RESEARCH TRIANGLE INSTITUTE

AN ECONOMIC ANALYSIS OF THAILAND'S NATIONAL FAMILY PLANNING PROGRAM: EVALUATION OF THE PAST AND PLANNING FOR THE FUTURE

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Under Contract to

Policy Development Division
Office of Population
Bureau for Technology and Science
United States Agency for International Development
Department of State
Washington, DC 20523

Contract No. AID/DSPE-C-0062

Revised February 1982

RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

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Acknowledgement

This study was carried out under US/AID Contract AID/DSPE-C-0062 by the Research Triangle Institute, Integrated Population and Development Planning Program, during the period April 1981 to February 1982. Without the active support of USAID/Bangkok and the Ministry of Public Health of the Royal Thai Government, it would have been difficult for us to have finished the project. We are indebted to Mr. Tony Bennett of Columbia University, NY, and Mrs. Rachaniwan Uthaisri of the Chulalongkorn University for providing data that are essential for the study. Mr. Hong Sik Ahn and Ms. Beverly Jones have provided excellent research assistance for the project.

1. Purpose and Scope of the Study

The National Family Planning Program (NFPP) of the Royal Thai Government has been widely praised in recent years for its contribution to reducing the fertility rate of Thailand. However, the full implication of the fertility reduction attributable to the NFPP for future government savings from expenditures averted has not been evaluated against the cost of financing such a program. The importance of such measurement is that a favorable benefit to cost ratio would make the existence of the NFPP justifiable even on pure economic grounds. It is possible that a dollar invested in Thailand's family planning program could yield more returns than any other alternative investment opportunity that the government might have. Furthermore, a high benefit-cost ratio should also make policy-makers realize the serious consequences in terms of increased future government spending if for any reason the current level of family planning effort is reduced. Thus the main purpose of this study is to empirically estimate the monetary returns to the total investment made by the government in the NFPP during the period 1972 to 1980. Monetary returns are defined as the total short-run and long-run government savings measured against the total cost of such a program. It should be made clear that only those government expenditures (such as health and education) whose relation to population growth is well understood will be included in the calculation. It should also be pointed out that benefits or costs to an individual or to the society that are not directly related to government spending, as important as they may be, are not in the scope of the present study.

In order to derive a measure of the monetary returns to the national family planning program, both the effectiveness of the program in reducing the Thai birth rate and the implications of such a reduction in terms of future governmental spending averted need to be evaluated and calculated. In fact, unless the effectiveness of the NFPP is assessed correctly, all the other calculations which follow will be biased. The effectiveness of the Thai NFPP, defined as the number of births averted or the reduction in the fertility rate due to the existence and effort of the program, has been analyzed elsewhere (e.g., Hogan, 1979). However, when results are obtained mainly by using family planning service statistics, it is possible that the impact of the family planning program is overestimated. This is because the Couple-Years of Protection (CYP) method does not consider what would be the adoption rate through the private sector if the public family planning program did not exist. In other words, when counting people who would not have practiced contraception without an organized public program, the CYP method fails to exclude those "new acceptors" who either switched from the private sector to the public sector for their contraceptive supplies or who started practicing contraception on their own initiative without the influence of the program.

The present study will first re-evaluate the impact of the NFPP on Thailand's fertility with a multivariate regression approach. The regression analysis approach attempts to estimate the net effect of a family planning program. The net impact of a family planning program can be estimated if some key determinants of demand for children are included simultaneously. This can be done by regressing a regional fertility rate on family planning program inputs and on one or more

socioeconomic variables. This approach is preferable to the CYP method because it does try to separate and thus control one component of the fertiltiy decline which is due to a decrease in the demand for children as a result of socio-economic development.

The results of the estimation of the effectiveness of the NFPP will be integrated into a substantially revised RAPID model which will evaluate future government savings from the births averted through the NFPP during the period 1972 to 1980. Total savings as well as sectoral savings in education, public health, housing and infrastructure, and other social services will be calculated. Finally, total expenditures for the public family planning program during 1972 to 1980, from both internal and external funding, will be used along with projected savings to calculate various cost-benefit indices.

The present study also goes beyond the evaluation of the NFPP in the past and into the planning of it for the future. A marginal analysis of returns to future investment in NFPP will be conducted first. The result of this analysis should tell us the economic profitability of any additional investment in the NFPP beyond the current level. Then we will examine the marginal return to the proposed 1982-1986 NFPP expenditures. Finally, by using the fertility regression and the demographic model developed in the study, the minimum level of NFPP expenditures for the next five years that is required in order to achieve the demographic goal of the Fifth Five-Year Development Plan to reduce the population growth rate to 1.5 percent by the end of 1986 will be calculated.

2. An Analysis of Fertility Decline in Thailand, 1962-1980

2.1. Some theoretical considerations of family planning programs as one determinant of the aggregate fertility rate

In order to analyze the fertility decline in Thailand for the last two decades, we adopt a supply-demand model of family size decision-making (Easterlin, 1975). In such a framework, demand for children is a function of the cost and benefit of raising them and supply of children is the biological maximum when no contraception of any kind is practiced. As socioeconomic conditions progress (higher education, increased urbanization, increased female labor force participation), the economic cost of raising children increases and the economic benefit diminishes; thus the demand for children decreases. On the other hand, as better nutrition increases the fecundity of women, supply of children increases over time. Eventually, supply of children will exceed demand for children and there will be "unwanted" births.

The possibility of unwanted births creates a demand for contraceptives; however, the demand for contraceptives also depends on the costs, monetary and psychological, of using them. In such a model, a family planning program could possibly reduce fertility by lowering the demand for children through educating the public to the advantages of a small family. However, a family planning program's main influence on fertility usually comes from the role it plays in assisting couples to regulate or eliminate "unwanted children." More couples would practice contraception when there is a family planning program, because such a program usually lowers the monetary and psychological cost of using contraceptives. A family planning program can, as in the case of Thailand, lower the cost of practicing contraception by improving the accessibility of

contraceptives to the general public, by providing safer and more effective types of contraceptives, by legitimizing the use of various types of contraceptives, and by providing subsidized contraceptives for public use.

Thus we hypothesize that the fertility rate in Thailand is a decreasing function of the level of socioeconomic development and the level of family planning program activity. Furthermore, this relation should be a non-linear one, since as fertility falls the intrinsic value of children rises and it would take larger socioeconomic change and a higher level of family planning activity to induce further declines in fertility. It is also reasonable to assume there is a lower limit to the fertility level after which point fertility will no longer respond to further socioeconomic development or to increases in family planning program effort.

2.2 Empirical specification of the model

In the present case, we assume specifically that the total fertility rate in Thailand is a function of income level and the level of family planning program effort as measured by the amount of government expenditures allocated to the NFPP. The total fertility rate was chosen to represent the fertility level because it is independent of the age structure of the female population, yet reflects changes in age-specific fertility rates. Income is perhaps the best single development index because it is closely related to other relevant socioeconomic indices. One may argue that factors such as education, urbanization, should also be included into the model. To include all relevant variables into the model might be theoretically correct but not empirically feasible. First of all, data for all relevant factors may not be available. In the present case (Thailand), only income per capita and urbanization data were available for the time period under consideration. Furthermore, it is

not necessarily desirable to include all factors in the model. Most socio-economic factors are highly correlated with each other on an aggregate level and this multicollinearity problem would reduce the efficiency of the estimated coefficients. An econometrics textbook situation is to include only the most important factor. In the present case, that is income per capita. Expenditures for the family planning program summarize both the number of personnel and the amount of commodities employed for that purpose.

The selection of an appropriate functional form for the fertility response is guided by theoretical considerations of diminishing returns to resources. We assume that the fertility function takes the form of a logistic curve.

$$(1) \qquad TFR_{t,i} = \frac{\gamma}{1 - e^{\alpha + \beta_1 INP_{t,i} + \beta_2 FPE_{t,i} + \varepsilon_{t,i}}}$$

where

$TFR_{t,i}$ = Total fertility rate of region i in year t

$INP_{t,i}$ = GRP per capita of region i in year t

$FPE_{t,i}$ = Family planning program expenditure per capita in region i in year t

γ = Asymptote of the function

e = Base of a natural logarithm

$\varepsilon_{t,i}$ = Random disturbance term.

We also expect that α, β_1, and β_2 all have negative values. The choice of a logistical model also allows us to make more reasonable fertility projections for future time periods. Since the fertility level has been high during the observation period and we really do not have observations to estimate the lower limit of the fertility function, we opt to assign a value of 2.2, approximately the replacement level of fertility in Thailand, to r. Rearranging terms and taking the log of the function, we reach a transformed equation:

$$(2) \qquad \ln \frac{TFR_{t,i} - 2.2}{TFR_{t,i}} = \alpha + \beta_1 INP_{t,i} + \beta_2 FPE_{t,i} + \varepsilon_{t,i}$$

The values of α, β_1, and β_2 can then be estimated by a linear regression method.

2.3. Data, statistical method, and empirical results

The model as described in Section 2.2 will be tested using a newly assembled set of data (see Tables A1 and A2 in the Appendices). It is composed of five years of cross-regional observations. Total fertility rates come from various estimations based on surveys or census; these rates are believed to be the best available ones for Thailand (National Academy of Sciences, 1980). We obtained GRP (Gross Regional Product) per capita data for years 1972, 1975, and 1978 from internal tabulations by the National Statistical Office of the Royal Thai Government (RTG). 1962 and 1967 data on GRP per capita are derived from consumer expenditure surveys and have been adjusted to the 1972 price level (World Bank, 1979). Calculation of family planning expenditure per capita is based on total expenditure and the total population of the country in each year. Since we were officially advised that funds for family planning activity are distributed proportionally to regions according to their population size, and we do not have any contradictory evidence, we assume per capita expenditure is the same for all regions in any given year. We should point out that the fact that in both 1962 and 1967 the values of family planning expenditure are zero does not imply there were no observations for that variable. In fact, the zero value of the variable of family planning expenditure in the early years actually provides a nearly ideal experimental situation in which the importance of the existence of the level of a family planning program can be tested. Total expenditures for the NFPP from 1972 to 1980 by source of funding are reported in Table 1.

TABLE 1. NATIONAL FAMILY PLANNING PROGRAM EXPENDITURE BY YEAR AND BY SOURCE OF FUNDING

	National Family Planning Program Expenditure (in Baht)				
	Ministry of Public Health	Foreign Aid		Total	Per Capita
		USAID	Other		
1972	13,805,876	25,667,000	--	39,472,876	1.03
1973	13,863,092	34,117,000	24,191,280	72,171,372	1.81
1974	18,307,296	39,639,000	27,656,600	85,602,896	2.07
1975	23,059,235	16,600,000	37,992,940	77,652,175	1.83
1976	29,324,695	82,000,000	24,000,000	135,324,695	3.13
1977	59,716,860	74,516,316	25,216,173	159,449,349	3.60
1978	67,968,000	65,978,246	40,518,260	174,464,506	3.87
1979	58,626,000	67,778,246	87,515,920	213,920,160	4.64
1980	61,972,000	71,966,560	101,898,340	235,836,900	5.00

Sources: 1977 and 1979 National Family Planning Evaluation Report; various internal documents from the Department of Health of the RTG and USAID/Bangkok.

