of events. As Knodel points out, this conclusion also has policy implications for the developing world, where evolving structures are perhaps less important than mentalities, and where the increasing momentum of similar changes in mentality appears already to be bringing about family limitation more rapidly in each succeeding case.

The relation of the conclusions offered here to recent general theories of the fertility transition other than Knodel's does, however, need clarifying, and this is difficult. Charles Tilly has suggested that declining infant mortality plus an awareness of national structural and cultural changes, where these penetrated traditional culture at the local level, could have led parents to limit their families to fewer children, and to invest more heavily in the

education of these children, knowing that they would survive and, through education, would prosper, thereby guaranteeing the support of their aging parents. Save for a skepticism about the specific role of infant mortality, nothing offered here necessarily contradicts Tilly's thesis, in the sense that his is potentially a statement parallel to the thesis offered here. In the first place, Tilly's theory, and the one offered by Knodel and confirmed here and by Lesthaeghe and Wilson, may all assume to some degree if perhaps only on a national level, the shift from labor-intensive, familial labor to a mobile, market-oriented labor economy. And beyond this, some such secular motives as Tilly discusses may indeed have moved parents in secularizing areas, whether or not these areas were also feeling direct population pressure, to limit their families. It is not at all clear from the evidence presented here that local events leading to an expectation of maintained or higher incomes through the education of children or otherwise were a common or a unique element in the early family-limitation behavior found in this study. But here again national events could have created such income expectations on a national scale, encouraging parents locally to re-examine their fertility behavior and educational investment wherever the local culture did not effectively discourage such new behaviors. Smaller families could be a plausible consequence, both because for various local personal and secular reasons wives and husbands wanted these, and because on a national scale public education and its increasing relevance made it clear that at least one child in each family would, if educated, either prosper or at least be able to maintain the parent's economic status and so be able to assist his parents in their old age. True, areas which began fertility-limitation in central Sweden were not uniformly areas which, in the years 1840-1890, showed an unusually early or wide availability of public education once the creation of local primary schools was mandated, but once again, a certain flexibility may be required, to wit, as in the idea that local educational expectations were set nationally, and so local parents proceeded on the assumption that education for their fewer children would become available.

Tilly's thesis does, of course have as a converse that proletarianization, another component of economic and social modernity and in this case one which must work locally for the thesis to function, often led to increased fertility both marital and total. With wages to expect and nothing more to expect than wages, under certain circumstances the new proletarians may have had no incentive to limit, and even had positive incentives to increase, fertility. The evidence from the Swedish case examined here is ambiguous, as suits a sometimes ambiguous prediction on the part of the Tilly thesis tested here with mere aggregate data. This part of

his thesis does not seem to hold true in Åsunda, or indeed in the general Västmanland - Uppsala node, where some proletarianizing groups had to practice family limitation in order to generate the aggregate m values observed. The capitalistic farmers alone were too few to raise values this high, and indeed in Åsunda the "other landless" seem to have contributed to the family-limitation phenomenon. Up in Hälsingland, on the other hand, the newly arrived timber industry did offer cash jobs to smallholders after 1855, and later simply bought them out, and insofar as this truly was proletarianization (a doubtful conclusion before 1890) this was in fact associated with a rise in marital fertility, in a region still marked by evidence of the widespread use of family limitation.

The important thing about the Tilly hypothesis is that it functions best if taken to mean that a new set of expectations and attitudes determined at the national level eventually moved most individuals not experiencing proletarianization, and some who were, in localities where the crust of the traditional and above all the religious culture was broken, and in certain degree regardless of the local experience of infant mortality or of population pressure or of economic development or of educational progress, to begin to limit their families for a variety of secular motives. One such motive was to have fewer but educated children to care for them in their old age, but some other motives surely predated this new structure of expectations and some of these motives were essentially local, including local versions of population pressure. In this view, furthermore, to some degree local but eventually in a higher degree national or even international economic pressure, progress and cultural secularization, "liberal culture" in short, also helped determine the pace at which the crust of the traditional culture in various localities was in fact broken, thereby permitting both old motives and motives related to this very change of culture itself to assert themselves in the form of family limitation. Thus stated, the Tilly thesis consistent with the evidence from Sweden, but thus stated, it loses its apparently hard edge of structural causation locality by locality and describes instead essentially the great structural and cultural transformation of the nineteenth century, which appeared in a few and soon in all localities of Sweden largely as a new set of national expectations and a new national culture, to a degree and increasingly independent of local structural circumstances. This great change, perhaps much aided in some initial areas by locally declining infant mortality and by population pressure, was the event the statistics for Sweden describe. It was complex, and rich with variation, but it was also very clearly as much a cultural as a structural event even on the national and most certainly on the local level. It was, in what it did to traditional

culture and what it replaced that culture with, the necessary and often the sufficient event which, in this largest perspective, lay behind the advent of family limitation in Sweden.⁵⁵

The crucial ingredients in the picture, around which any theory must be built, seems clear. The prior shift from a familial to a market-oriented labor system, of which Lesthaeghe and Wilson speak, is not inconsistent with the secularization process discussed here or with some wider "neo-Tillian" version of that process.* Population pressure and/or declining infant mortality do recur with a curious near-consistency, as clearly in Västmanland and Uppsala provinces and with vague potential in the Hedemora area though less so in Hälsingland. In a wider sense, population growth short of severe pressure may have subtly assisted in altering both the labor economy and personal relationships in the early nineteenth century, leading, for example, to the growing illegitimacy which in turn put the social precepts and social control of established religion under a strain. In all these senses prior though generally subtle structural events, not always measurable in every locality, cannot be ruled out, and certainly the idea that different structural circumstances among different groups in different areas contributed to different desires to limit fertility is entirely substantiated by the evidence offered here. But none of these considerations rivals its validity or significantly alters the powerful trend of the evidence in all recent researches on the fertility transition in western and non-western societies, which says that the weakening of the traditional moral and above all religious authorities, most largely caused by the onslaught of liberal culture and its expectations, was if not the then surely a necessary and eventually possibly even a sufficient condition for the advent of family limitation behavior. Beyond these considerations, the single structural event whose local correlates we have been seeking all these years may very well not exist. A single, largely cultural event very clearly does exist.

One of the most persuasive confirmations of this view comes from recent enquiries into the circumstances of the fertility transition in the United States. Here, one might assume, secularization had occurred long before that transition, at the time of the American Revolution. Surely thereafter it had to have been one or a series of structural changes which explains the advent of massive family limitation behavior in the United States circa 1840-1890? Yet possibly not. Maris Vinovskis (Fertility in Massachusetts, N.Y., 1981) has long urged on demographers the importance of cultural differences and cultural change in explaining

* Nor (1983) is a general expectation of higher per-capita income within this market-oriented labor system to be ruled out as a related factor, though its local manifestations may be elusive.

variations and changes in the level of fertility in the nineteenth-century United States. A new book by James Reed, From Private Vice to Public Virtue; The Birth Control Movement and American Society since 1830 (Toronto, 1979) goes beyond Vinovskis and suggests that "the essential cultural prerequisites for the success of the birth-control movement were the secularization of society or the celebration of material well-being and pleasure ... and the progressive rationalization of relationships." It appears that, even in America, the men and women who initiated the fertility transition were not so much the creatures of a single measurable structural change which impacted them locally in ways discernable by multivariate statistics, as they were the creations of and participants in the evolution of modern, secular, liberal, and yes, in certain senses, capitalist, culture and its expectations. This event, so largely cultural by the time it reached most localities and late-modernizing nations, had to occur, and in time it alone could achieve the fertility transition even in America.

VI

Other Sources of Variation in Marital Fertility in Central Sweden, 1855-1890.

Even assuming that the indications of family limitation in the Sala - Södra Fjerdhundra area, in Arboga, and near Hedemora, Hanebo and Forsa härad are reliable, and that the social and religious information on these and other areas is also reliable, there remains one interesting and relevant aspect of the earlier data drawn from the Tabellverk in 1855. After the family limitation deaneries in and close to region three (Graph 2) are removed, how are we to explain the remaining variation in fertility, and above all the variation in fertility per unit nuptiality between the remaining deaneries of the east region on the one hand and the deaneries of the west region on the other? Not, presumably through family limitation on a scale comparable that suspected in the deaneries in or near region three in 1855 and apparently found in these areas in 1890. The remaining deaneries in the east region on Graph 2, or rather those which fell into Västmanland, Kopparberg and Gävleborg, and so were studied for 1890, show no 1890 m values higher than .200 or, with bridal pregnancy removed (groups 2-6 instead of 1-5 in the regression) .127 in 1890 (Stora Tuna in the latter case excepted). No härad within these remaining east region deaneries in the three tested provinces,

save for such obviously family-limitation-linked härader as Säter, Stora Skedevi, or Svärdsjö in Stora Tuna deanery, or Söderbärke härad which also adjoins Hedemora, showed a crude m value of over .250 or a refined value (groups 2-6 in regression) ⁵⁶ over .220 in 1890. The average crude m value in these remaining, testable east region deaneries and härader was .150 and the average refined m value below .100. Four of these deaneries, which run down middle of the east region on Graph 2, Gävle, Leksand, Norra Fjerdhundra and Vestra Rekarne, show crude m values averaging below .100 with still lower refined values. In general such east region m values are higher than the m values for those härader, such as Grängärde, Nås and Malung, which geographically bordered the west region deaneries on Graph 2 and which are usually classified with West Sweden geographically, where m values were near zero and refined m values circa -.250. But it is difficult to imagine that sufficient family limitation is represented by the difference between a refined m value of circa .150 to +0, found in the east region on Graph 2, and one of circa 0 to -.250, presumably typical of the West region if the m values for Grängärde, Nås and Malung can be taken as representative of that region, to account for the difference between fertilities which in the eastern region ran in the 3500-4200 range and in the western region in 4400-5500 range in 1855. Could so little a difference in m values at such insignificant levels so much later in time, i.e. in 1890, account for earlier differences in total and (given nearly equal illegitimacy rates) in marital fertilities on the order of 25% lower in the east region than in the west? Possibly, in which case the hypothesis offered here might have to be substantially revised. But there are other possible explanations.

It has become common for historical demographers to encounter societies where the evidence does not indicate the presence of a significant degree of family limitation and where, despite relatively high nuptiality, marital fertility is low compared with other regions in the same society. John Knodel has found this in Germany and Daniel Smith attempts to explain it in his analysis of the variations in fertility among the parish studies for seventeenth and eighteenth century France. ⁵⁷ This same paradox of high nuptiality yet low marital fertility in the apparent absence of a significant degree of family limitation is what is found in much of the east region of central Sweden in 1805 and in 1855 (Graph 2). How can it be explained? There are in fact many possible explanations, as noted earlier, such as that nutrition was worse in the east region, or that women in the east region tended more to marry men far older than themselves, or that marriage durations here were longer and so marital fertilities per year of married life longer than in the west region. But the explanation which, to Daniel

Scott Smith, made the most sense for France, and which best fits the known facts of Swedish life, is that by and large women in the east region more frequently breast fed their babies and did so for longer periods than in the west region. Present medical research indicates that nursing is as effective a means of birth control as any of the alternatives to the pill (Economist, May 1981).⁵⁸ Jan Sundin has recently explained startling differences in infant mortality rates in nineteenth century Sweden by reference to well documented differences in nursing habits. In the regions where infant mortality approached 50%, mothers did not nurse their babies at all. By implication, and this is being established in subsequent work, in areas where infant mortality was below 15%, nursing was relatively common and prolonged. Since other factors also influenced infant mortality, particularly within these extremes, infant mortality cannot stand as a surrogate variable for nursing practices. But work is now being done on the provincial doctors' reports, which in Sweden were frequent and detailed, to establish a map of nursing practices in nineteenth century Sweden. Once this is done, it may be possible to say whether nursing or something else was the initial "device" which, even in the apparent absence of a substantial degree of family limitation, enabled all the deaneries of the east region to achieve so much lower marital fertility than the west region.⁵⁹

Gävle, Leksand, Norra Fjerdhundra and Vestra Rekarne deaneries would be the logical places to begin such a study, as here of all the east region, save for the deaneries geographically adjoining the west region, 1890 m values and so the degree of family limitation involved was possibly lowest. For that matter, the deaneries geographically adjoining the west region, such as Vester-Dal and Norrbärke, which had zero to negative m values, should be studied as well. All these six deaneries showed little evidence of family limitation as late as 1890 yet consistently showed lower total fertilities per unit nuptiality and by deduction lower marital fertilities than any of the deaneries in Värmland and in western Örebro province, i.e. the "west" region, in 1855. Nursing practices here, as compared with those in the west region, may hold the key.

If no explanation for the east region's lower fertilities per unit nuptiality in 1855 can be found in nursing practices, or in age differences between spouses, in marriage durations or in nutrition, then it may be necessary to return to some form of entirely conscious fertility limitation within marriage, to explain the lower total fertilities per unit nuptiality and lower marital fertilities found in the east region as early as 1805 and quite marked there by 1855. Possibly, despite 1890 m values near or below zero, even such eastern areas as Gävle, Leksand, Norra Fjerdhundra, Vestra Rekarne, Vester-Dal and Norrbärke deaneries still showed, already

in 1805 or 1855, a limited and evidently stagnant (since marital fertility did not fall farther by 1890 and 1890 m values are only 0 to .150) yet nonetheless mildly effective degree of conscious family limitation which was not found in the west region deaneries of Värmland and western Örebro provinces and which explains the lower marital fertilities in these eastern deaneries. In which case, 1890 and earlier m values for the mass of deaneries in the western provinces graphed in 1855 may have approached -1.0, and negative m values in this range must, in Sweden, be the only guarantee of the absence of family limitation!⁶⁰ But such early and attenuated forms of fertility limitation within marriage, if they were widespread in the east region studied here and in all of Sundbärg's "East Sweden" by 1855, would not pose fatal problems for the explanation of the more modern form of family limitation which had spread only to the third region areas identified here by 1855 or by 1890, and which immediately thereafter took both these and indeed all areas of Sweden south of Norrland into m values and marital fertility levels unheard of previously. John Knodel was aware of the possibility that a limited degree if not a peculiar form of family limitation might have been widespread in Sweden before 1890.⁶¹ Knodel based his awareness largely on his failure to understand that early m values for Sweden as a whole, which from 1750 to 1890 range precociously from .160 to .320, are largely the result of the inflating effects of widespread bridal pregnancy on this statistical measure. Corrected m values (groups 2-6 in the regression) for Sweden as a whole before 1890 seldom run above .150. Still, Knodel's reasoning, as offered in his 1977 article in Population Studies, remains relevant. The widespread existence of a limited degree, perhaps limited to certain social groups, and/or of a peculiarly attenuated form of conscious family limitation within marriage, while perhaps in some parts of Sweden a preparatory stage for later events, does not change the substantial evidence that in Sweden as elsewhere widespread family limitation in the modern sense was a cultural innovation whose time, save in the few "third region" localities identified in this study, was to come largely after 1890.

In all of this, it is important to remember that even the relatively high fertility in the west region was, at circa 5000 TFR, far from the highest known to man. Swedish fertility was in this sense loaded with restrictions, conscious and unconscious, even before the great breakthrough of the fertility transition after 1890. Between 1805 and 1890, family limitation in the modern form had begun in some rural areas, possibly in an attenuated form in other areas. Nuptiality went or was pushed down in all regions in the mid-nineteenth century, and this lowered total fertility. In Leksand and Rättvik, the old, strict controls on illegitimate fertility held this to

below 3% of total fertility, while it rose above 10% elsewhere, with the result that total fertility in these exceptional areas was relatively reduced. Whether or not conscious measures to reduce fertility were present, nursing, long age-intervals between spouses, short marriage durations, and poor nutrition depressed total and marital fertility. Some of these factors surely also operated sufficiently even in the west region to ensure that fertilities here, while relatively high, were far from the highest on human record. Here, too, the Swedish church remained strong longer than in any area save in Leksand - Rättvik and in Norrland, and this religious control, while it may have helped delay the advent of family limitation in such western areas as Värmland especially, probably did aid in enforcing the late and infrequent marriage which so lowered nuptiality, and with it fertility, in this region.

Perhaps never before or since the nineteenth century has human fertility been restrained in so many different ways at the same time. Today, for example, in Sweden family limitation is everywhere the primary conscious method of limiting fertility. The increasingly late marriage age and low marriage frequency found today these can scarcely be identified primarily as deliberate means of fertility limitation in modern Swedish society. Because family limitation by means of birth control practices is now so widespread, the effects late and infrequent marriage are now largely redundant, and so these practices do not compare with the discouragement of marriage by local cultures or with the conscious pressure on illegitimate fertility also found in such cultures in the nineteenth century. Nursing's preventive effect is now similarly redundant; age differences between spouses are less than ever before and so do not significantly limit fertility; and marriage durations, which are in the net shorter by reason of divorce, are also made irrelevant by the presence of modern birth control in the service of a target family size which ranges from two to three children. Poor nutrition is scarcely any longer a check on fertility anywhere in Sweden. There is a kind of tedium about modern life beside which the variety of the limitations on fertility in nineteenth century Sweden stands for a time in which the modern world was being born and all things were possible.

Footnotes

1. Gustav Sundbärg, Emigrationsutredningen, Bilaga 5, Bygdestatistik, Stockholm, 1910; S.D. Wicksell, Befolkningsrörelsen i Sveriges Häradar...1911-1925..., Malmö, 1934; Karl Arvid Edin and Edward P. Hutchinson, Studies of Differential Fertility in Sweden, London, P.S. King and Son Ltd., printed in Stockholm, 1935; S.D. Wicksell and C.E. Quensel, Undersökning av de demografiska elementen, deras regionala varitationer..., Sveriges Officiella Utredningar, 24, 1938.
2. Hofsten, E. and Lundström, H., Swedish Population History: Main Trends from 1750 - 1970, Urval 8, Statistical Central Bureau, Stockholm, 1976; Eva Bernhardt, Trends and Variations in Swedish Fertility, A Cohort Study, Urval 5, Statistical Central Bureau, Stockholm, 1971. John Knodel, "Family Limitation and the Fertility Transition: Evidence from the Age Patterns of Fertility in Europe and Asia," Population Studies, 31, nr. 2. 1977; Carl Mosk, "Scandinavian Historical Demography: An International Perspective," Working Paper No. 132, Department of Economics, University of California, Berkeley, October, 1979.
3. For "West Sweden", "East Sweden", and "North Sweden", see Sundbärg, Emigrationsutredningen, Bilaga V, Bygdestatistik, 4-9; for demographic data on the provincial level, see also E. Hofsten and H. Lundström, Swedish Population History (Stockholm, 1976).
4. For example, David Gaunt, "Family Planning and the Preindustrial Society: Some Swedish Evidence", Aristocrats, Farmers, Proletarians: Essays in Swedish Demographic History, Studia Historica Uppsaliensia, 47, Uppsala, 1973; Christer Winberg, Folkökning och proletarisering, Meddelanden från Historiska Institutionen i Göteborg, 10, Gothenburg, 1975; and John Rogers and Ingrid Eriksson, Rural Labor and Population Change: Social and Demographic Developments in East-central Sweden during the Nineteenth Century, Studia Historica Uppsaliensia, 100, Uppsala, 1978.

5. Project on the Fertility Transition in Sweden, 1890 - 1930, led by John Rogers and Thomas Nilsson, Historiska Institutionen, Uppsala University, Uppsala.
6. See note 1, above, for the primary early analyses which published and used the post-1860 härad data. The officially published data, largely on the provincial level, is published as part of the Folkräkningar (census) of, for example, 1890, 1900, 1910, 1920, 1930 etc. Other data from these censuses is found in other volumes of Bidrag till Sveriges Offentliga Statistik, known as BiSOS. The best general description of the post-1860 Statistical Central Bureau is found in Karin Koch, Statistiska Centralbyrån 100 År, Stockholm 1959. The best account of the pre-1860 Tabellverk is in Minnesskrift med anledning av den Svenska befolkningsstatistikens 200-åriga bestånd, Stockholm, 1949, especially the contribution by C.E. Quensel.
7. The proportion of widows is also given by the Tabellverk, however, so the nuptiality variable can be modified so as to take this into consideration. In this analysis, this has not been done through modifying the nuptiality variable itself, however, but through giving, in Table 1, the proportion of widows in each locality alongside the proportion over 15 years who were married. As the subsequent discussion and note 21 point out, the crucial changes and differences in the nuptiality variable as used here - the proportion of women over 15 who were married - were plainly not a function of such variations in the proportion of widows over time or from locality to locality. The crude nuptiality variable also has another minor effect relating to local variations in the age-structure of women over 15, but on the deanery level these variations were so minor and so unrelated to the variations in nuptiality discussed here as not to merit inclusion in Table 1.
8. See the works by Karin Koch and C.E. Quensel, referred to in footnote 6, above.
9. Jan Sundin, "Family Research by Computer: A Swedish Example", in Family Building and Family Planning in Pre-Industrial Societies, Reports from the Family History

Project, nr. 1, Historiska Institutionen, Uppsala universitet, Uppsala 1980; Anders Brändström and Jan Sundin, "Infant mortality in a changing society: the effects of child care in a Swedish parish", to appear in Tradition and Transition: Historical Studies on Microdemography and Social Change in Sweden, Report nr. 2 from the Demographic Database, Umeå, 1981.

- 10 Demographic Database, Umeå University, S-901 87 Umeå, Sweden; address of the Uppsala project is in note 5, above.
11. The Total Fertility Rate is expressed as

$$TFR = \sum_{\omega_1}^{\omega_2} \frac{B_x}{P_x} \times 1,000$$

where B_x is the number of live births registered during the year to mothers of age x , where " x " represents an interval of one year of age, and P_x is the midyear population of women of the same age. The age-specific fertility rates are to 54, 15 to 44, or whatever range is available and appropriate.

In usual practice, the total fertility rate is calculated by a shorter method. The specific birth rates are calculated for 5-year age groups and thus the subscript i represents 5-year intervals such as 15 to 19, 20 to 24, and 45 to 49 years. The expression for total fertility, using seven 5-year age groups, for example is then

$$TFR = 5 \sum_{i=1}^7 \frac{B_i}{P_i} \times 1,000 \quad (5)$$

where B_i is the number of live births registered during the year to mothers of age group i , i is an interval of 5 years, and P_i is the mid-year population of women of the same age. The

rate for the age group to five successive single years so that the sum of the age-specific rates will be commensurate with that above.

The total fertility rate states the number of births 1,000 women would have if they experienced a given set of age-specific birth rates throughout their reproductive span. A rate of 5,602 for Peru in 1961, for example, means that if a hypothetical group of 1,000 women were to have the same birth rates at each single year of age as were observed in Peru in 1961, they would have a total of 5,602 children by the time they reached the end of the reproductive period, taken as 49 years old, assuming all of them survived to that age. The procedure for computing the total fertility rate is shown in the table.

In this analysis, the .05 - 3% of total fertility ascribable to women below age 20 in Sweden, has been omitted, so TRF figures are correspondingly low. This amount is so small and its variation so limited that it has no effect on the analysis.

Nuptiality is simply the proportion of women over 15 years of age who were married. Subtleties of this measure are discussed in the following text and in footnotes 7, above, and 21, below. Fundamentally, this is a crude measure whose test lies in its use, as demonstrated in Graphs 1 and 2, below, and in the results of the paper.

TFR is calculated for all children born in 1805 and 6, and in 1855 and 6, as reported in the annual tables for these years, and for all women present late in 1805 and 1855, as reported in the five-year tables for these years. Nuptiality is based upon the five-year tables for 1805 and 1855. The author has used Xerox copies of the original Tabellverk tables for each deanery; the originals are to be found in the archive of the Statistical Central Bureau in Stockholm.