Equation (2) is estimated by an Ordinary-Least-Square method and the result is reported in Table 2. The estimated coefficients for the constant term, income per capita, and family planning program expenditure per capita, all have the expected sign and are statistically significant. About sixty-three percent of the total variation is explained by the logistic function. The result is quite strong considering the limited number of observations used in the estimation. The evidence here does suggest that in Thailand both income and family planning program effort have significant effects on the total fertility rate.

TABLE 2. REGRESSION ESTIMATION OF A TOTAL FERTILITY FUNCTION

Variable	Estimated Coefficient	t-statistics
Constant	-.327597**	-4.40
INP	-.000040*	-2.30
FPE	-.073393*	-2.71

*Significant at .05 level
**Significant at .01 level

The regression coefficient for the family planning expenditure variable is quite robust. When estimated under different empirical specifications of the model--linear, non-linear, first difference, with urbanization variable, or without urbanization variable--the coefficient of the family planning expenditure variable retains its magnitude and remains statistically significant.

Table 3 shows actual versus predicted TFRs for Thailand. The predicted TFRs are based on estimated coefficients derived from income and family planning expenditure data. The model predicts quite well. The comparison of actual and predicted TFR is also illustrated in Figure 1.

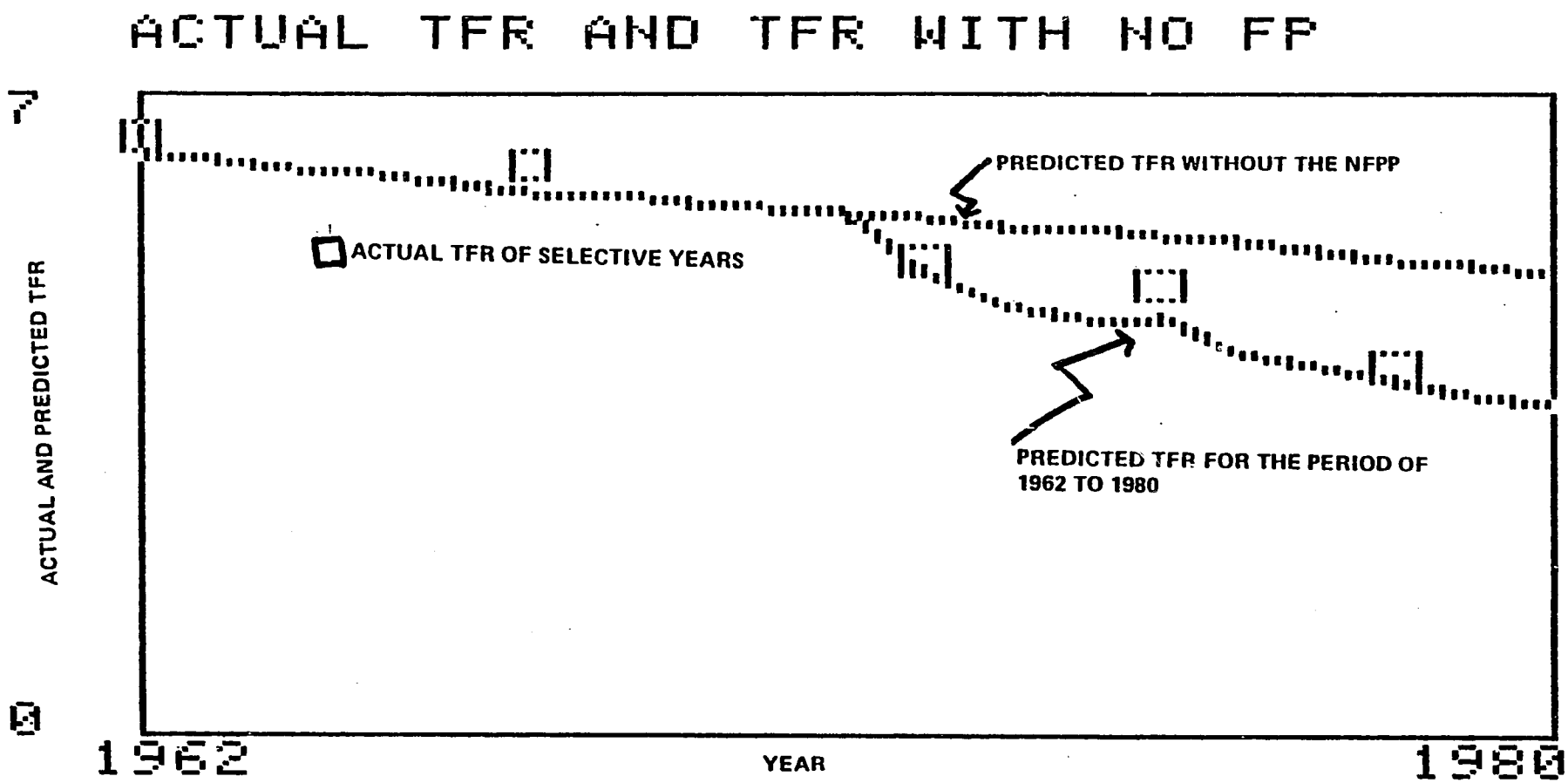

Figure 1.

Actual and predicted total fertility rates of Thailand, 1962-1980

TABLE 3. ACTUAL AND PREDICTED TOTAL FERTILITY RATES

Year	Actual TFR	Predicted TFR
1962	6.48	6.23
1967	6.19	5.89
1972	5.13	5.03
1975	4.90	4.58
1978	3.98	3.86

2.4 The net impact of the NFPP on Thailand's fertility decline

From the estimated equation:

$$(3) \qquad TFR = \frac{2.2}{1 - e^{-.327597 - .000040\ INP_t - .073393\ FPE_t}}$$

the impact of the NFPP on Thailand's total fertility rate between 1972 and 1980 can be calculated. Table 4 reports the predicted TFR of Thailand with and without a family planning program. Column Three lists the predicted TFRs for Thailand based only on the actual GDP per capita pattern experienced by Thailand while assuming that FPE equals zero. Column Two, on the other hand, is obtained when both actual GRP per capita and family planning expenditure per capita are substituted into equation (3). The difference between the two is the net effect of the NFPP on the total fertility rate.

TABLE 4. PREDICTED TFR OF THAILAND
WITH AND WITHOUT THE NFPP, 1971-1980

Year	Predicted TFR with NFPP	Predicted TFR without NFPP	Net Effect of NFPP on TFR
1971	5.65	5.65	0.00
1972	5.03	5.60	-0.57
1973	4.65	5.52	-0.87
1974	4.54	5.50	-0.96
1975	4.58	5.43	-0.85
1976	4.13	5.33	-1.20
1977	3.98	5.26	-1.28
1978	3.86	5.14	-1.28
1979	3.69	5.08	-1.39
1980	3.59	4.99	-1.40

Table 5 summarizes the total decline in Thailand's TFR between 1971-1980 and 1962-1980 and the amount of the decline attributable to changes in income and changes in family planning program expenditure. Predicted TFR for 1971 minus predicted TFR for 1980 with the NFPP give us the total decline in TFR between 1971 and 1980. Predicted TFR for 1971 minus predicted TFR for 1980 without the NFPP, on the other hand, gives us the amount of decline which was brought about by increases in income level. The difference between the two, then, is the amount of fertility decline during 1971 to 1980 which is attributable to the effort of the NFPP. Our findings reveal a very strong impact by the NFPP on Thailand's fertility, more than twice as large as that of per capita income level. In a similar procedure, 1962-1980 changes in TFR are also analyzed. During these two decades, the impact of income changes was about the same as that of the family planning program effort.

TABLE 5. CALCULATED IMPACT OF THE NATIONAL FAMILY PLANNING PROGRAM ON THAILAND'S TOTAL FERTILITY RATE, 1962-1980, 1971-1980

Period	Total Decline in TFR	Percent-age	Decline of TFR Due to Change in INP	Percent-age	Decline of TFR Due to Change in FPE	Percent-age
1971-1980	2.06	100%	.66	32%	1.40	68%
1962-1980	2.64	100%	1.24	47%	1.40	53%

2.5 The relative importance of the NFPP and some policy implications

Now let us examine the marginal effectiveness of income and family planning expenditure in reducing fertility. From equation (3):

$$\frac{\partial TFR}{\partial INP} = \text{Marginal effectiveness of increase in income in reducing fertility rate}$$

$$= \frac{-(2.2)\ (.000040)\ (M)}{(1-M)^2}$$

where

$$M = e^{-.327597 - .000040INP - .073393FPE}$$

and

$$\frac{\partial TFR}{\partial FPE} = \text{Marginal effectiveness of increase in family planning expenditure in reducing fertility rate}$$

$$= \frac{-(2.2)(.073393)(M)}{(1-M)^2}$$

Since M is a function of both INP and FPE, the marginal effectiveness of these variables depends partly upon their relative level. Using current years of GDP per capita and family planning expenditure per capita, we evaluate those two marginal measurements; the results are reported in Table 6.

TABLE 6. THE MARGINAL EFFECTIVENESS AND ELASTICITY OF PER CAPITA GDP AND PER CAPITA FAMILY PLANNING EXPENDITURE WITH RESPECT TO TOTAL FERTILITY RATE, WHOLE KINGDOM, 1972-1980

Year	Marginal Effectiveness of GDP Per Capita	Elasticity of GDP Per Capita	Marginal Effectiveness of FPE Per Capita	Elasticity of FPE Per Capita
1972	-0.00025907	-0.22098	-0.47534	-0.09730
1973	-0.00020712	-0.20085	-0.38004	-0.14793
1974	-0.00019283	-0.1[illegible]528	-0.35381	-0.16141
1975	-0.00019860	-0.20803	-0.36439	-0.14550
1976	-0.00014440	-0.17919	-0.26495	-0.20103
1977	-0.00012833	-0.17293	-0.23546	-0.21322
1978	-0.00011687	-0.17466	-0.21444	-0.21479
1979	-0.00009962	-0.16228	-0.18278	-0.23007
1980	-0.00009079	-0.16056	-0.16658	-0.23196

However, a better index to look at is "elasticity," which is independent of the absolute level of a variable. We define

E_{INP} = Income Elasticity

= percentage change in TFR with respect to a one percent change in GDP per capita

$$= \frac{\partial TFR}{\partial INP} \Big/ \frac{\overline{TFR}}{\overline{INP}}$$

and

E_{FPE} = Family Planning Expenditure Elasticity

= percentage change in TFR with respect to a one percent change in family planning expenditure per capita

$$= \frac{\partial TFR}{\partial FPE} \Big/ \frac{\overline{TFR}}{\overline{FPE}}$$

where $\overline{TFR}$, $\overline{INP}$, and $\overline{FPE}$ are the mean values of those variables. An

evaluation of these two elasticities with current years of INP and FPE level is also reported in Table 6. An interesting pattern of change emerges. While the income elasticity decreases over time, the family planning expenditure elasticity has been increasing since 1972. In 1980, the latter is slightly larger than the former. Hence, at present levels of fertility, income, and family planning expenditure, a one percent increase in FPE can reduce fertility more than a one percent increase in INP.