12. The social variables for these härader circa 1890 are from G. Sundbärg, Emigrationsutredning, Bilaga V, Bygdestatistik (Stockholm 1910). The age-specific marital fertility data is based on parish-level data on children born in 1889 and 1890, found in the archive of the Statistical Central Bureau in Stockholm under Byrån för befolkningsstatistik; Länssammandrag över befolkningsrörelsen (Arbetstabeller med barnmorskors ålder, civilstånd, o.s.v., församlingsvis),

HI:bad, v.5-6-7, and on data on all women by sex and civil status in each pastorat early in 1890, also in the S.C.B. archive, under Folkräkning 1890: Arbetstabeller - Prickningslistor (befolkningen enligt kön, ålder, civilstånd, o.s.v) HI:ba, v.12-16.

13. See, for example, Karl Arvid Edin and Edward P. Hutchinson, Studies of Differential Fertility in Sweden, London, P.S. King and Son Ltd., printed in Stockholm, 1935

14. It should be emphasized that in this paper the argument is conducted on a very practical level. That is to say, in the first place, that all the data presented, that on variations in total fertility in 1805-6 and in 1855-6, as with the later data on marital fertility in some of the same areas in 1889-90, and with the subsequent data on the economic correlates of fertility in this region, are kept as close as possible to the original data in the sources. Thus, the Total Fertility Rate and the crude measure of nuptiality initially used here involve only simple combinations of the information found in the Tabellverk, combinations calculated without added assumptions about the levels of unknown variables. Secondly, the "controlling out" of such other variables as illegitimate fertility and infant mortality can, fortunately, be done largely by eye, because within the sample these vary so little and are so plainly irrelevant to the variations in fertility studied here. Table 1 will permit anyone with a desk-top computer to confirm the relative constancy and or irrelevance of such peripheral variables, by more systematic means. Thirdly, scattergrams and other simple descriptive devices are used to depict the vital relationships among the essential variables in the analysis, as with Graps 1 and 2, below. Correlations and multivariate analyses would confirm the conclusions drawn here and elsewhere in the paper (depending on how one structures both variables and analysis), but such techniques are not employed because they throw away too much vital information and render the rest so abstract that a Swedish audience could neither recognize nor assess the use of sources with which they are uniquely familiar. Thereby a vital contribution to improving this work would be lost. Here, too, judicious use of Table 1 and a small computer will substantially confirm the relevant conclusions. The ultimate practicality is that a series of such rough-and-ready uses of admittedly weak but independent data, that on

total fertility up to 1855-6, on marital fertility circa 1890, on the demographic and economic correlates of fertility 1855-90, and on cultural changes in the period around 1890, produces a result whose very consistency is the best guarantee that the conclusions reached in this paper could have substance. Working close to the data therefore need not discredit the results.

15. See E. Hofsten and H. Lundström, *Swedish Population History* (Stockholm, 1976). Daniel Scott Smith, "The Demographic History of Colonial New England", *Journal of Economic History*, 1972, Nr. 1, 165-183, implies that nuptiality was already a characteristic cause of relatively low Swedish fertility even before 1800.
16. See note 14. As can be deduced from the information in Table 1, there was some correlation between extremely high infant mortality and high fertility and between extremely low infant mortality and low fertility in 1805, but this was a weak correlation across all the deaneries listed. By 1855, for complex reasons, this weak correlation between infant mortality and total fertility had disappeared. As will be noted later, there is at no time a significant correlation between variations in illegitimate fertility and the major variations in total fertility discussed here. Only nuptiality, then, and it only in 1855, produced a strong correlation with total fertility as measured here and in the process elucidated the regional differences within this overall relationship which proved of vital importance to the present analysis. As a matter of fact, therefore, nuptiality was the variable which by 1855 best explained the variations in total fertility and which illuminated the vital regional variations in the fertility level at which this relationship existed, leading the way to this investigation of the origins of family limitation in the areas where the nuptiality-fertility relationship existed at the lowest levels of total fertility per unit nuptiality. But, again, the choice of nuptiality as variable was also determined by theory: in theory, lowered nuptiality was, by 1855, the chief conscious strategy in Sweden for achieving lower total fertility. This was well known already; see for example E. Hofsten and H. Lundström, *Swedish Population History* (Stockholm, 1976). Thus, all other variables being effectively equal, areas which, at any given level of

nuptiality achieved relatively the lowest total fertilities, and also the lowest absolute total fertilities, must be automatically suspected of also employing some other form of conscious fertility control, presumably within marriage. As will be seen from Graph 2 and the ensuing discussion, this seems to have been the case.

17. G. Sundbärg, Emigrationsutredningen, Bilaga V, Bygdestatistik, pages 4-9, (Stockholm, 1910). Sundbärg developed this concept further in later writings.
18. E. Hofsten, H. Lundström, Swedish Population History, (Stockholm, 1976), gives figures for fertility and nuptiality for all provinces circa 1805. Natural fertility is a controversial and difficult concept, and the word "natural", in quotations, is used here for Sweden only in the loose sense of fertility in Sweden prior to 1805, without the later and presumably largely conscious restraints on nuptiality and on marital fertility which were characteristic, respectively, of the nineteenth and twentieth centuries in Sweden. In general, the absolute levels of fertility hereafter associated with this Swedish "natural" fertility are not inconsistent with more closely defined natural fertility as discussed in John Knodel, "Natural Fertility: Age Patterns, Levels, Trends" (to be included in Determinants of Fertility in Developing Countries, a volume for the National Academy of Sciences, Washington, D.C., scheduled to appear in 1982) and in Knodel's references. This does not mean, however, that "natural" fertility as discussed here for Sweden is true natural fertility by the definitions offered by Knodel and others.
19. See note 18 for the operational definition of "natural" fertility in Sweden as used in this paper.
20. Again, see Emigrationsutredningen, Bilaga V, Bygdestatistik, pp.4-6, (Stockholm, 1910).
21. While discussing the reliability of the two major variables used in 1805 and 1855, it should be reaffirmed that the "nuptiality" variable seems not to be as corrupt as at first

glance "the proportion of women over 15 years old who are married" might indicate. A study of age-specific mortality rates by sex, using the data in Tabellverk, indicates that the major graphed variations in this "nuptiality" variable both within and across the regions identified in 1805 and above all in 1855, and over time from 1805 to 1855 for all regions, are not related to slight variations in the tendency of men to die before their wives, variations which in theory otherwise could create some variation in the rather "dirty" nuptiality variable used here, by creating variation in the proportion of widows from area to area or from period to period, and hence raising or lowering the proportion of women over 15 actually married for purposes of this "nuptiality" variable. Another way to approach the same issue, is to say that there appear to be no systematic variations in the proportion of widows in the various deaneries and times examined here, which could have created the local variations in "nuptiality", defined as the proportion of women over 15 currently married, or created the time-and-regional differences in fertility per unit nuptiality, delineated here. If anything, the proportions of widows (see Table 1) indicate that the regional differences in nuptiality, and in fertility per unit nuptiality, discussed here are understated by the nuptiality variable used! Further, as footnote 7, above, indicates, local variations in the age-structure of women over 15 were, on the deanery level, so minor and so totally unrelated to the variations in nuptiality used here, that this data was not included in Table 1, even though in theory such variations also enter into the nuptiality variable used here.

22. See references cited in note 18, above.
23. John Rogers and Ingrid Eriksson, Rural Labor and Population Change, Studia Historia Uppsaliensia, 100, Uppsala, 1978.
24. Ansley J. Coale and T. James Trussell, "Model Fertility Schedules: Variations in the Age Structure of Childbearing in Human Populations", Population Index, 40 (1974), 185-258; see also Erratum, Population Index, 41 (1975), 572; and A. J. Coale and T. J. Trussell, "A New Procedure for Fitting Optimal Values of the Parameters of a Model Schedule of Marital Fertility Rates", Population Index 44 (1978). In this

analysis, Coale and Trussell's advice has been followed to the letter, and with groups 1-6 observed (in five-year groupings), groups 1-5 have been put into the regression, and the mean square error then calculated for groups 1-6. Exceptions to this are discussed in the text and footnotes, below.

25. See text and footnotes, below, and Appendix I.
26. Again, see the longer discussion of the use of "m" in Sweden and of the Åsunda data, in Appendix I.
27. The procedure here is essentially to replace the $m = 0$ and $m = .1$ parameters for married women in Coale and Trussell's "m" with a parallel set of parameters for the age-specific fertility of all women in Sweden, with the powerful tendency of the age-specific fertility curves for married and for all women to co-vary over the long run in Sweden as justification. The main reason that in 1855 more areas do not register strongly positive values with this measure is probably that changes in nuptiality peculiar to the middle of the nineteenth century in Sweden tend to bias the measure toward negative values just in 1855, a bias which has largely disappeared by 1890. The data for Vestra Fernebo are in Tables 1 and 2.
28. See note 24.
29. Again, see Appendix I for the evidence that bridal pregnancy is indeed the culprit.
30. Appendix I discusses the problem of bridal pregnancy in general, and considers a long-term solution to this problem. The short-term solution applied here in the case of "Arboga", and in the Sala-Södra Fjerdhundra area is, as can be seen less desirable. That is, the m values encountered here, as often elsewhere in central Sweden, are inflated, and the mean square errors are definitely much increased (see Graph 2 in Appendix I for an example of how this works) by the high fertility of women 20-24, a fertility almost certainly

attributable to bridal pregnancy. Putting groups 2-6 (women 25-49) in the regression instead of groups 1-5 (women 20-45), deflates the m values in cases where high group 1 fertility (women 20-24) had artificially inflated them and where the underlying value is in fact much lower, but unfortunately, as Coale and Trussell warn in their articles, group 6 (women 45-9) fertility is statistically so volatile that the resulting curves are sometimes still badly fitted. Furthermore, as Appendix I indicates, for some reason in Sweden a sample size roughly double the minimum urged by Coale and Trussell and generally used here (at least 100 woman-years in each group of women), is required to bring fits into a reasonable range, say .0009 - .007, and this sample size problem affects, for example all the härader in the Sala-Södra Fjerdhundra except Övre-Tjurbo, regardless of whether groups 1-5 or 2-6 are in the regression. The result is, that first bridal pregnancy distorts m and creates bad fits (high mean square errors), then, when one shifts to groups 2-6 in the regression, the volatility of fertility in group 6 often still leaves bad fits and, on the härad level, the marginal sample sizes prevailing in the Sala-Södra Fjerdhundra area härader, and sometimes elsewhere, further worsen the fits, as sample size is usually smallest among group 6 (45-9) women. There is no easy way out of this dilemma. Nonetheless, the 1855 evidence, the general trend of m values in these parts of Västmanland (even though they are badly fitted) as compared with m values elsewhere, and the geographic location of Sala-Södra Fjerdhundra precisely adjoining what from all the evidence seems to have been a major locus of family limitation in Uppsala province, lead to a strong suspicion of family-limitation activity in this area circa 1855-1890. The social correlations and the data on declining infant mortality offered later in this article may tend further to confirm this suspicion.

31. Again, see John Knodel "Natural Fertility" and references cited therein, cited in note 18, and scheduled to appear in Determinants of Fertility in Developing Countries, National Academy of Sciences, Washington, D.D., 1982.
32. John Knodel, "Family Limitation and the Fertility Transition; Evidence from the Age Patterns of Fertility in Europe and Asia," Population Studies, 31, 1977; Christer Winberg, Folkökning och Proletarisering, (Gothenburg, 1975).

33. Kjell Söderberg, Den första massutvandringen: En studie av befolkningsrörlighet och emigration utgående från Alfta socken i Hälsingland, 1846-1895, Acta Universitatus Umensis, Umeå studies in the Humanities, 39, Umeå, 1981.
34. See, for example, the discussion in John Knodel, "Family Limitation and the Fertility Transition:...", Population Studies, 31, nr.2, 1977, note 17.
35. David Gaunt, "Family Planning and the Preindustrial Society;...", in Aristocrats, Farmers, Proletarians, Studia Historica Uppsaliensia, 47, Uppsala, 1973.
36. John Rogers and Ingrid Eriksson, Rural Labor and Population Change, Studia Historica Uppsaliensia, 100, Uppsala, 1978.
37. Tabellverk's detailed occupational statistics, in addition to its demographic information, and the härad data in Sundbärg's Emigrationsutredning (see note 41) permit fairly close structural description of the deaneries and härader, respectively. Sala deanery, Hedemora härad and the crucial Hälsingland härader, in particular, were not structurally similar, nor was each unique as far as the descriptive powers of these sources go, through of course minor local variations made every locality in one sense or another unique.
38. The quotation is a direct translation from the printed census pages which the priests and deans filled in. Actually, the best results, though very similar to those on Graph 3, are achieved by taking the average of this "welfare" variable with the percent considered "poor" in each area, which was also listed on the census forms. This reduces local variations in the interpretation of both "welfare" and "poor". But in Graph 3, "welfare" has been used as part of an effort to use raw rather than synthesized variables throughout.
39. Again, the härad data are from Gustav Sundbärg, Emigrationsutredningen, Bilaga V, Bygdestatistik, (Stockholm, 1910).
40. Crude nuptiality in 1890 can be calculated directly from the data on married and unmarried women over age 15 in the SCB sources cited in note 12, above, and another measure can be calculated indirectly from Sundbärg, source cited in 39, above. The impact of low nuptiality in Våla can readily be

seen in Table 2, in the difference between its average marital fertility of 7006 and its low total fertility of 3884. Table 2 also indicates a relative absence of family limitation in these two härader, which had m values below .100.

41. Gustav Sundbärg, Emigrationsutredningen, Bilaga V, Bygdestatistik, (Stockholm, 1910), data on härader.
42. Ansley Coale, "The Demographic Transition", paper presented at the plenary Session of the International Union for the Scientific Study of Population Meeting, Liege, 1973; John Knodel, "Family Limitation and the Fertility Transition", Population Studies, 31, nr 2, 1977.
43. Ms. Larsson is a doctoral candidate in the Department of Sociology at Stockholm University, working under Professor Gösta Carlsson. Her dissertation, on the relationship between variations in other demographic behaviors on the one hand, and structural and religio-cultural factors on the other, in Sweden circa 1890, will be complete in 1983. Her map of religious characteristics of various härader in Sweden circa 1890 is a part of this dissertation. The author and Ms. Larsson expect to publish a brief joint summary of their results, respectively on härader where family limitation seems to have begun earliest and on the religious characteristics of these as compared with other härader in Sweden in 1890, in an international journal in 1983.
44. This is based on a combination of sources, including bishop's visitation records, local records of religious conditions and of the enforcement of social control by the State Church (neither migration nor marriage could take place until the local priest approved the reading ability, religious knowledge and character of the person involved, and, in the case of migration, the local priest documented these and received a receipt from the local priest in the parish to which the migrant moved. Annual records, tested and shown to cover 98% of the population, recorded the relevant behaviors), and the records of local sects. It is almost impossible to convey to someone not familiar, how totally controlled and totally recorded Swedish society was in the years 1686-1895. The degree of control over social and demographic behavior exercised by the Swedish Church, and by some of the sects which nearly replaced it in some areas, is the main subject of Ms. Larsson's dissertation (see previous

note). Suffice it to say that in no western country did a traditional church systematically seek to and succeed in enforcing social behavior, as much or as successfully as in Sweden. Sexually, the old injunction against bastardy tended to give way, massively in the nineteenth century, but the Church in a sense replaced this with subtle re-enforcement of the evolving injunctions against frequent or early marriage in the same period. Generally the Church was opposed to birth control and to family limitation and never officially favored either. Its injunctions were taken over, indeed re-vivified, by some of the sects which locally succeeded it. For a general view of the social role of the State Church, see H. Pleijel, Hustavlans' värld (Stockholm, 1970). See also the references in notes 36 and 51 for further evidence of the role and records of the Swedish Church.

45. Again, see John Knodel, "Family Limitation and the Fertility Transition", Population Studies, 31, 2, 1977.
46. General infant mortality trends by province are found in E. Hofsten and H. Lundström, Swedish Population History, Stockholm, 1976.
47. Same source as in note 46, above.
48. Ann-Sofie Källemark, "Familjen som utvecklingspegl", unpublished manuscript, 1977.
49. Hofsten and Lundström, Swedish Population History (Stockholm, 1976) establishes the general evolution of fertility levels in the various provinces of Sweden from 1855 to 1930, and the leadership of East Sweden, and of the Lake Mälaren area in particular, after 1890, can be seen both in this source and in Edin and Hutchinson, Studies of Differential Fertility in Sweden (London, Stockholm, 1935). These sources, and Knodel "Family Limitation and the Fertility Transition", Population Studies, 31, 2, 1977, also establish that 1890 is the approximate turning point for the massive adoption of family limitation in Sweden.
50. Hofsten and Lundström, Swedish Population History (Stockholm, 1976).
51. See H. Pleijel, Hustavlans Värld, Stockholm, 1970; and Egil Johansson, "The History of Literacy in Sweden as Compared

- with Some Other Countries", Educational Reports Umeå, nr. 12, 1977.
52. The general upsurge in illegitimacy in the nineteenth century has already been discussed, and can be seen clearly in Table 1; as Hofsten and Lundström, Swedish Population History (Stockholm, 1976) show, this continued into the twentieth century. Hofsten and Lundström also document the fall in marriage age and rise in marriage frequency after 1870.
  53. See note 14.
  54. "Modes of Production, Secularization, and the Pace of the Fertility Decline in Western Europe, 1870-1930", paper delivered at a conference sponsored by the Institute for Population Studies, Princeton University, summer 1980.
  55. See Tilly's essay "Questions and Conclusions" in Charles Tilly, ed., Historical Studies of Changing Fertility (Princeton, 1978); and his "Population and Pedagogy in France", History of Education Quarterly, 13 (1973). The Swedish educational data are in Margitta Schelin, Den officiella skolstatistiken i Sverige, 1847-1881, Pedagogiska Monografier, 20 (1978), Umeå university, Sweden.
  56. See discussion in text and note 30 above.
  57. John Knodel, "Natural Fertility in Preindustrial Germany", Population Studies, 32, nr. 3, 1978; Daniel Scott Smith, "A Homoeostatic Demographic Regime: Patterns in West European Family Reconstitution Studies", in Ron Lee, ed., Population Patterns in the Past (New York, 1977).
  58. "Science and Technology", section, The Economist, May 30, 1981, p. 87. The particular citation there is to remarks by Professor Roger Short, head of the reproductive biology unit at the University of Edinburgh.
  59. Jan Sundin and Anders Brändström works cited in note 9; see also Ulla-Britt Lithell, Breast Feeding and Reproduction: Studies in marital fertility and infant mortality in 19th century Finland and Sweden, Acta Universitatis Uppsaliensis: Studia Historica Uppsaliensia, 120 (Uppsala, 1981). Future work on a map of nursing practices in nineteenth century

Sweden is being undertaken by Brändström and also by Lithell.

60. Or, alternatively, there was possibly from an early date in the east region a kind of conscious family limitation which, while it did not even as late as 1890 always raise m values significantly above the near-zero level which, in this hypothesis, also prevailed in the western region, or drastically lower marital fertility to unprecedented levels, was still sufficient to explain lower fertilities per unit nuptiality and lower marital fertilities here. See, in this respect, the hypothesis offered for an area which fell between East and West Sweden, by Christer Winberg, in Folkökning och proletarisering (Gothenburg, 1975).
61. John Knodel, "Family Limitation and the Fertility Transition", Population Studies, 31, 2, 1977, pages 243 ff.

Appendix I
with
Göran Broström

Coale and Trussell's "m" visits Sweden, or, why do we get such lousy fits?

Coale and Trussell's m index is a measure of the tendency of a given age-specific marital fertility curve to deviate systematically from a model "natural" fertility curve in the direction of a model "family-limitation" or "parity-dependent fertility control" marital fertility curve.¹ The chief characteristic of the deviation which presumably indicates family-limitation is a proportionately greater departure below the model natural fertility curve among older married women presumably a result of the cessation of fertility as married women achieve their planned family sizes and stop having children. When such a deviation from the age-pattern of "natural" fertility is clearly established, and especially where this tendency increases over a period of decades, the "m" index may be taken as one indicator of the advent of family limitation. With some forms of aggregated data, it is nearly the only indicator available.

The computer program which calculates an "m" value for a set of observed age-specific marital fertilities essentially fits to these observed values, by means of logarithmic regression, a set of predicted age-specific marital fertilities which, as nearly as possible by this method match, or fit, the observed data and which correspond to a given stage on the predicted evolution from a model "natural" fertility curve to a "family-limitation" curve. The m value for this fitted curve within the model system falls along a continuum in which a "natural" fertility curve yields an m equal to 0 and a "family-limitation" curve yields an m equal to 1. Lower and higher values are possible. The value for this fitted curve within the model system is the m value assigned to the actual data submitted to the program.

Coale and Trussell's program also provides a measure of the "goodness of fit" of the fitted m curve to the actual data. They use simply the mean square error of the regression by which an m curve, and so m value, was fitted to the observed data. While they recommend that only the observed fertility values for married women 20-24, 25-29, 30-34, 35-39 and 40-44 be used in the regression which fits a model m curve to the observed data, as the fertility rate of women 45-49 is too variable to be reliable, they also suggest that the observed values for all groups of women be used in calculating the mean square error of the resulting m curve fitted by

means of the regression. Coale and Trussell suggest that, where sample sizes surpass the minimum of 100 woman-years in every observed age-group in the marital fertility curve, a mean square error of .010 be regarded as a "terrible" fit, .005 as a "mediocre" fit, while, by definition, a mean square error of .000 denotes a perfect fit.

The problem, in Sweden, is that the fits are often very bad indeed. Repeated runs of the m program on individual-level data from Tuna and Fleninge parishes 1820-1890, using material stored in the Demographic Database in Umeå, on similar data from Åsunda härad (a härad is a civil district of 1-10 parishes) circa 1825-1885, published in John Rogers and Ingrid Erikssons 1978 dissertation,² and on aggregated data on age-specific marital fertility in the härader of Västmanland, Kopparberg and Gävleborg provinces in central Sweden in the years 1889-90, from the archive of the Statistical Central Bureau in Stockholm, yield mean square errors which in two-thirds of all cases run between .004 and .01. According to Coale and Trussell, these are mediocre to terrible fits of the modelled m values to the actual data. While in perhaps a fifth of the localities tested the mean square error of the fitted m value was below .004, in most of these cases mse was in the .004 - .002 range, or little better than mediocre by Coale and Trussell's standards. Only one locality approached or surpassed an mse of .001, the point at which "good" fits might be said to begin. On the other hand, a significant minority, perhaps a fifth of all localities tested, showed mean square errors worse than .01, Coale and Trussell's "terrible" fit, and these ranged as high as .07, which might be labelled "abysmal" (see Appendix Graphs 1 and 4). To a worrisome degree the model employed by Coale and Trussell does not fit the Swedish data.

The main problem with the Swedish data seems to be that the fertility of married women 20-24 was so high. In roughly two-thirds of all localities, the observed fertility for women 20-24 exceeded the practical value assigned by Coale and Trussell's model by .025. Appendix Graph 1 shows the close relationship of this kind of positive deviation of the observed fertility in group 1 (women 20-24) from the predicted model value with the total mean square error in each case. (All cases in Appendix Graph 1 include at least 2000 woman-years of experience, to eliminate lesser sources of variation.) This graph shows that the inability of the model to accomodate such high group 1 fertility is the major source of high mean square error in these cases. Appendix Graph 2 shows in the case of Ockelbo härad in Gävleborg province precisely how this bad fit results. Observed fertility among married women aged 20-24 in 1810 was .520. The predicted value under the model curve fitted was .434, a discrepancy of .087. Further, the model curve fitted, while

lower than actual fertility at this point, is still selected to have relatively high group 1 fertility, and so tapers off only gradually from a group 1 fertility of .434 to predicted fertilities for succeeding age-groups of .390, .337 and .261. But the actual fertilities in Ockelbo tumble from group 1's .520 to subsequent figures of .338, .322 and .222, all significantly below the values in the model curve. Thus, the high group 1 fertility in Ockelbo "deceives" the program into fitting a model curve which, while still not high enough in group 1 fertility, is too high to accomodate the actual fertility in immediately succeeding groups. Small wonder that the goodness-of-fit measure for the m curve fitted was a disastrous $mse = .072$! Coale and Trussell's model simply cannot describe the pattern of marital fertility in Ockelbo. In such a situation, frequent in nineteenth-century Swedish data, m values are meaningless.