2.6 Forecasting Future Fertility Rates

The main focus of this section has been the impact of the NFPP on fertility during the period 1972 to 1980. It is also useful to examine the impact of alternative future expenditure patterns for the NFPP from 1980 to 2010 on future fertility trends. For this purpose we calculate two possible trends in fertility rates under two assumptions about the amount of public funds allocated to the NFPP. Table 7 shows two projections of Thailand's total fertility rate for the period 1981 to 2010. The two projections are made using the logistic function estimated in Section 2.3, with the same assumption that GDP per capita grows at a rate of 5.2 percent per annum.[1]

The first projection is made under the assumption that family planning expenditure per capita also increases by 5.2 percent per annum. The resulting fertility rates are the lower of the two projections. The second projection is made under the assumption that from 1980 on family planning expenditure per capita would stay at the current 1980 level of five baht per capita. The two projections are shown in Figure 2.

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[1]Perhaps it would be more interesting to assume instead that GDP grows at a constant rate and let the population size determine GDP per capita. However, because of the simultaneous relation between GDP per capita and fertility rate and the five-year- projection nature of the demographic model, it is not possible to do so.

TABLE 7. PROJECTIONS OF TOTAL FERTILITY RATE UNDER VARIOUS ASSUMPTIONS ABOUT FAMILY PLANNING EXPENDITURE PATTERN, 1981-2010

	Projections of Total Fertility Rate	
Year	(1) FPE Per Capita Increases 5.2 % Annually from 1980 Level	(2) FPE Per Capita Remains at 1980 Level
1981	3.51997	3.56113
1982	3.45078	3.53102
1983	3.38331	3.50024
1984	3.31747	3.46899
1985	3.25340	3.43713
1986	3.19111	3.40478
1987	3.13068	3.37206
1988	3.07217	3.33886
1989	3.01561	3.30525
1990	2.96114	3.27142
1991	2.90856	3.23717
1992	2.85811	3.20278
1993	2.80973	3.16814
1994	2.78740	3.13340
1995	2.74200	3.09853
1996	2.69878	3.06369
1997	2.65762	3.02887
1998	2.61852	2.99413
1999	2.58156	2.95957
2000	2.54663	2.92523
2001	2.51375	2.89116
2002	2.48290	2.85741
2003	2.45404	2.82409
2004	2.42712	2.79122
2005	2.40216	2.75891
2006	2.38258	2.73907
2007	2.35779	2.69604
2008	2.33828	2.66563
2009	2.32051	2.63599
2010	2.30437	2.60714

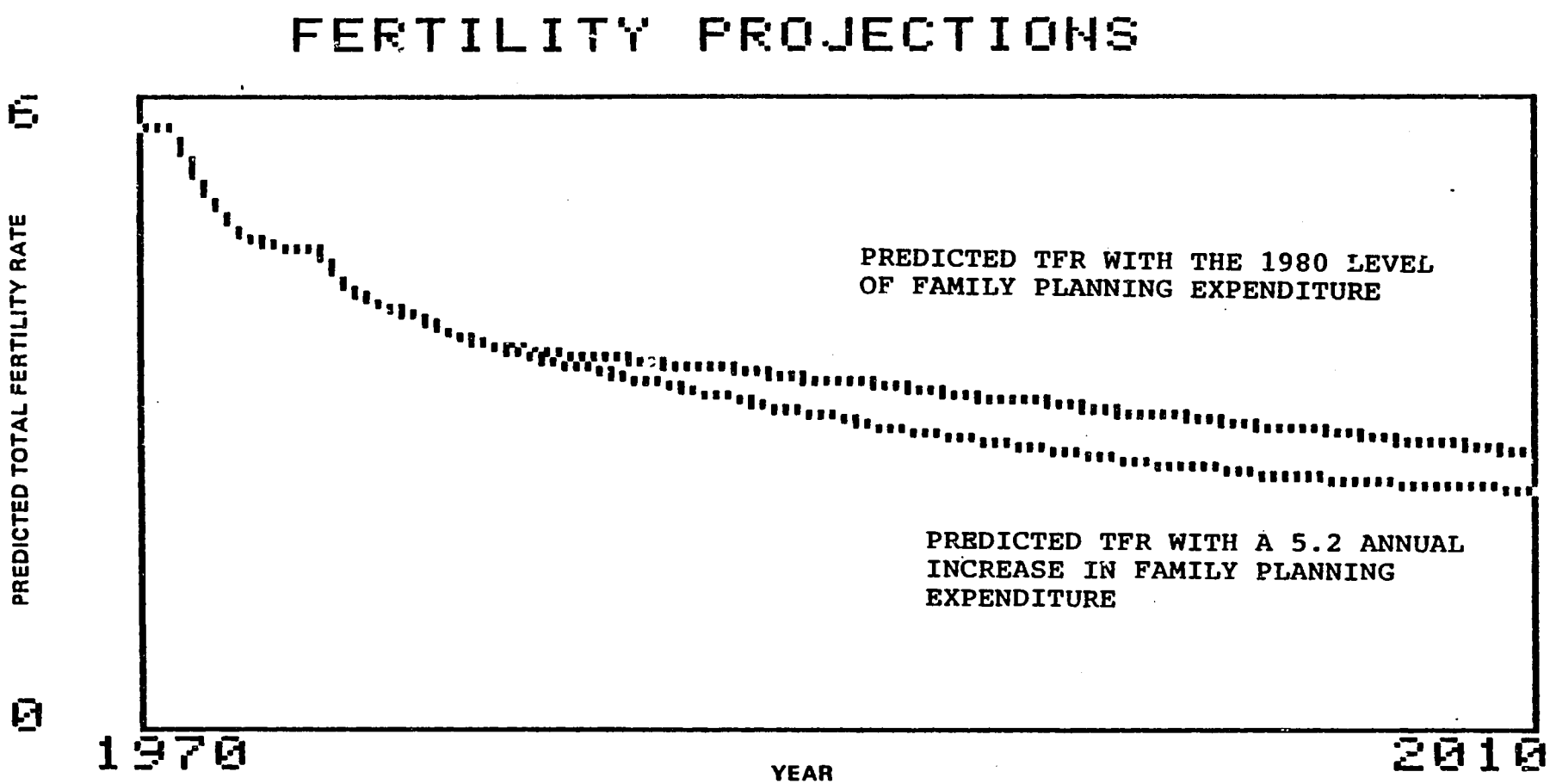

Figure 2.

Predicted total fertility rates of Thailand with constant and increasing family planning expenditures, 1981-2010

The differences between the projections which use a constant current expenditure level and an increasing level are not mathematically large, but they can be demographically significant in terms of their implications for the population growth rate. For example, in 1995 TFR would be as low as 2.7 in the first projection and still close to 3.1 in the second projection.

3. The Impact of the NFPP on Public Savings Through Government Expenditures Averted

3.1 Population projections

The total fertility rate calculated using the regression equation described in Chapter 3 is used in a demographic projection model to determine the future size of the population as a function of expenditures in the family planning program. The model is a standard cohort projection model which calculates the number of people in each 5-year age cohort as new births occur, and as people age and die.

The demographic model uses a one-sex model that disaggregates the population into 16 five-year age cohorts, from 0-4 years old to 75 and over. For each age group except the 0-4 group, the population is increased by people aging into that cohort and decreased by people aging out of it and by deaths. The 0-4 age group is increased by births and decreased by aging and deaths.

Births are calculated from the total fertility rate and the age specific distribution of fertility. Thus, the total number of births occurring at a particular time to the women of a given age is the product of the total fertility rate, the fraction of total lifetime births occurring during the given age and the number of women in that age group. The United Nations Model for Southeast Asia which matches different levels of total fertility rates with age specific fertility rates is used so that as the total fertility rate changes over time, a corresponding change occurs in the age specific distribution.

$$BIRTHS_t = \sum_{AGE = 15-19}^{40-44} TFR_t \times \%BIRTHS_{AGE} \times \frac{(POP_{AGE,t} + POP_{AGE,t-5}) \times \%Female}{2}$$

Where:

$BIRTHS_t$ = Number of births from time t-5 to t

TFR_t = Total fertility rate at time t

$\%BIRTH_{AGE}$ = The percentage of total lifetime births that occur during the five-year period specified by AGE

$POP_{AGE,t}$ = Population of five-year age cohort, AGE, at time t

%FEMALE = The percentage of the population aged 15-44 that is female

This equation calculates total births by summing the births occurring to females in each of the five-year age cohorts between 15-19 and 40-44. The total fertility rate is multiplied by the percentage of births occurring during a woman's lifetime which occur during a particular five-year period, the average population for the specified cohort, and the percentage of the population aged 15-44 that is female.

The size of the 0-4 age group is increased by births and decreased by deaths occurring during the first five years of life.

$$POP_{0-4,t} = BIRTHS_t - BIRTHS_t \times (DEATHRATE_{0-4,t} + DEATHRATE_{0-4,t-5}) / 2$$

Where:

$POP_{0-4,t}$ = Population aged 0-4

$BIRTHS_t$ = Number of births occurring during the five-year period, t-5, to t

$DEATHRATE_{0-4,t}$ = The mortality rate for the first age cohort at time t

Mortality is based on life expectancy and an OECD set of model life tables appropriate for Thailand.[1] Age-specific mortality rates are then

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[1]Clairin, Remy, Julien Conde et al. Mortality in Developing Countries, Tome III, Vol. V/Vol. VI, (Paris, Development Centre of the Organisation for Economic Co-operation and Development, 1980.)

calculated for the appropriate life expectancy levels. For this analysis, life expectancy is assumed to increase from 57 years in 1970 to 61 years in 1980 to 70 years by 2010.

The population aged 5-74 is divided into 15 five-year cohorts, from ages 5-9 to ages 70-74. The size of each age group at any time is determined from the size of the preceding cohort (five years younger) and the percentage of that cohort that survives during the five-year period it takes to age into the next cohort. Thus, each cohort is traced as it ages with the passage of time and as some of its members die.

$$POP_{AGE,t} = POP_{AGE-5,t-5} \times \text{SURVIVAL RATE}_{AGE,t}$$

$$\text{SURVIVAL RATE}_{AGE,t} = 1 - \frac{(\text{DEATHRATE}_{AGE,t} + \text{DEATHRATE}_{AGE,t-5})}{2}$$

Where:

$POP_{AGE,t}$ = Population in AGE cohort at time t

$\text{SURVIVAL RATE}_{AGE,t}$ = Percentage of the population in cohort AGE-5 surviving to the next age cohort

$\text{DEATHRATE}_{AGE,t}$ = The mortality rate, the percentage of the cohort that will not survive to the next cohort

The size of the final age cohort, ages 75 and over, is determined by the number of people surviving from the 70-74 cohort and the number of surviving people over 75.

$$POP_{75+,t} = POP_{70-74,t} \times \text{SURVIVAL RATE}_{70-74,t} + POP_{75+,t} \times \text{SURVIVAL RATE}_{75+,t}$$

Where:

$POP_{75+,t}$ = Population aged 75 and over at time t

$POP_{70-74,t}$ = Population aged 70-74 at time t

$\text{SURVIVAL RATE}_{AGE,t}$ = The percentage of the population in AGE cohort surviving form time t-5 to time t

Once the population for each 5-year age cohort has been calculated for 5-year intervals beginning in 1970, the projections are then interpolated for the intermediate years.

Two population projections have been prepared for this analysis. Both projections assume no net international migration. The projections begin in 1970 using the adjusted figures from the 1970 Census which are shown below.

1970 BASE POPULATION
(Thousands)

Age	
0-4	6,155
5-9	5,390
10-14	4,797
15-19	3,970
20-24	3,043
25-29	2,441
30-34	2,360
35-39	2,014
40-44	1,691
45-49	1,282
50-54	1,039
55-59	863
60-64	677
65-69	496
70-74	329
75+	279
TOTAL	36,800

SOURCE: Country Demographic Profiles, Thailand (Washington, D.C.: U.S. Bureau of the Census, April, 1978).