Proportionately smaller excesses of observed over predicted fertilities among married women 20-24 in other localities are associated with proportionally smaller mean square errors, as is seen in Appendix Graph 1, until in the end an observed group 1 fertility only .020 - .025 above the model is associated with mean square errors in the .005 - .002 range, approaching a decent fit. Beyond this point, reducing the excess of observed group 1 fertility over predicted model fertility does not systematically reduce mean square error. In sum, where sample size is safely over 2000 women years of experience, the chief systematic cause of high mean square errors in the nineteenth-century Swedish data appears to be the frequent tendency of fertility among married women 20-24 to far exceed the capacities of the model. Only where this excess of observed over model group 1 fertility is less than .025 does the problem appear to cease.

What caused this problem in the first place? The answer is very probably that in the nineteenth-century the overall rate of bridal pregnancy in Sweden was virtually the highest in Europe, and that this rate may have been higher still among brides who married before age 25. Ann-Sofie Källemark has written of this pattern of high bridal pregnancy in Sweden.³ The earliest reliable data is from 1911, and at that time more than one-third of Swedish brides were pregnant at marriage. This rate varied on the provincial level from a low of circa 30% to a high of over 40% of all brides pregnant at marriage. The rates in Västmanland and Kopparbergs län, two of the three provinces which supplied data for the present study, are in the 37-46% range, among the very highest in Sweden in 1911. Källemark's own research into three nineteenth-century parishes in central Sweden yields rates of pre-marital pregnancy which are very close to 30% regardless of the decades or parish selected.

Significantly, in every one of these three parishes, while women pregnant at marriage are only slightly younger than other brides, such women tend to be just enough younger than the average marriage age of circa 25 years that they fall overwhelmingly into the 20-24 (inclusive) age bracket. Thus, these pregnant brides, who are counted as "at risk" for only the average of 5 months of married life before they actually have a baby, and who therefore have an astronomically high marital fertility rate, affect almost exclusively the fertility rates for married women 20-24. Few such brides fall into the next age group while "bridally pregnant". While the local statistical data available for the nineteenth-century in the Swedish Tabellverk do not include any significant information on bridal pregnancy, and while few other individual-level studies for the nineteenth-century have calculated this rate, as Källemark's study has done, the astronomically high relative fertility rates for married other women 20-25 (=20-24 inclusive) in other studies which do include information on nineteenth-century Swedish fertility do indicate a consistent pattern in which 25-50% of brides are pregnant at marriage and in which most of these, in turn, marry and have their first babies before age 25. After this point, they are only normally "at risk" for further pregnancies, but they have also passed on in to the next age group.

The presumed high rate of bridal pregnancy in nineteenth-century Sweden, and the associated high fertility in age-group 1, does more than produce a high mean square error when Coale and Trussell's m-model is applied to such data. There is a definite if loose correlation between the tendency of group 1 fertility to exceed the model, and positive m values (graph 3). Where actual fertility at ages 20-25 exceeds the model by more than 30 points (i.e. .400 actual v. .370 model) and up to the maximum of 90 points (i.e. .600 actual v. .510 model), the m values assigned to these areas tend to drift upward from an average m of .220 to an average m of .320. The correlation is loose around this slope, but there is a clear implication that the systematic peculiarity of high group 1 fertility presumably due to bridal pregnancy can, in extreme cases, entail not only badly fitted m curves, but also positive distortions in m on the order of +.100. The reason for this seems to be that the sharp discrepancy between the high fertility among women 20-25 and the more normal fertility rates among older groups of women (40-44, 45-49) causes Coale and Trussell's program to fit a model curve which as much as possible shows this same feature, and such a "drop off" in fertility rates in older groups of women is characteristic of family limitation. Hence, ever higher rates of fertility among women 20-25 tend to produce model m curves with ever higher m values, as in Appendix Graph 3.

John Knodel has in fact encountered similar problems with m and with m in lesser degree and frequency in his German data, and has definitely pinned down bridal pregnancy as the cause.⁴ It is hardly surprising that Coale and Trussell's m model cannot cope with a significant degree of bridal pregnancy, as its model parameters and its exclusion of married women 15-20 were designed specifically to rule out bridal pregnancy from consideration. Hence, wherever, as occasionally in Germany and frequently in Sweden, significant bridal pregnancy in age group 20-24, high error functions and a positively distorted m are to be expected. Indeed, the characteristic positive distortion in m values caused by high bridal pregnancy may explain why Knodel, in an earlier article, found m values ranging from .16 to .32 for Sweden as a whole from 1749 to 1880. If it can be shown that high rates of bridal pregnancy were widely characteristic of Sweden throughout this period, the suspicion must be that bridal pregnancy, and not a precocious first stage in the adoption of family-limitation in Sweden, explains these early, middle-level m values for Sweden in the late eighteenth and early nineteenth-centuries. Such a proof that these earlier m values in Sweden were spurious would substantially reinforce Knodel's hypothesis that the great breakthrough in family-limitation (and in m values, naturally) after 1880 in Sweden was, here as elsewhere, in important senses an innovation, that is, a form of behavior substantially without precedent in the 1749-1880 period.⁵

Knodel himself employs an elegantly simple solution to the problem of bridal pregnancy in cases where individual-level data is available, as it is to him in his German villages. He simply counts women who had children within eight months after marriage as if they had been at risk for the same period of time on the average as women who had their children nine months or more after marriage, thereby reducing the fertility rate among married women in group 1 (20-25) by increasing the number of woman-years these women were at risk without increasing the number of children born to this group.⁶ Where aggregated statistics on marital age-specific fertility are used, individual cases of bridal pregnancy cannot be isolated and compensated for in this way, and this solution to the distortions caused by bridal pregnancy cannot be applied.

One solution with Swedish aggregated data would be simply to substitute for the model "natural fertility" and "family-limitation" parameters in Coale and Trussell's m -program, the parameters for fertility among all married women in Sweden circa 1845-50 and circa 1935-36. Such a "Sweden- m " program should build in, and so eliminate from consideration, most of the distortions caused by high bridal pregnancy and still capture the essence of the change in the structure of marital fertility in Sweden as the fertility transition

took place. It would, however, create problems in Swedish localities where bridal pregnancy was not common, possibly underestimating "m" and giving poor fits in these instances. The solution in this case is to use Coale and Trussell's m and "Sweden m" simultaneously.

There are, however, still other sources of the high mean square error functions encountered when applying the m model to Swedish data. Appendix Graph 4 shows the relationship (in a sample of localities in which group 1 fertility is never more than .025 above the model, the level below which high group 1 fertility seems to cause no substantial increases in mean square error), between sample size in total woman years and mean square error. Below 1500-2000 woman years, mean square errors range from .003 to .0256, that is, from little better than mediocre to worse than terrible. Bridal pregnancy can be ruled out as a source of this problem, and not simply because all localities are below the .025 excess observed over model group 1 fertility, the point at which problems with mean square error seem to begin. Consider, for example, that neither Åsunda Cohort II Bönder (farmers) nor Tuhundra nor Svärdsjö show any excess group 1 fertility over the model's predictions, yet in these cases the mse is .006 - .0256. Further, while Sundborns (group 1 fertility .011 over the model), Husby (.015) and Söderbärke (.025 over) show mean square errors in the .015 - .019 range, Folkare (group 1 fertility .010 over the model), Forsa (.012 over) and Gamla Norbergs (.018 over), with larger sample sizes, show considerably lower mean square errors, ranging from .003 to .004. Plainly, the reason for the higher error in the former three cases is not the mild rate of bridal pregnancy which may still exist here, since the latter three cases appear also to have manifested this, but sheer small sample size.

Appendix Graph 4 suggests, therefore, that aside from all considerations of bridal pregnancy, a sample size on the order of 1500-2000 woman-years is also necessary in Sweden to ensure error functions in the .005 - .001 range, in short, to guarantee a decent fit of the m model. This implies a sample with at least 200 woman-years in group 1, married women 20-24, because this tends to be the smallest age group in terms of woman-years in any sample and particularly in nineteenth-century Sweden, where compared with elsewhere in Europe relatively few women were married by this age. Such a sample size is double the minimum of 100 woman-years in every group, which in Sweden is equivalent to a total of 750-1000 woman-years, recommended by Coale and Trussell. The apparent need for significantly larger sample sizes in Sweden suggests some further source or sources of variation from the m-model in the Swedish data beyond bridal pregnancy, causing as far as can be seen unsystematic variation, which in samples below 1500-2000 also

contributes to bad fits and high mean square errors. More cases must be made available before the source or sources of this variation is understood. In the mean-time, larger samples are advisable. The evidence of graphs 1 and 4 suggests that, where bridal pregnancy is not a problem, or is controlled out, and where sample sizes are adequate, m -values in Sweden should be attended by mean square error functions between .007 and .0001, quite respectable by Coale and Trussell's own standard and essentially the same range encountered in the data from nineteenth-century German villages analyzed by John Knodel.⁷

Still, the exact source of the variations which make larger samples advisable in Sweden will need to be investigated. Moreover, even with bridal pregnancy removed from consideration and with sample sizes doubled or more over Coale and Trussell's recommended level, (see the right-hand side of graph 4) there still seems to be a tendency of Swedish mean square error values to hover in the .003-.005 range, a trifle higher than the average for Knodel's German villages. Clearly, the problems of the Swedish data are by no means solved. Furthermore, even with good fits, the interpretation of m values is far from automatic, as well-fitted but quite false m values can arise from a variety of circumstances. In this respect, it might be well to point out here that numerous further potential sources of high mean square error and/or of distorted or misleading m values have been identified. Some discussion of these problems might be helpful.

For example, a cross-sectional sample in which younger cohorts of women have suddenly begun to limit their families, but older cohorts have not, could in theory lead to both high mean square error and a deceptively low m value. Fertility for women in age groups 3 (30-34 and 4 (35-40) might drop off substantially, while the relative fertility of women in age groups 5 and 6 (40-50), cohorts who do not practice family limitation, might remain at levels predicted under "natural" fertility. A curve of this sort, which "sags" in the middle, would produce a badly fitted model m curve and an m value which is probably too low, the latter the result of the program's sensitivity to the high fertilities among older women. Thus, " m " would show nothing even though the younger cohorts of women were applying family-limitation intensely and even though total marital fertility, for which these younger women account for a large proportion, was low. Something of this sort may have occurred in Fleninge in the 1870's and 1880's, as here total (>3 000) and marital (>5 000) fertilities so low as possibly to indicate family limitation were nonetheless accompanied by an age-specific marital fertility curve which "sags" well below the model in groups 3 and 4, (age 30-40), producing an m value of .250 with mse = .03. To test

this possibility, it will be necessary to compare the lifetime fertility behavior of the Fleninge cohort aged 30-40 in 1880 with that of the cohort then 40-50 years old. Substantially lower fertility, and a high m value with a low mse for the former group alone, will confirm the hypothesis that sharply differing cohort behaviors, with respect to family-limitation, can lead to cross-sectional age-specific marital fertility curves which do not register neatly or even accurately on the m scale. This form of cohort phenomenon could explain locally mediocre fits and slightly low m values in Sweden particularly in the period 1890-1925 when family-limitation made its sudden and dramatic break-through. Where the advent of family-limitation behavior was most sudden, m may temporarily become a useless measure unless cohorts are analyzed separately.

Jacques Dupaquier has further pointed out that, even in the absence of family planning, differences in marriage age from locality to locality can "deceive" Coale and Trussell's " m " program. He points out that women who marry young, for example before age 20, tend to have their children earlier and, for this and related reasons, their fertility by age 40-44 is very low, and by age 45-50 is virtually zero. This is the case even though these women do not seem consciously to limit their fertility at all. The more such women there are in a locality, the lower will be the average fertilities of all women in the later age groups, and the more the " m " program will tend to yield a high value for m ! Conversely, and again for various reasons sometimes unrelated to family limitation, some women who marry over age 30 are still having children in their early 40's and to a degree even up to age 50. The more such women there are in a given area, the higher will be its fertility in groups 4 and 5 (age 40-50), and the greater will be the tendency of Coale and Trussell's program to fit a model fertility curve which yields a low value for m . Dupaquier calculates that differences in the proportions of women marrying at various ages over time within a given locality, or more plausibly between localities, could create differences in m values on the order of .100.⁸ Dupaquier does not consider the impact of such marriage-age-related phenomena on mean square error, but there could conceivably be implications for this error function as well, in cross-sectional data where different cohorts have radically differing marriage ages.

Admittedly, Dupaquier's examples are extreme, as he posits one case where 40% of women marry before age 20 ($m = .134$) and another where 40% marry over age 30 ($m = 0$) to make his point. He must do this because in fact his own data show it is only women marrying under 20 and over 30 who show significant tendencies to, respectively, early and late cessation of child-bearing. In Sweden, whatever the temporal and geographic differences in marriage age,

so few women ever married before age 20 or (first marriages) after age 30 that virtually no impact on m or on mse can be anticipated. This is confirmed by a lack of correlation between m values and the proportion of married women aged 20-30 who were in fact 20-25 (a crude index of early marriage but, the only one available) across 45 härader in central Sweden in 1890. The reason for the lack of correlation is probably that the massive proportions marrying before age 20, or after age 30, hypothesized in Dupacquier's example of potential distortions, seem not have existed anywhere in Sweden, and minor local variations in the proportion marrying at age 20-25 versus 25-30, the usual range of variation for first marriages in Sweden, were not sufficient to distort m values at all.

But Dupacquier's observation, together with the earlier evidence of problems associated with bridal pregnancy, does make a point. There are in fact many demographic phenomena unrelated to family limitation which can cause misleading or distorted m values and/or enlarge the mean square error. Knodel, for example, adds to this list variations in nutrition, in the frequency of intercourse, and in the age difference between spouses. Any of these could produce moderately a high m value where there was no family limitation or, conversely, lower the m value in such a way as to obscure family-limitation practices well under way.⁹ Some of these behaviors could, in theory, also distort an age-specific marital fertility curve sufficiently to yield a very bad fit of whatever model m curve was fitted. Further, where these factors or actual family-limitation behavior varied from cohort to cohort, they could create peculiar amalgamated curves in cross-sectional data, which includes all cohorts, and so cause still greater errors. The solution to all such residual problems as may exist in the Swedish data, even after controlling out bridal pregnancy and taking larger sample sizes, is twofold: One wherever possible use m in a time-series of observations, where the long-term growth of family limitation is most likely to manifest itself reliably, and two, wherever possible "clean up" local data by using cohorts instead of cross-sectional samples. Used together, these two further advices will take the researcher about as far as this single measure can go toward reliability.

Coale and Trussell's own advice is to use m whenever possible in a long time series with frequent observations. For they were well aware that " m " is best at describing the extremes of natural fertility, where $m = 0$, and of family limitation, where $m = 1$. As they note, steady progress in m over time from negative to positive values and within positive values toward $m = 1$, almost certainly captures the transition from natural to controlled fertility both within the terms of the model and in reality. But at any given point

in time, and particularly where intermediate stages in the transition may be concerned ($m + .150$ to $+ .500$), no one reading of m can be considered reliable. Too many peculiarities can arise in any sample, in any demographic regime, and in the intermediate stages of the fertility transition, for a single value for m , particularly in this range, to have significance. On the other hand, steady progress over time through a substantial part of the m spectrum is very difficult to interpret as anything but the advent of family-limitation. It makes the analysis very nearly immune to all problems.

Problems related to differences in demographic behavior between cohorts, which may create "noise" in fertility patterns when aggregated into a cross-sectional sample, can be removed by using cohorts rather than cross-sectional data. It is probably no accident that the best "fits" for m in the Swedish data are for the two cohorts which John Rogers and Ingrid Eriksson studied in Åsunda. The samples are large, approximately 4000 woman-years; bridal pregnancy does not appear to have been as high here, or anywhere in Uppsala province, as elsewhere in Sweden; and the data are, of course, for single cohorts, respectively of women married shortly after 1825 and shortly after 1855. The m values are .297 and .447, respectively, for these cohorts, and the mean square errors are .0006 and .0008. Cross-sectional data for adjoining areas, available through the Statistical Central Bureau, show m values in the .300 - .500 range in 1890; and it is expected that, when processed, the cross-sectional data for Åsunda härad will show a further increase in m in 1890 over the level shown by the second cohort. ¹⁰

In Åsunda, then, all of the advices of this article have been applied. Large samples, the relative absence of bridal pregnancy, the use of cohorts, and the beginning of a time-series permit us to do as much as can be done, through m alone, to detect the onset of family-limitation in the middle of the nineteenth-century in this locality in central Sweden. But of course Rogers and Eriksson did not stop with the age-specific curve of marital fertility, nor should any researcher in Sweden or elsewhere. For each cohort, and for different social groups within each cohort, they used additional indicators of fertility limitation available to researchers with individual-level data. These include studies of the length of intervals between births, measures of the proportion of a woman's total fertility which occurs after a certain age, and analysis of the ages at which women conceived their final children. Many of these tests are under challenge right now, as John Knodel, Jacques Dupaquier and others discuss their reliability just as they have debated the reliability of Coale and Trussell's m . ¹¹ But m properly used, in conjunction with whatever of these further tests prove most reliable, will tell us as much as can ever know about the advent of

family planning in Sweden or anywhere. In the case of Åsunda, the sound results for m , in conjunction with the general trend of the other tests, particularly the trend to long birth-intervals, makes it very likely that the fertility transition began among the farmers of this härad in Uppland sometime in the middle of the nineteenth-century. While Dupacquier or Knodel could no doubt conceive of a demographic artifact which would produce all of these results in the absence of family limitation, a little common sense must in the end be applied. If the fertility transition in Sweden did not begin in Åsunda härad circa 1850, where did it begin?

Footnotes to appendix I

1. Coale, Ansely T and T James Trussell, 1974. "Model Fertility Schedules: Variations in the Age Structure of Childbearing in Human Populations", Population Index, 44:203-211; see also "Erratum", Pop. Index 41:572.
2. John Rogers and Ingrid Eriksson, 1978. Rural Labor and Population Change: Social and Demographic Developments in East-central Sweden during the Nineteenth Century, Studia Historica Uppsaliensia, 100. The 1889-90 aggregate data are listed under Folkräkningen 1890 (women by age and civil status) and under Byrån För Befolkningsstatistik, 1844 ff. (births by age and civil status of mother), in the archive of the Statistical Central Bureau in Stockholm.
3. Ann-Sofie Källemark, 1977. "Att vänta barn när man gifter sig: Föräktenskapliga förbindelser och giftermålsmönster i 1800-talets Sverige", Historisk Tidskrift, 1977, 181-199.
4. John Knodel, 1980. "The Secular Increase in Fecundity in German Village Populations: An Analysis of Reproductive Histories of Couples Married 1750-1899", unpublished paper, University of Michigan Population Studies Center, January 1980, pp. 10ff.
5. John Knodel, 1977. "Family Limitation and the Fertility Transition: Evidence From the Age-Patterns of Fertility in Europe and Asia", Population Studies, 31, 2, 219-249, see especially 233, 243. Alternately, the .16 - .32 m values for 1749-1880 may be an artifact resulting from Gustav Sundbärg's estimations of age-specific marital fertility from the data on total age-specific fertility in the official statistics. Only after 1884 was marital age-specific fertility available in the official statistics. If previous to this, Sundbärg overestimated marital fertility 20-24 as a proportion of total fertility, group 1 fertility would be high and m values positively distorted!
6. Knodel, 1980; see note 4, above.
7. John Knodel, 1978. "Natural Fertility in Pre-Industrial Germany". Population studies, 32, 3, see especially tables 3 and 4, pp 488, 491.

8. Jacques Dupacquier, 1980. "Du Contresens à L'Illusion Technique", unpublished reply to John Knodel's criticisms of French measures of fertility limitation, made available by John Knodel, 1980. Dupacquier's original estimate of the distortion in m was larger but his m values for the two hypothetical cases were wrongly calculated; Knodel's corrections are used here.
9. Knodel, 1977 (see note 5, above), footnote 17, p 224.
10. See note 2, above. Details on sample-size have been obtained directly from John Rogers, and m calculated for the Åsunda samples at the Demographic Database, Umeå University.
11. See previous references to work by Knodel, Dupacquier.

MAPS, GRAPHS AND TABLES

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Map1:
Provinces of Sweden circa 1890,
with lines indicating
Sundbärg's West Sweden, East Sweden,
and North Sweden.

MAP 2 FOOTNOTE

1. The deaneries (prosterier) depicted on this map and an Map 3 are essentially the same as the deaneries analyzed in 1855 and were the same in 1805, (save where certain 1805 deaneries had not yet been disaggregated into their later, 1855-1890 entities, as with Hälsinglands Vestre Övre and Nedre deaneries, which were separated after 1805). In each case, of course, the tiny parts of any of these deaneries which fell in another län or province, were dropped from the analysis. But the SCB-based "deaneries" which are synthesized and analyzed in 1890 do not always match the deanery boundaries on Maps 2 and 3. Specifically, "Köping" deanery loses the suburbs of Köping, to wit Köpings landsdel and Kungs Barkarö annex to "Arboga" deanery in the 1890 analysis and thus has a sub-urban bias, while "Köping" is more rural, relative to the true Arboga and Köping deaneries depicted on the maps. Finally, in the actual 1890 analysis, Norra Fjerdhundra lacks the parishes of Huddinge (pop. 1 500) and Osterunda (800), which are instead amalgamated with Södra Fjerdhundra. This may negatively bias "Södra Fjerdhundra" in the analysis, with respect to family limitation, compared with the actual Södra Fjerdhundra deanery found on the maps. Other discrepancies between mapped and analyzed deaneries are negligible.

(Simtuna härad includes Tärna and Norby parishes, in the 1890 map (map 3), and Våla härad includes Huddinge parish, although earlier sources place the former parishes in Övre-Tjurbo härad and the latter in Torstuna härad).

Map 2: Deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparberg, Gävleborg län, 1855.

GRAPH 1:

TOTAL FERTILITY RATE VERSUS
NUPTIALITY (% OF WOMEN OVER
15 MARRIED) FOR SIX PROVINCES,
ALL DEANERIES, 1805-6.

○ ÖRBYHUS

NUPTIALITY

60

55

50

45

* See text, footnote 11, for calculation of Total Fertility Rate

Map 3:

Deanery and Härad boundaries in Västmanland, Kopparberg, Gävleborg provinces circa 1890, härad boundaries as defined by G. Sundbärg, Emigrationsutredning, (1910).

Deaneries only in Uppland

GRAPH 2:
TOTAL FERTILITY RATE VERSUS NUPTIALITY (% OF WOMEN OVER 15 MARRIED)
FOR SIX PROVINCES, ALL DEANERIES 1855-6.

GRAPH 2-a:
TFR v.s. NUPTIALITY FOR RECONSTITUTED DEANERIES IN VÄSTMANLAND KOPPARBERG GÄVLEBORG PROVINCES, 1890

GRAPH 3:
ALL DEANERIES IN VÄSTMANLAND, KOPPARBERG, GÄVLEBORG PROVINCES, TOTAL FERTILITY RATE VERSUS PRO-
PORTION DEPENDENT UPON PUBLIC OR PRIVATE WELFARE, 1855 (●=VÄSTMANLAND, □=KOPPARBERG, △=GÄVLEBORG)

ALL HÄRADER IN VÄSTMANLAND, KOPPARBERG, GÄVLEBORG PROVINCES, TOTAL FERTILITY RATE 1890 VERSUS CULTIVATED LAND
(tunnland) PER 100 INHABITANTS, 1905 (● = Västmanland, □ = Kopparberg, △ = Gävleborg)

GRAPH 4:

NOTE: TOTAL FERTILITY RATE 1855 GIVES SAME RESULT, VERSUS 1890 T.F.R.