Projection A, No Family Planning Program, assumes that there was no family planning program from 1970 to 1980 and that none begins after 1980. Under this assumption the total fertility rate declines slowly from 5.71 in 1970 to 5.0 by 1980 and to 2.84 by 2010, following the pattern of the regression equation when the family planning expenditures coefficient is set at zezo.

Projection B, Actual Family Planning Program, uses the actual expenditures of the family planning program from 1972 to 1980 to estimate fertility for

that period. Expenditures are assumed to continue at the 1980 rate, 5 baht per person after 1980. In this case fertility declines more rapidly, dropping to 3.6 by 1980 and to 2.6 by 2010.

The results of these projections are shown in Figure 3. With No Family Planning Program, Projection A, the population grows from 36.8 million in 1970 to 48.6 million by 1980, an increase of 32 percent. The population reaches 63 million by 1990, 79 million by 2000 and 95 million by 2010. The average annual growth rate from 1970 to 2010 is 2.4 percent.

With the Actual Family Planning Program, Projection B, the population grows by 26 percent from 1970 to 1980, reaching 46.5 million in that year, 2.1 million less than under Projection A. The population reaches 57 million by 1990, 69 million by 2000 and 80 million by 2010, 15 million less than under Projection A. The average annual growth rate from 1970 to 2010 is 1.96 percent.

Figure 4 compares the number of births under the two projections. By 1980, 8 years after the beginning of the family planning program, births would be 27 percent lower than if there had been no family planning program. The total number of births averted between 1970 and 1980 is about 2.4 million.

The number of births averted each year increases rapidly during the 1972-1985 period as the fertility rate drops most rapidly. Births averted rise from 100,000 in 1972 to over 450,000 by 1985. The difference in number of births between the two projections drops from 1985 to 1995 as the declining fertility keeps the total number of births low (See Figure 5).

After 1995 the difference grows again due to effects on the number of people of reproductive ages. By 2000, people born during the 1970s are reaching their prime reproductive years. Thus, a birth averted in the 1970s results in additional births averted around 1995. The number of births averted per year declines to about 400,000 by 1995, but increases again to 600,000 by 2010, as this "echo effect" begins to accumulate.

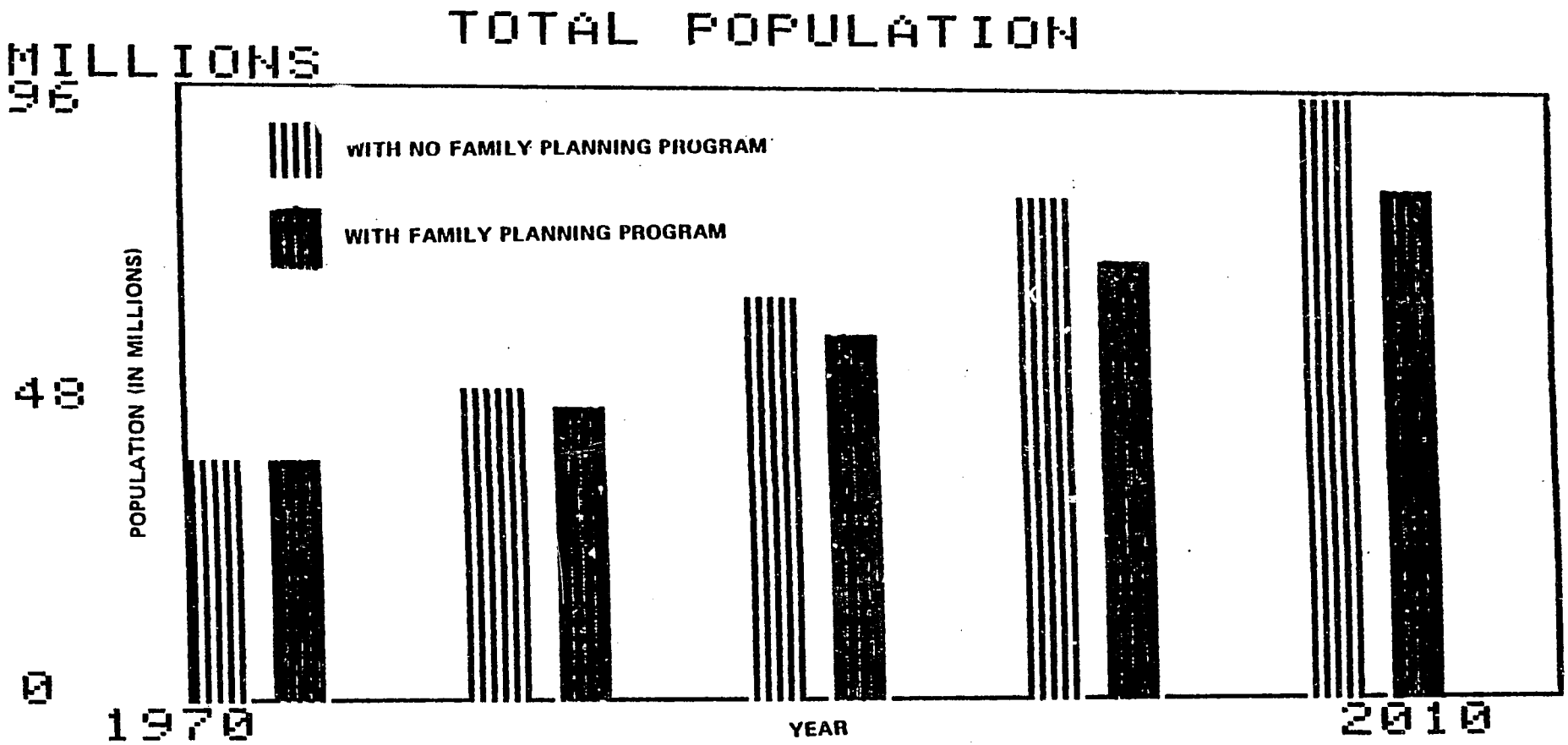

Figure 3.
Total population.

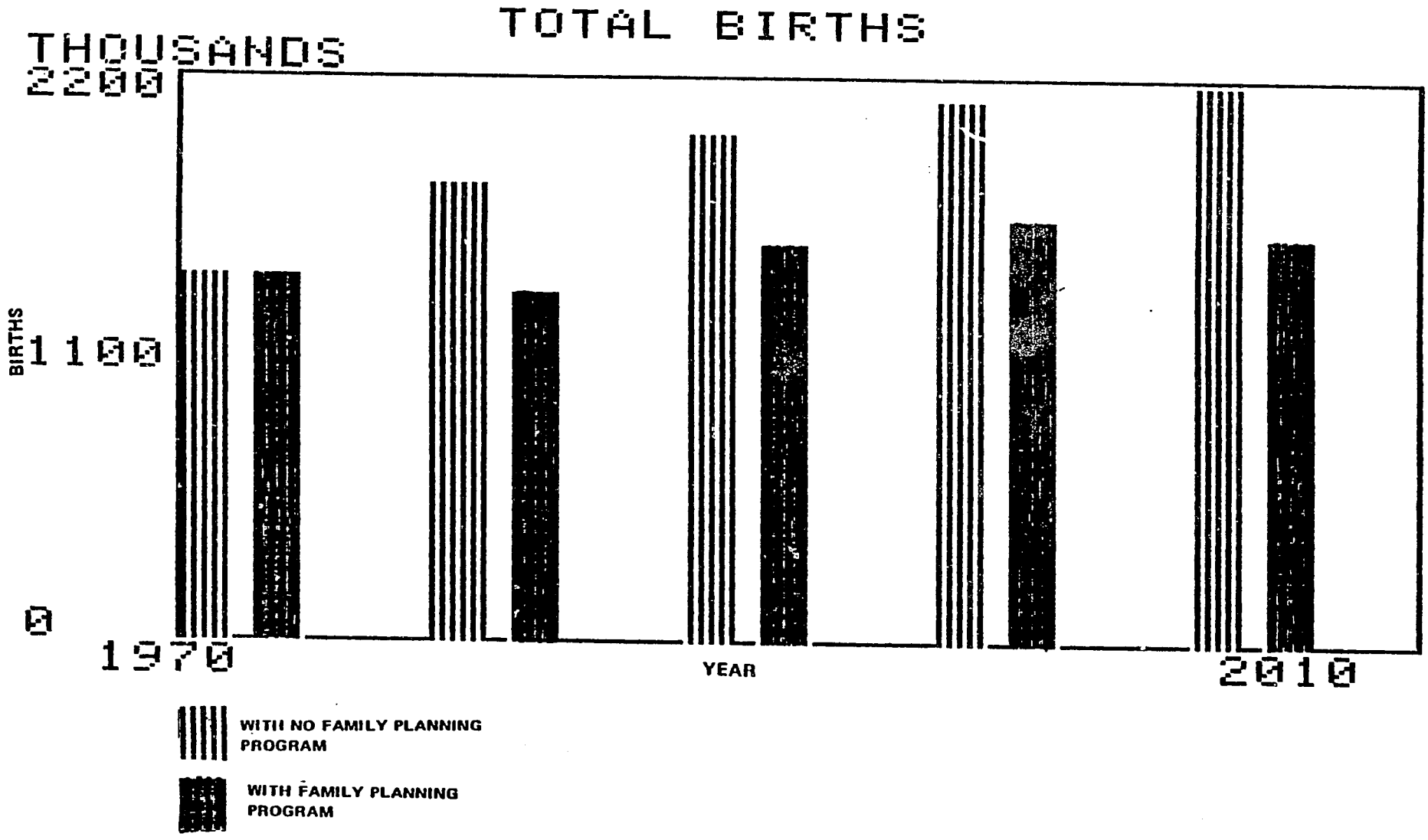

Figure 4.
Total births

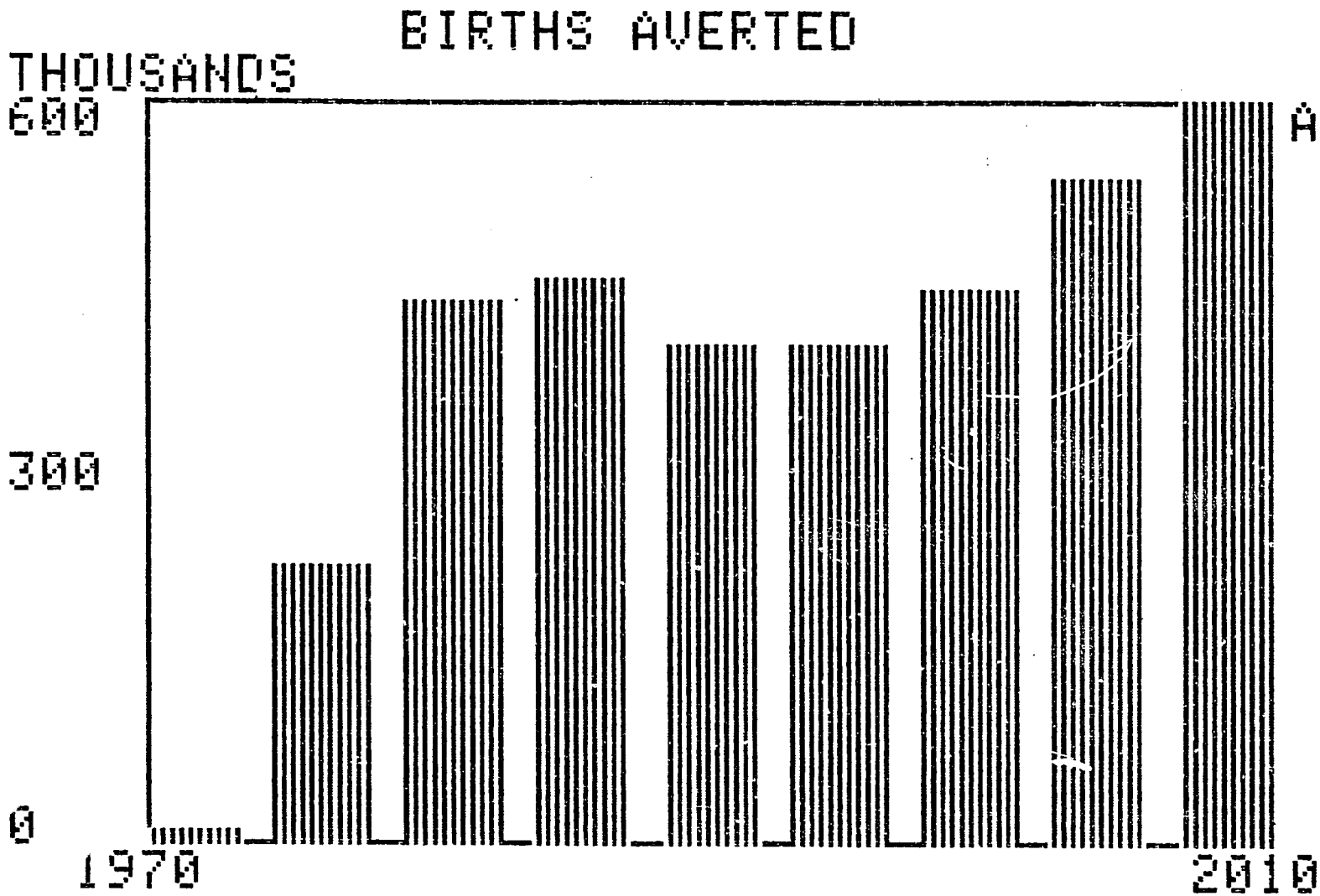

Figure 5.

Births Averted Due to
National Family Planning Program

These population projections are used to calculate the differences in total government expenditures in education, health, housing infrastructure and other social services that result from the family planning program. All costs are expressed in constant 1979 baht.

3.2 Education

The educational system in Thailand consists of primary schooling, secondary schooling, vocational education, university level education and other specialized education. This analysis examines only primary and secondary education expenditures, the only areas where the data permit a detailed cost analysis.

Children normally enter primary school at the age of 6 and continue until the age of 12. The costs assoicated with each student include both capital costs (for classrooms and equipment) and current costs (for salaries and operating supplies). Current costs are a function of the number of students and capital costs are a function of the growth in the number of students (requiring new school places to be created). Therefore, the total costs for primary education are found by multiplying the number of students by the current cost per student and adding the capital cost per student multiplied by the number of additional students expected in the next year.

$$TPC_t = PS_t \times PCC_t + (PS_{t+1} - PS_t) \times PKC_t$$

where

TPC_t = total primary costs in year t

PS_t = number of primary students in year t

PCC_t = primary current costs per student in year t

PKC_t = primary capital cost per student in year t

The number of students is found by multiplying the population aged 6 to 12 by the percentage of those children enrolled in primary school. For the

purposes of this analysis, the primary enrollment rate is assumed to have increased at a 1.5 percent annual rate from 83 percent in 1975 to 89 percent by 1980. It is further assumed that the 1.5 percent annual growth rate will continue until it reaches 100 percent by 1980.[1]

The current and capital costs have been derived from educational expenditure data contained in Thailand's Budget in Brief (Fiscal Years, 1970-1981). Beyond 1980, the estimated costs are assumed to remain constant at the 1980 values. These are 1,169 baht per student for current costs and 15,717 baht per additional student for capital costs. These values will probably increase in the future; the assumption of constant values is a conservative one, underestimating the savings as a result of family planning expenditures.

Secondary educational expenditures are calculated in a manner similar to those for primary. Cost figures used for secondary education are from the same sources as primary. They are 1,134 baht per student for current cost and 19,034 baht per student for capital costs. The secondary enrollment rate is assumed to have increased at a 2.0 percent annual rate from 27 percent in 1975 to 30 percent by 1980. It is also assumed that this rate of growth will continue through 2010 when the secondary enrollment rate reaches 54 percent.

Figure 6 presents total educational expenditures under the two projections. Under both projections, the costs rise from 6,400 million baht in 1970 to almost 12,000 million baht by 1976. The first differences do not appear until 1977, the year in which capital expenditures would be spent on children born the first year affected by the program.

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[1]The annual growth of the primary and secondary enrollment rates was derived from projections made by the National Educational Board's Index on Policy, Paper No. 8-9 in 1979 for the 1982-1986 period.

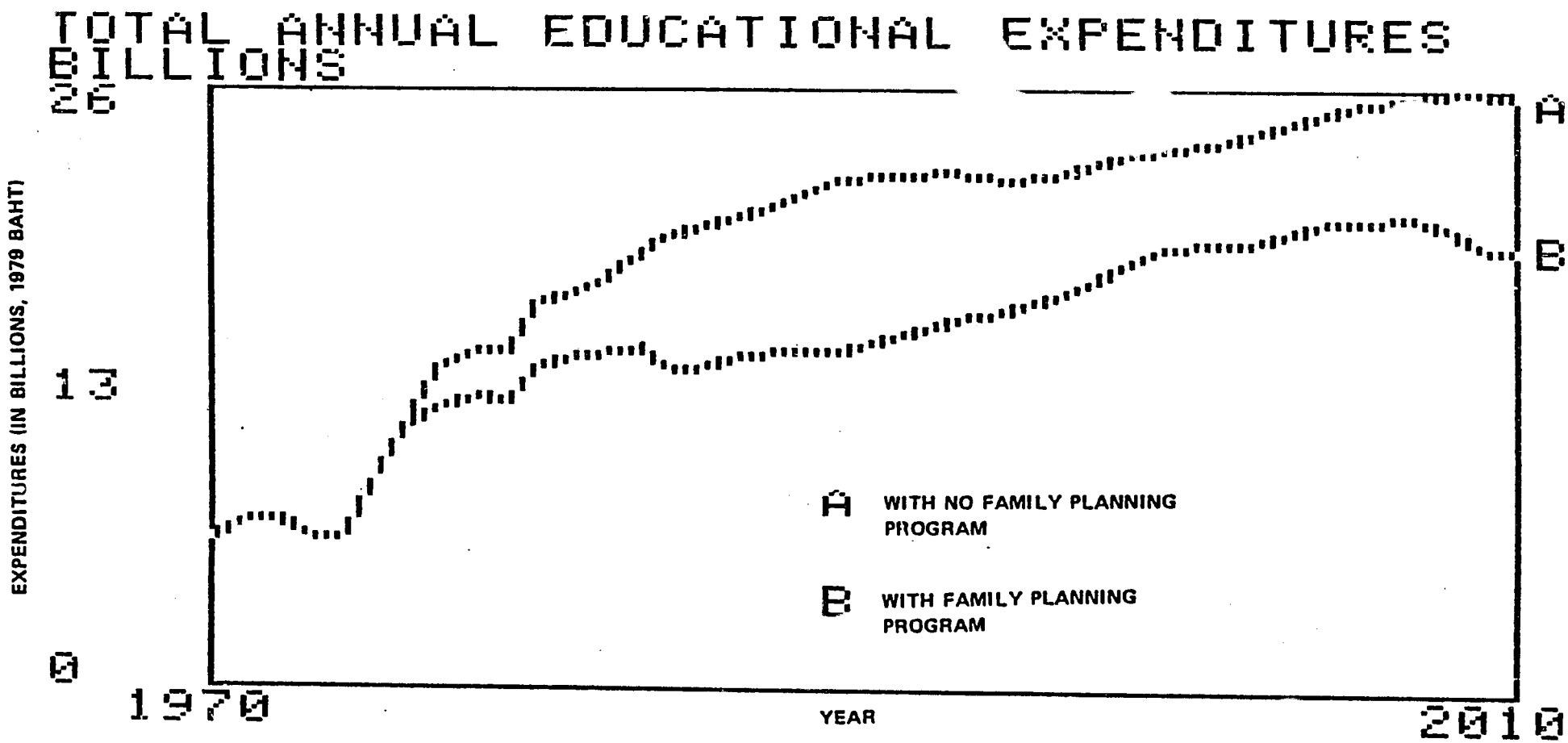


Figure 6.
Total annual educational expenditures

In the No Family Planning Program projection, the annual expenditures continue to rise rapidly, reaching 22,000 million baht by 1990, 24,000 million baht by 2000 and nearly 26,000 million baht by 2010.

With the Family Planning Program projection, the annual expenditures increase slowly after 1980. Expenditures increase from 14,100 million baht in 1980 to 15,000 million baht by 1990. Although the decline in fertility slows after 1980 with this projection, this decline is offset by the larger number of people attaining reproductive age. Thus, the number of births begins to rise after 1980. These children begin to enter primary school in the late 1980s, causing educational expenditures to start rising again. The increase is slow, however, because increasing expenditures at the primary level are partially offset by declining expenditures at the secondary level. Annual expenditures reach a peak of 20,400 million baht by 2005, after which they begin to decline again because of the new decline in births which occurs around the year 2000.

The annual savings in educational expenditures achieved as a result of the family planning program are about 2,500 million baht in 1980 and between 4,000-6,500 million baht per year from 1985 to 2010. The cumulative savings for the period 1970 to 2010 are 170,000 million baht.

3.3 Health

The health system in Thailand consists of large urban hospitals, rural health clinics, maternal and child health programs, and other special programs. Due to a lack of detail in the expenditures data, this analysis considers all health expenditures together. It does not examine the impacts on different portions of the health budget.

As with education, costs are divided into current costs and capital costs. Thus, total health expenditures are found as follows:

$$THE_t = POP_t \times HCC_t + (POP_{t+1} - POP_t) \times HKC_t$$

where

THE_t = total health expenditures at time t

POP_t = the size of the population at time t

HCC_t = per capita current health expenditures at time t

HKC_t = health capital expenditures per additional person

Information on health expenditures was drawn from Thailand's Budget in Brief (Fiscal Years, 1970-1981). These figures were used to estimate the per capita expenditure figures for each year from 1970 to 1980. For 1980 the figures are 68 baht per person for current expenditures and 952 baht per additional person for capital expenditures. These rates are assumed to remain constant after 1980. Again, this conservative assumption tends to underestimate the savings resulting from the family planning program.

Total health expenditures (shown in Figure 7) were about 1,550 million baht in 1970 (in 1979 baht). Expenditures for the two projections are the same through 1971, but begin to differ immediately after the first births are averted by the family planning program. Expenditures reach 4,500 baht by 1980 under Projection A, and continue to 5,700 million baht by 1990; 6,900 million baht by 2000 and 7,900 million baht by 2010.

With the Family Planning Program projection, they reach 4,100 million baht by 1980 (9 percent less than with no family planning), 4,900 million baht by 1990 (14 percent less), 5,800 million baht by 2000 (16 percent less) and 6,400 million baht by 2010 (19 percent less).