GRAPH 5:

PERCENT DECLINE IN INFANT MORTALITY 1805-1855 VERSUS TOTAL FERTILITY RATE IN 1855-6, DEANERIES CHIEFLY IN FOUR PROVINCES IN CENTRAL SWEDEN.*

(Extreme cases from two other provinces)

* Note: Most of the decline in infant mortality was accomplished by 1835. Absolute levels of infant mortality are discussed in the text.

GRAPH 6:
PERCENT DECLINE IN INFANT MORTALITY 1805-1855 VERSUS PERCENT CHANGE IN
TOTAL FERTILITY RATE 1805-1855, DEANERIES CHIEFLY IN FOUR PROVINCES IN
CENTRAL SWEDEN. (Extreme cases from two other provinces.)*

* Note: Most of the decline in infant mortality was accomplished by 1835. Absolute levels of infant mortality are discussed in the text.

APPENDIX GRAPH 1: MEAN SQUARE ERROR VERSUS PRESUMED INCIDENCE OF BRIDAL PREGNANCY MEASURED AS THE EXCESS OF FERTILITY OF WOMEN 20-24 OVER THE PREDICTED VALUE FOR THIS GROUP IN THE MODEL M CURVE FITTED (COALE AND TRUSSEL); FOR HÄRADER IN VÄSTMANLAND, KOPPARBERG, GÄVLEBORG PROVINCES, 1890, WHERE SAMPLE SIZE EXCEEDS 2000 WOMAN YEARS.

APPENDIX GRAPH 2: OBSERVED VERSUS MODEL
AGE-SPECIFIC MARITAL FERTILITIES IN OCKELBO
HÄRAD IN GÄVLEBORG PROVINCE, 1889-90.
COALE AND TRUSSELLS $M = .147$, $MSE = .022$.

APPENDIX GRAPH 3: EXCESS OF GROUP 1 (MARRIED WOMEN 20-24) FERTILITY OVER THE PREDICTED M-MODEL FERTILITY FOR THIS GROUP VERSUS OVERALL M VALUE (GROUPS 1-5 IN THE REGRESSION), FOR ALL HARADER IN VÄSTMANLAND VÄSTMANLAND (●) KOPPARBERG (□) AND GÄVLEBORG (△) PROVINCES, 1889-90.

APPENDIX GRAPH 4:

MEAN SQUARE ERROR VERSUS SAMPLE SIZE IN WOMAN-YEARS FOR HÄRADER IN VÄSTMANLAND, KOPPARBERG, GÄVLEBORG PRO-
VINCES 1890 AND FOR ÅSUNDA COHORT I (age 20, ca. 1825) AND COHORT II (age 20, ca. 1855). EACH DIVIDED IN TO FARMERS AND
IN TO ALL LANDLESS*

*EXCLUDES ALL CASES WHERE BRIDAL PREGNANCY IS SUSPECTED TO BE HIGH, I.E. WHERE OBSERVED FERTILITY 20-24 EXCEEDS
MODEL IN FERTILITY BY .025.

Table 1: Demographic values, deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparbergs, Gävleborgs provinces, 1805-1855.

1805 Region Three						
Deanery	Nuptiality ¹	% Widows ²	TFR ³	TFR per ⁴ unit nup- tiality	Illegiti- ⁵ macy %	Infant ⁶ mortality %
Åsunda	53.97	14.8	4278	79.27	5.93	21.39
Trögd	53.05	15.0	3825	72.10	8.39	19.73
Lagunda	51.82	14.1	4801	93.62	7.57	19.27
Ulleråker	53.66	15.5	3775	70.35	6.23	22.55
Södra Fjerdhundra	50.93	16.4	3933	77.22	7.36	21.32
Sala	53.67	14.2	3659	68.18	7.57	24.50
Hedemora	51.06	15.4	3700	72.46	6.81	15.22
Mora	52.60	18.6	4202	79.89	0.81	13.71
Häls. Östra	(50.00)	11.9	3550	71.00	4.50	14.86
Häls. V. Nedre (+Övre)	49.79	13.6	3670	73.71	4.13	11.53
Häls. Norra	52.21	13.7	4221	80.85	3.57	14.43
Håbo	53.45	16.3	4310	80.64	6.82	31.23

Footnotes.

1. Nutpiality = % of women over 15 who were married, in 1805.
2. Widows = % of women over 15 once married and now widows, in 1805.
3. TFR = Total Fertility Rate, 1805-6. See footnote 11 for method of calculation.
4.
$$\text{TFR per unit nutptiality} = \frac{\text{TFR}}{\text{nuptiality}}$$
5. Illegitimacy = Illegitimate births as % of all births, 1805-6.
6. Infant mortality = Dead under one year of age as % of all live births, 1805-6.
7. Population in Vestre Rekarne is below 3000 both in 1805 and in 1855. Other deaneries range from 4000 to 30.000 total population.

Table 1 : Demographic values, deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparbergs, Gävleborgs provinces, 1805, 1855.

1805
East Region .

Deanery	Nuptiality	Widows	TFR	TFR/nupt.	Illegit. %	Infant mort. %
Arboga	53.90	14.0	4055	75.23	8.93	28.93
Häls. V. Övre (+ Nedre)	49.79	13.6	3670	73.71	4.13	11.53
Dom	50.63	13.2	4000	79.00	9.65	23.63
Munktorps	54.29	14.9	4448	84.74	8.09	23.85
Waksala	50.53	16.2	4197	83.06	5.51	26.57
Norunda	54.24	14.9	3977	73.69	5.98	21.59
Örbyhus	(61.24?)	15.1	4597	(75.07?)	4.67	15.04
Stora Tuna	51.75	15.1	3820	73.82	3.81	14.64
Vestre Fernebo	50.31	15.5	4465	88.75	7.14	23.18
Vestra Rekarne ⁷	51.12	15.7	4583	89.65	9.81	25.70
Köpings	49.90	13.0	4805	96.29	7.99	22.59
Oland och Frösåker	50.26	15.7	4523	89.99	4.21	18.16
N. Fjerdhundra	51.68	14.2	3732	72.21	7.16	19.48
Gästrikland	52.54	12.8	3935	74.90	4.37	15.86
Rättvik	48.38	18.9	4164	86.07	1.57	12.38
Leksand	49.74	16.6	3978	79.98	1.01	13.81
Vester Dal	51.42	15.3	4306	83.74	2.17	14.25
Norrbärke	53.01	12.1	5137	96.91	3.86	24.01
Hagunda	53.24	16.2	4432	83.25	2.14	25.21
Gävle	53.27	12.6	4451	83.56	7.55	19.34
Glanshammar	51.94	13.5	4437	85.43	5.05	17.25
Kumla	51.99	15.3	4592	88.32	3.40	15.11
Wisnum (Värml.)	54.76	12.3	5070	92.59	4.18	17.56
Fellingsbro	(43.32?)	17.0	4262	(98.38?)	6.72	24.41
Örebro	49.99	15.5	4464	89.30	4.74	19.95

Table 1: Demographic values, deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparbergs, Gävleborgs provinces, 1805, 1855.

1805
West Region.

Deanery	Nuptiality	Widows	TFR	TFR/nupt.	Illegit. %	Infant mort. %
Gillberga	47.80	12.0	4133	86.46	5.09	15.88
Nors	49.80	12.8	4477	89.90	7.07	18.49
Nyed	48.91	12.3	4676	95.60	5.76	15.91
Kil	48.88	12.5	4626	94.64	6.17	17.56
Edsberg	51.14	15.1	4682	91.55	4.77	19.21
Nordmark	48.50	11.5	3838	79.13	5.40	15.47
Nora	50.20	12.9	(6258?)	(130.00?)	6.47	23.97
Wisnum (Örebro)	50.60	10.9	4471	88.36	4.18	16.67
Jösse-Fryksdal- -Älvdal	52.09	11.25	4429	85.03	6.29	13.64

Table 1: Demographic values, deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparbergs, Gävleborg provinces, 1805, 1855.

1855
Region Three (see Graph 2)

Deanery	Nuptiality ¹ %	Widows ² %	TFR ³	TFR per unit nuptiality ⁴	Illegitimacy ⁵ %	Infant mortality ⁶ %
Åsunda	49.00	17.0	3228	65.88	10.53	16.62
Trögd	47.85	18.6	3028	63.28	9.68	12.90
Lagunda	49.11	16.3	3519	71.66	9.39	10.62
Ulleråker	49.11	17.0	3319	67.58	7.77	12.62
Södra Fjerdhundra	49.72	15.3	3476	69.91	10.68	12.43
Sala	47.05	15.6	3278	69.67	11.06	13.76
Hedemora	50.54	16.1	3689	72.99	9.40	14.18
Mora	50.52	17.4	3874	76.68	2.78	12.28
Häls. Östra	52.39	13.1	3808	72.69	9.99	11.89
Häls. V. Nedre	53.45	12.3	3727	69.73	8.46	11.04
Häls. Norra	53.61	13.4	3423	63.85	8.62	13.53
Håbo	46.02	17.0	3293	71.56	10.43	18.10

Footnotes.

1. Nuptiality = % of women over 15 who were married, in 1855.
2. Widows = % of women over 15 once married and now widows, in 1855.
3. TFR = Total fertility Rate, 1855-6. See footnote 11 for method of calculation.
4.
$$\text{TFR per unit nuptiality} = \frac{\text{TFR}}{\text{nuptiality}}$$
5. Illegitimacy = Illegitimate births as % of all births, 1855-6
6. Infant mortality = Dead under one year of age as % of all live births, 1855-6
7. Population in Vestre Rekarne is below 3000 both in 1805 and in 1855. Other deaneries range from 4000 to 30.000 total population.

Table 1: Demographic values, deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparbergs, Gävleborgs provinces, 1805, 1855.

1855
East Region (Graph 2)

Deanery	Nuptiality	Widows	TFR	TFR/nupt.	Illegit. %	Infant mort. %
Arboga	48.25	15.5	3674	76.15	10.88	12.93
Häls. V. Övre	50.40	13.3	3911	77.60	14.51	11.44
Dom	47.10	16.7	3530	74.95	9.86	18.17
Munktorps	48.45	16.8	3728	76.95	10.06	19.83
Waksala	46.23	13.8	3524	76.23	8.29	18.51
Norunda	47.13	16.7	3709	78.70	11.27	14.18
Örbyhus	48.07	15.6	3735	77.70	10.55	13.82
Stora Tuna	48.45	16.9	3915	80.80	8.78	14.19
Vestre Fernebo	49.55	15.2	4081	82.36	11.75	13.25
Vestra Rekarne ⁷	45.61	18.0	3520	77.18	10.95	21.17
Köpings	47.12	14.8	3832	81.32	9.86	13.29
Oland and Frösåker	47.14	13.6	3933	83.43	9.93	15.60
N. Fjerdhundra	49.17	14.4	4117	83.73	9.79	12.30
Gästrikland	52.60	14.1	4288	81.52	8.16	11.26
Rättvik	50.26	17.9	4175	83.07	2.64	11.98
Leksand	50.76	15.0	4307	84.85	2.80	11.55
Vester-Dal	52.84	13.9	4590	86.87	4.37	11.97
Norrbärke	50.43	14.6	4570	90.62	8.61	14.81
Hagunda	52.16	16.2	4508	86.43	8.02	12.21
Gävle	50.96	16.1	4485	88.01	8.16	17.76
Glanshammar	49.51	12.9	4376	88.37	9.25	16.65
Kumla	48.76	14.0	4394	90.11	9.31	12.47
Wisnum (Värml.)	49.21	11.6	4383	89.07	10.48	13.31
Fellingsbro	48.21	13.1	4482	92.97	11.30	12.89
Örebro	47.42	14.8	4285	90.94	8.41	14.84

Table 1; Demographic values, deaneries in Värmland, Örebro, Västmanland, Uppsala, Kopparbergs, Gävleborgs provinces, 1805, 1855.