Total cumulative savings from 1970 to 2010 as a result of the family planning program are 31,000 million baht.

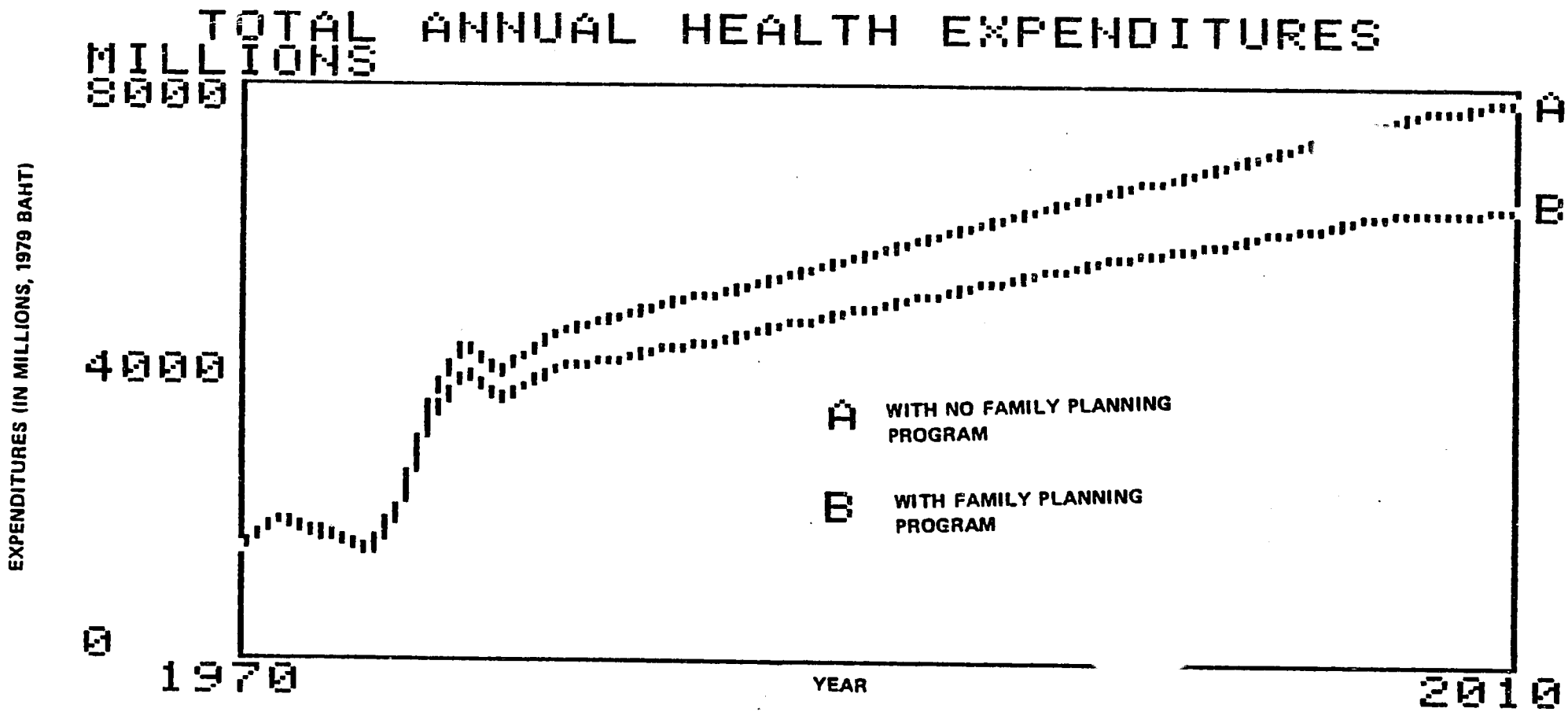


Figure 7.
Total annual health expenditures

3.4 Housing Infrastructure

Total requirements for housing will also be affected by changes in population size due to the family planning program. However, most housing is constructed privately and does not depend on government expenditures. Government-built housing is a small part of the total and would not necessarily be affected by the changes in population shown here. The government does invest heavily, however, in housing infrastructure, such as water supply, sewerage and refuse disposal and other sanitary services.

Information on housing infrastructure costs has also been derived from Thailand's Budget in Brief (Fiscal Years, 1970-1981). These expenditures include items related to capital expenditures, such as sewerage facilities, water lines, new housing, etc., and items related to current expenditures, such as water, manpower, energy costs and all administrative costs. The calculation of current expenditures has been done on a per capita basis. Capital expenditures, however, are related to the growth in the number of households. Thus, total expenditures are calculated as follows:

$$THIE_t = POP_t \times HOCC_t + (NH_{t+1} - NH_t) \times HOKC_t$$

where

$THIE_t$ = total housing infrastructure expenditures at time t

POP_t = population at time t

$HOCC_t$ = housing infrastructure current costs per capita at time t

NH_t = number of households at time t

$HOKC_t$ = housing infrastructure capital costs per additional household at time t

Actual figures for expenditure for 1970 to 1980 are taken from Thailand's Budget in Brief (Fiscal Years, 1972-1980). The 1980 figures of 9 baht per

person of current expenditure and 4083 baht per person of capital expenditure are used for all years beyond 1980.

The total number of households will not be affected by changes in births for about 20 years or so, since households are formed by adults. The average size of households will be affected immediately, of course, as a lower number of births means fewer children per household.

The number of households has been calculated by assuming that the general pattern of household formation will not change. First the number of people between the age of 20 and 60 in 1970 is divided by two to find the number of potential heads of households. This number is then divided by the actual number of households to find the ratio of potential heads of households to actual. This ratio is used in the future to multiply the population 20 to 60 divided by 2 to find the nubmer of households in any future year.

Total housing infrastructure costs are shown in Figure 8. Expenditures under the two projections begin to diverge immediately after 1971 since there is a difference in current expenditures. Capital expenditures are not affected until 20 years later, however. With Projection A expenditures reach 1,610 million baht in 1980, 2,000 million baht in 1990, 2,500 million baht in 2000, and 2,900 million baht in 2010. With the Family Planning Program projection expenditures increase to 1,590 million baht in 1980 (1 percent less than in Projection A), 1,900 million baht by 1990 (5 percent less), 1,800 million baht in 2000 (28 percent less), and 2,100 million baht in 2010 (28 percent less). Cumulative savings from 1970 to 2010 are about 13,000 million baht.

3.5 Other Social Services

There are a number of other social services that also generate government expenditures which are closely related to population size. In this analysis we have included in this "other" category expenditures for administration,

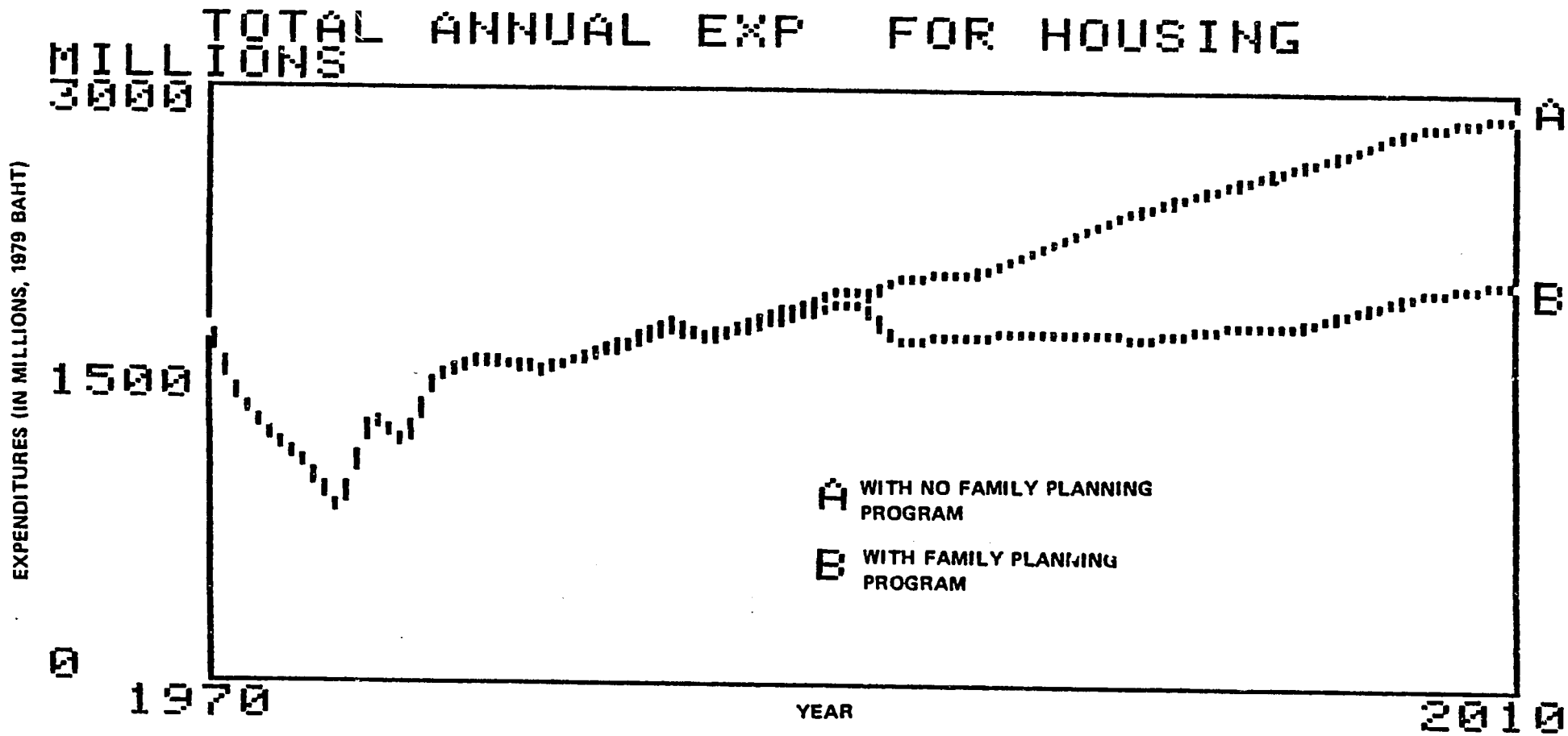


Figure 8.
Total annual housing expenditures

mother and child care, care of the mentally ill, fire protection, and other social services. Information on expenditures in these categories from 1970 to 1980 is from Thailand's Budget in Brief (Fiscal Years, 1970-1981). Per capita current and capital expenditures are held constant after 1980 at 63 baht per capita current expenditure and 330 baht per additional person for per capital expenditure.

Other social service costs are calculated as follows:

$$TOSSE_t = POP_t \times OSSCC_t + (POP_{t+1} - POP_t) \times OSSKC_t$$

where

$TOSSE_t$ = total other social service expenditures at time t

POP_t = the size of the population at time t

$OSSCC_t$ = per capita current other social service expenditures at time t

$OSSKC_t$ = other social service capital expenditures per additional person

Figure 9 shows the total annual expenditures for other social services. In Projection A they rise from 2,000 million baht in 1970 to 3,500 million baht by 1980 and 6,500 million baht by 2010. With the Family Planning Program projection (B) they are 7 percent less in 1980, 11 percent less in 1990, 14 percent less in 2000 and 17 percent less in 2010. Cumulative savings from 1970 to 2010 are 21,000 million baht.

3.6 Total Expenditures

Adding together the expenditures for education, health, housing infrastructure and other social services yields total expenditures for these sectors. They are shown in Figure 10. The savings resulting from the family planning program amount to 3,300 million baht in 1980; 8,500 in 1990; 6,700 in 2000; and 10,100 million baht in 2010. The cumulative savings from 1970 to 2010 are 235,000 million baht.

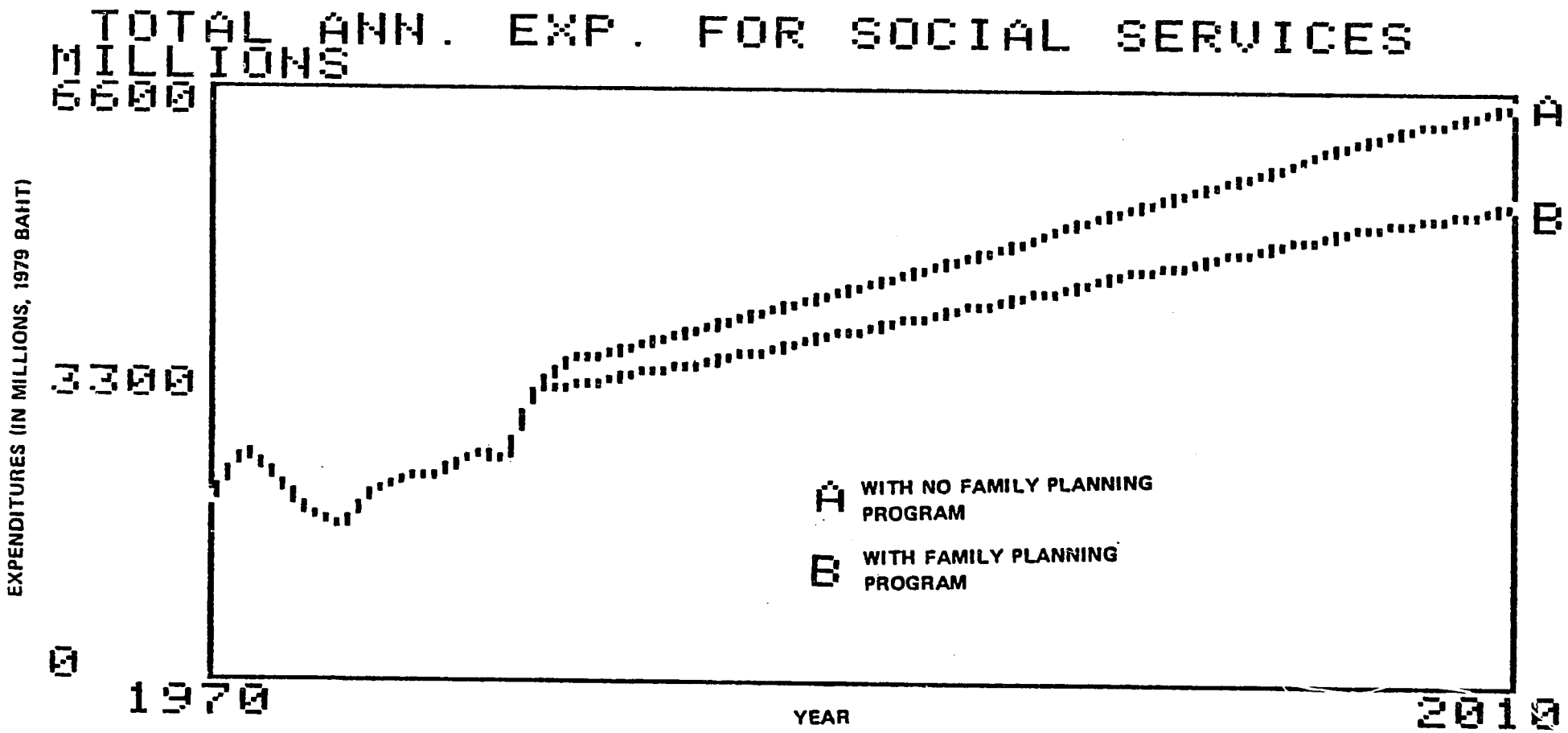


Figure 9.
Total annual social services expenditures

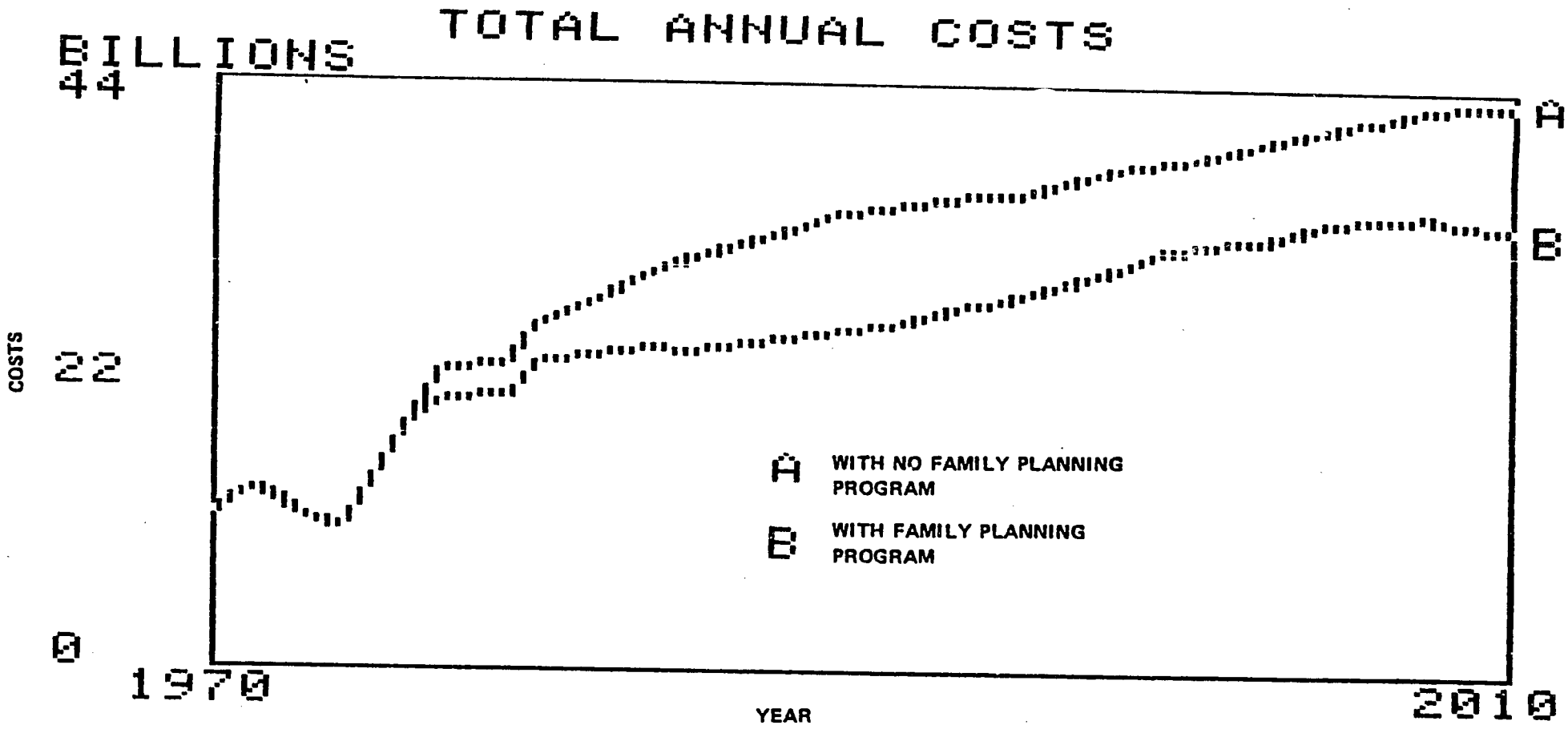


Figure 10.
Total annual costs.

4. Evaluation of Average Return to Investment in the 1972-1980 National Family Planning Program

In the first part of the paper, we examined the effectiveness of public expenditure on the family planning program and derived enough information to calculate the costs of births averted throughout the program. In the second part, we estimated future savings to the public in terms of government expenditures averted due to births averted. A logical final step is to bring these results together by comparing expenditures and savings, or costs and benefits, in order to compute the rate of return to public investment in the NFPP. There are several ways to do this; in this part of the paper we present costs and benefits from three different perspectives.

4.1 Definitions and perspectives

Three measures of the costs and benefits of the NFPP will be shown for three different cases. The three measures are: average cost per birth averted, average benefit per birth averted, and returns to one birth averted in the program. The three perspectives from which these measures will be shown are: Case One--only the costs and benefits which occurred in the period 1972-1980 are included, thus this case presents the minimal total benefits; Case Two--the costs of averting births between 1972-1980 are compared to the benefits extending from 1972-2010 from births averted in 1972-1980; Case Three--the actual costs of averting births between 1972-1980 plus the projected costs of averting births between 1981-2010, at the 1980 rate of five (5) baht per capita, are compared to the benefits from births averted 1972-2010.

In Figure 11, the annual family planning expenditures occurring in Projection B are compared with the annual savings resulting from reduced fertility. Family planning expenditures never exceed savings. In 1975 the

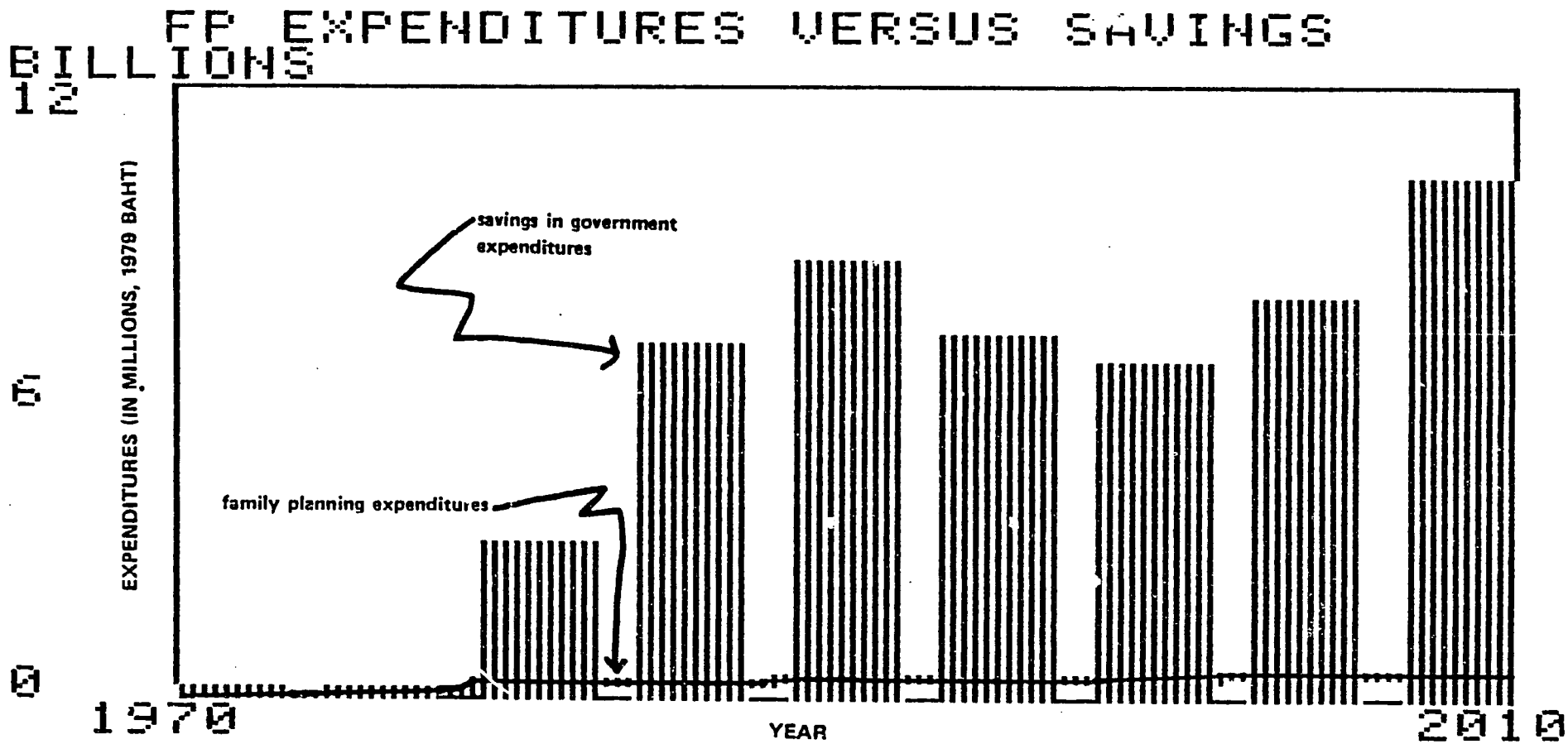


Figure 11.