1855
West Region (Graph 2)

Deanery	Nuptiality	Widows	TFR	TFR/nupt.	Illegit. %	Infant mort. %
Gillberga	46.52	11.2	4420	95.01	7.72	11.77
Nors	45.59	12.8	4315	94.65	10.54	10.79
Nyed	45.24	12.8	4508	99.65	12.09	12.31
Kil	43.35	11.8	4141	95.53	12.67	12.52
Edsberg	47.61	13.6	4815	101.13	8.83	13.25
Nordmark	47.86	11.6	5052	105.56	4.37	11.64
Nora	47.97	12.0	5208	108.57	12.70	15.60
Wisnum (Örebro)	47.09	11.4	5270	111.91	11.48	16.37
Jösse-Frykdal- -Älvdal	47.54	11.0	4900	103.07	12.06	10.25

Table 2: Demographic values, deaneries and häradar in Västmanland, Kopparberg, Gävleborg provinces, 1889-90.

Deanery and overlapping häradar ¹	m/mse ² groups 1-5	MFR ³	TFR ⁴	Age-specific marital fertilities					
				20-24	25-29	30-34	35-39	40-44	45-49
Sala	.335/.013	6600	4120	.468	.288	.259	.187	.098	.020
Yttr-Tjurbo härad ⁵	.291/.015	6985	4566	.485	.288	.294	.221	.101	.008
Övre-Tjurbo hd.	.355/.015	6436	3918	.462	.287	.243	.174	.097	.025
(Simtuna hd.)	see below								
Södra Fjerdhundra	.241/.009	6940	4265	.461	.317	.271	.213	.113	.013
Torstuna hd.	.345/.016	7921	4822	.570	.365	.277	.236	.118	.019
Simtuna hd.	.188/.008	6488	3983	.416	.292	.267	.202	.111	.010
(Övre-Tjurbo hd.)	see above								
Arboga	.421/.017	5765	3543	.385	.235	.250	.176	.065	.042
Åkerbo hd.	.165/.005	6346	3895	.379	.302	.238	.218	.104	.028
Hedemora	.268/.002	6560	3875	.401	.339	.264	.193	.103	.015
Hedemora hd.	.497/.003	6544	3493	.441	.311	.274	.182	.076	.025
Husby hd. ⁵	.314/.016	6068	3455	.378	.342	.226	.154	.101	.013
Folkare hd.	.158/.003	6810	4249	.392	.351	.272	.212	.119	.015
Mora	.247/.003	6883	4129	.368	.376	.289	.218	.112	.018
Mora hd.	.289/.006	6903	3785	.448	.341	.254	.213	.105	.019
Älvdal hd. ⁵	.079/.016	6484	4568	.398	.284	.278	.190	.130	.016
Särne och Idre hd. ⁵	.114/.004	6912	4857	.344	.382	.298	.228	.115	.015
Hälsinglands Östra	.341/.002	7530	4738	.488	.377	.295	.225	.107	.016
Hanebo hd.	.450/.001	7531	4797	.470	.393	.319	.220	.088	.015
Norråla hd.	.297/.006	7525	4702	.497	.367	.281	.228	.115	.016
Hälsinglands Norra	.325/.007	6905	4446	.459	.342	.268	.190	.107	.015
Bergsjö hd.	.212/.020	6950	4236	.476	.310	.264	.198	.125	.017
Enånger hd.	.239/.007	6926	4562	.449	.325	.269	.210	.113	.020
Delsbo hd.	.370/.008	6586	4217	.434	.353	.241	.179	.098	.009
Forsa hd.	.454/.003	7108	4814	.470	.372	.290	.180	.094	.015

Table 2 continued: Demographic values, deaneries and häradar in Västmanland, Kopparberg, Gävleborg provinces, 1889-90.

[illegible]

Table 2 continued: Demographic values, deaneries and härader in Västmanland, Kopparberg, Gävleborg provinces, 1889-90.

Deanery and overlapping härader ¹	m/mse ² groups 1-5	MFR ³	TFR ⁴	Age-specific marital fertilities					
				20-24	25-29	30-34	35-39	40-44	45-49
Hälsinglands Vestra									
Nedre	.138/.007	7070	4637	.436	.332	.274	.230	.127	.015
<u>Alfta hd.</u>	.174/.010	7385	4700	.476	.311	.305	.242	.122	.021
<u>Bollnäs hd.</u>	.150/.010	7028	4682	.426	.357	.251	.234	.126	.012
<u>Arbrå hd.</u>	.043/.010	6617	4419	.383	.317	.272	.203	.138	.010
Hälsinglands Vestra									
Övre	.155/.005	7580	5170	.461	.355	.313	.237	.133	.017
<u>Järvsjö hd.</u>	.434/.012	8109	4660	.587	.352	.337	.218	.105	.023
<u>Ljusdal hd.</u>	.061/.005	7463	5371	.429	.356	.304	.245	.144	.014
Dom	.146/.002	6738	4582	.390	.343	.272	.226	.116	.015
<u>Siende hd.</u>	.248/.003	6915	4466	.438	.328	.279	.214	.108	.016
<u>Tuhundra hd.</u>	.004/.006	6656	4722	.324	.364	.263	.242	.125	.014
Norrbo hd.	.216/.005	6894	4416	.434	.331	.265	.219	.113	.016
(Ytter-Tjurbo hd.)	see above								
Munktorp	.107/.009	6832	4477	.417	.317	.253	.231	.125	.023
<u>Snefringe hd.</u>	.176/.016	6948	4403	.460	.309	.262	.213	.125	.020
(Tuhundra hd.)	see above								
Köping	.087/.007	6480	4146	.350	.341	.243	.209	.120	.032
Åkerbo hd.	.165/.005	6346	3895	.397	.302	.238	.218	.104	.028
<u>Skinskatteberg hd.</u>	.208/.011	7082	4550	.417	.388	.248	.223	.119	.022
Vestra Rekarne ⁵	.008/.007	6563	3899	.333	.328	.282	.200	.133	.037
(Åkerbo hd.)	see above								
Norra Fjerdhundra	-.011/.014	7020	4018	.367	.373	.278	.218	.154	.014
<u>Våla hd.</u>	.098/.004	7006	3884	.378	.373	.281	.229	.128	.014
(Torstuna hd.)	see above								
(Simtuna hd.)	see above								
Vestra Fernebo	.192/.005	6980	4582	.421	.352	.260	.224	.117	.022
<u>Vagnsbro hd.</u> ⁵	.098/.031	6733	4179	.412	.332	.241	.183	.144	.034
<u>Gamla Norberg hd.</u>	.233/.004	7054	4717	.423	.359	.265	.238	.107	.018
Norrbo hd.	.216/.005	6894	4416	.434	.331	.265	.219	.113	.016

Footnotes for Table 2:

1. In all cases, 1805, 1855 and 1890, deaneries are those parts of the deanery found within the province where the deanery is primarily located. Also, deaneries analyzed in this table for 1890 are 90%+ the same area as deaneries 1805 and 1855, save in the cases of Arboga and Köping and Norra and Södra Fjerdhundra, discussed in note 1 on Map 3. Briefly, Arboga and Köping cover only 50-75% of the same area and are biased respectively toward and away from parishes near cities, relative to the actual deaneries used in 1805 and 1855. Södra Fjerdhundra in 1890 acquires some 20% of the area of Norra Fjerdhundra deanery, because of similar problems of re-aggregation of deaneries from the 1890 data. The bias in this case is probably to reduce the indications of family limitation in Södra Fjerdhundra in 1890. If härad name is underlined, at least 90% of its population is in the deanery listed above it; if härad name is in parenthesis, less than 33% and as little as 1% of its population is in the deanery listed above it.
2. Coale and Trussell "m", groups 1-6 observed, 1-5 in the regression, mean square error calculated for groups 1-6 (=married women 20-49).
3. MFR = Marital Fertility Rate. Same as Total Fertility Rate, but for married women only.
4. TFR = Total Fertility Rate. See footnote 11, to the text.
5. Less than 100 woman years in at least one age-group of married women. Small sample.

Table 3

Correlation of 1855 and 1890 Measures*

TFR per unit nuptiality 1855

m in 1890	60-72.99	73-85.99	86-
.241 to .421	5	(Mora) 1	0
.065 to .197	(Hälsing-lands V. N.) 1	9	1
-.11 to .065	0	2	2

Table 3a: Collapsed*

	60-72.99	72.99-
.241 to .421	5	(Mora) 1
.241	(Hälsing-lands V.N.) 1	14

*Arboga not included.

Table 4: Relationship of the Preliminary Variables used in the study.

1855 Deaneries in Region three (Graph 2)	1890		Larson: "Secularization", Preliminary Results Only: Häradar
	On Border	Deaneries with m over .220	Häradar with m over .250
Sala.....	....	Sala.....	Yttra-Tjurbo.... Övre-Tjurbo
Södra-Fjerdhundra..	....	Södra Fjerdhundra...	Torstuna..... (Simtuna =.188/.008)
Hedemora.....	....	Hedemora.....	Hedemora..... Husby
Hälsinglands Östra..	....	Hälsinglands Östra.	Hanebo..... No information as yet
Hälsinglands Norra..	....	Hälsinglands Norra.	Delsbo..... Forsa
Hälsinglands Västra Nedra	....	(.138/.007).....	No..... No
No Others	Mora.... Hälsinglands Västra-Övre	Mora... (.155/.005)...	No..... No
	Arboga..	"Arboga"..... (biased +m)	Åkerbo
No Others		No Others	Of the approximately 35 häradar for which data are now available, only the 7 named above, plus Sundborn, Ockelbo, Stora Tuna and Grängärde häradar, are counted as "secularized". The latter four cases, where "secularization" exists without evidence of family limitation, are consistent with the theory discussed in the text.
		Plus m values near .250 in Säter Kopparberg-Aspeboda Svärdsjö; all those häradar adjoining Hedemora but are combined with other low m, häradar in Stora Tuna deanery, (.177/.002).	No Others

AUTHOR

Kenneth Lockridge is Professor of History at the University of Michigan and is an historian of American and European society in the early modern period. His books include **A New England Town, 1636-1736 (1970)** and **Literacy in Colonial New England (1974)**. Since 1972, he has been an advisor to and researcher at the Demographic Database at Umeå University. This essay grows out of a continuing interest in historical demography first expressed in "The Population of Nedham, Massachusetts, 1636-1736," **Economic History Review**, 1966.

THE FERTILITY TRANSITION IN SWEDEN.

This essay seeks to identify the localities in rural central Sweden where, in the years 1805–1890, the modern practice of family limitation first came to prevail. It then attempts to understand the origins of family limitation in these areas.

Three localities are identified chiefly by their low marital fertility in 1855 and by their low marital fertility and potentially “modern” patterns of age-specific marital fertility in 1890, as potential loci of early family-limitation behavior. But these areas seem to share no common or unique social structure or dynamic which could explain their early conversion to family limitation.

Rather, what these areas may share is a relatively secularized cultural climate, in contrast to localities where family limitation seems not to have begun at all and where the traditional state Lutheran church remained strong well into the nineteenth-century.

This result, if confirmed, matches perfectly the hypothesis offered by John Knodel and recently confirmed, simultaneously with this research, by Ron Lesthaeghe and Chris Wilson, namely that cultural change in general and in specific secularization was the only universal and necessary local precondition for the fertility transition in the western world.

The present essay attempts to reconcile this new theory to older, more structural theories of the fertility transition as represented by the work of Charles Tilly. It is possible that these different theories really describe the same phenomenon.

Reports from the Demographic Data Base, University of Umeå:

1. Time, Space and Man. Essays on Microdemography. Reports from the symposium Time, Space and Man in Umeå, Sweden June 1977. Editors: Jan Sundin and Erik Söderlund (Almqvist & Wiksell International, Stockholm Sweden. Humanities Press, Atlantic Highlands, N.J., USA 1979)
2. Tradition and Transition. Studies in microdemography and social change. Editors: Anders Brändström and Jan Sundin (The Demographic Data Base, University of Umeå, Sweden. 1981)
3. The Fertility Transition in Sweden: A Preliminary Look at Smaller Geographic Units, 1855–1890. Editor: Egil Johansson (The Demographic Data Base) University of Umeå, Sweden. 1983.

Volume 1 may be ordered through your local bookseller. Distributor: Almqvist & Wiksell International, Stockholm, Sweden.

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