Annual family planning expenditure vs. annual savings in government expenditure

savings of nearly 220 million baht far exceed the expenditure of 78 million baht. Thereafter, the net savings continue to grow, reaching over 9,700 million baht by 2010.

The savings resulting from the family planning program get larger the farther into the future we look. However, savings very far in the future are not as important to us us today as savings or expenditures made today. For example, if we had a choice of saving 1 million baht today or 10 years from today, we would choose to have it today, since those savings could be invested and would be worth much more than 1 million baht 10 years from now. If money could be invested to earn 10 percent interest per year, then 1 million baht today would be equivalent to 1.1 million baht next year.

This same concept can be applied to the savings and expenditures of family planning to determine the present value of future savings, called benefits, and expenditures, called costs. Since the NFPP involves two streams of benefits and costs over time, it is necessary to make these two streams comparable. The most common way to do this is to discount both streams back to the beginning of the project period. Thus, future benefits and costs are converted to present value by finding the amount today which, if invested at some given compound interest rate, would yield those future benefits or costs. This interest rate is called the discount rate.

The appropriate discount rate is not easy to define since it represents the degree to which society values present consumption versus future consumption. In this paper, we have used the Central Bank of Thailand's rate, the rate at which the Central Bank lends to the country's other banks, of 13½ percent. Using 13½ percent as the discount rate, we can calculate the present value in 1972 of costs and benefits for different time periods (Cases One, Two, and Three).

4.2 Case One: Costs 1972-1980 and benefits 1972-1980 from births averted 1972-1980

First, let us define:

A_t = Births averted in year t through the NFPP

B_t = Government expenditure averted in year t because of the births averted in 1972-1980

C_t = Amount of bahts that the Thai government and foreign donors invested in the NFPP in year t

i = Discount rate = .135

then,

DTB_T = Discounted total benefits to year T

$$= \sum_{t=1972}^{T} \frac{B_t}{(1+i)^{t-1972}}$$

DTC = Discounted total cost between 1972 and 1980

$$= \sum_{t=1972}^{1980} \frac{C_t}{(1+i)^{t-1972}}$$

BB_T = Average benefit up to year T of each birth averted between 1972-1980 through the program

$$= \frac{DTB_T}{\sum_{t=1972}^{1980} A_t}$$

CB = Average cost of each birth averted between 1972 and 1980

$$= \frac{DTC}{\sum_{t=1972}^{1980} A_t}$$

and

AR_T = Average return up to year T to a baht invested in the NFPP during the period 1972-1980

$$= \frac{DTB_T}{DTC}$$

$$= \frac{BB_T}{CB_o}$$

When both benefits and costs are restricted to the time period 1972-1980 (i.e. T=1980), then the return to 1 (one) baht invested in the NFPP is 7.22 baht (See Table 8). This suggests that the program quickly paid for itself.

TABLE 8. COSTS, BENEFITS AND RETURNS TO THE NFPP[1]

Case Period	Total Discounted Benefits (Millions of Baht)	Total Discounted Costs (Millions of Baht)	Average Benefit per Birth Averted (Baht)	Average Cost per Birth Averted (Baht)	Returns to Investment (Baht)
Case One 1972-1980*	4,647	644	1,963	272	7.22
Case Two 1972-2010**	14,387	644	6,082	272	22.36
Case Three 1972-2010***	22,163	1,359	1,373	84	16.31

*Births averted 1972-1980, costs 1972-1980, benefits 1972-1980
**Births averted 1972-1980, costs 1972-1980, benefits 1972-2010
***Births averted 1972-2010, costs 1972-2010, benefits 1972-2010

[1]All figures are expressed in 1979 baht discounted to 1972 at 13.5 percent.

4.3 Case Two: Costs 1972-1980 and benefits 1972-2010 from births averted 1972-1980

Here we use the same definitions as in Case One, except that we compute discounted total benefits to 2010 (i.e. T = 2010). These are benefits deriving from funds spent to avert births between 1972 and 1980. When these potential long run benefits are added to the actual, or historic benefits of 1972-1980, then the return to one baht invested in the program during 1972-1980 increases to 22.36 baht (see Table 8), which is about three times as large as the returns in Case One.

4.4 Case Three: Actual costs 1972-1980 plus projected costs 1981-2010 and benefits 1972-2010 from births averted 1972-2010

In this case, we examine the results of continued government expenditure for the NFPP, assuming that the per capita expenditure rate remains constant from 1981-2010 at the 1980 rate of five baht per capita. Our terms change slightly to reflect the extended time period under consideration:

DTB_T = Discounted total benefits to year T (2010)

$$= \sum_{t=1972}^{T=2010} \frac{B_t}{(1+i)^{t-1972}}$$

DTC = Discounted total costs between 1972 and 2010

$$= \sum_{t=1972}^{T=2010} \frac{C_t}{(1+i)^{t-1972}}$$

BB_T = Average benefit up to year T = 2010 of each birth averted between 1972 and 2010 due to the NFPP

$$= \frac{DTB_T}{\sum_{t=1972}^{2010} A_t}$$

CB = Average cost of each birth averted between 1972 and 2010

$$= \frac{DTC}{\sum_{t=1972}^{2010} A_t}$$

AR_T = Average return up to year T = 2010 to one baht invested in the NFPP during the period 1972-2010

$$= \frac{DTB_T}{DTC}$$

Calculating this third case, the present value of family planning expenditures (discounted to 1972) becomes 1,359 million baht (1979 baht). The present value of government savings becomes over 22,163 million baht. Therefore, the ratio of benefits to costs is 16.31 to 1 (See Table 8).

Besides examining the ratio of costs to benefits for Case Three, we have also calculated internal rates of return for each sector. The rate of return can be compared with the cost of capital to determine if the investment is a sound one. If the rate of return is higher than the cost of capital, then it makes sense to invest money to earn that rate of return; if it is lower, it would make more sense to invest the money elsewhere. The internal rate of return is calculated by finding the discount rate which will give a net present value of zero, where net value is total savings minus total costs.

Results from the analysis are as follows:

Sector	Internal Rate of Return
Education	100 %
Health	N/A
Housing and infrastructure	5 %
Other social services	15 %

The internal rate of return could not be calculated for the health sector because the costs for the family planning program never exceed health savings resulting from the program. Since the total costs sector is comprised of the results from the health sector, a total internal rate of return also could not be calculated.

As can be seen from the results presented above, the internal rate of return for the education sector is extremely high when compared with both the cost of capital (about 20 percent), as well as the other sectors. It is significantly higher than the IRR for the other sectors because educational expenditures alone comprise over 62 percent of the total expenditures for social services. Since the expenditures, on a per capita basis, are the highest for education, each birth averted results in a savings (discounted to the first year) of nearly 14,600 baht over a twenty-year period. Discounted savings from health, the second highest social service expenditure category, for the same twenty-year period amount to only 1,476 baht or 10 percent of that saved through education. Savings from the housing and other social service sector represent only 3 percent and .6 percent of savings from the education sector, respectively.

The internal rate of return for all sectors together would exceed 110 percent. This is sufficiently high to make the family planning program a very attractive government investment. Even if money had to be borrowed at today's high commercial market rates, the interest rate would not exceed 20 percent. A rate of return of 110 percent is far above any likely cost of capital to fund the family planning program.

It might also be interesting to compare the economic return to the family planning program with the economic return to other public investments. Table 9

lists the economic returns of four recent public investment projects in Thailand which are financed by the World Bank. The rate of return to the family planning program is even higher than the very high rate of return to energy development.

Table 9.

Economic Rate of Return to World Bank Financed Public Investment in Thailand

Investment Project	Economic Rate of Return
Power Generation	12%
Road Improvement	20%
Irrigation	23%
Energy Development	53%

Sources: Various issues of the World Bank News Release.

4.5 Sensitivity of benefit-cost ratio to the estimated family planning expenditure coefficient

Since the calculated cost of the NFPP is determined by the estimated effectiveness of the program in reducing fertility which is measured by the family planning expenditure coefficient (β_2) in the fertility equation, we would like to check how sensitive the benefit-cost ratio is with respect to the value of the estimated β_2 coefficient. Let us assume a statistically very unlikely situation where the true effectiveness of the program is much less than what we estimated and the true value of β_2 is two standard error of estimate below its estimated value. Then we subtract twice the value of the standard error of estimate of β_2 (.027067) from the estimated β_2 (.073393) and derived a low estimate of β_2 (.019259). By using this new value to project fertility rate, population, and sectoral expenditures, we get a benefit-cost ratio of 5.24 to 1 and an internal rate of return of 70 percent. The still highly favorable rate of return in the new result suggests that the conclusion about the high profitability of the NFPP is statistically sound.

5. Planning for Future Family Planning Program

5.1 Planning for the Future

The model that we have developed in Chapters 2,3,and 4 can also be used as a tool for planning future expenditure levels of the NFPP. To Planners, an analysis of future alternatives probably is just as important, if not more important than, an evaluation of past performance. The various benefit-cost ratios obtained in Chapter 4 do not necessarily offer guidance for determining an optional expenditure pattern for future family planning program efforts. Nor do they provide an answer to the question of the level of resources the government should be prepared to invest if a specific goal of the NFPP is to be achieved. In order to derive this additional kind of information for planning, we must go beyond the scope of average analysis and into marginal analysis.

5.2 Marginal Analysis of Returns to Future Investment in NFPP

A marginal return to the family planning program is defined as the increase in government savings as a result of additional expenditure in FPP above the current level. We proceed to simulate marginal returns of various levels of increase in FPE from the 1980 level of five baht per capita. In each case, we assume family planning expenditure per capita starts to rise gradually from 1981 and reaches the specified level by 1985 and remains at the new level thereafter. By comparing the future costs and savings (all discounted back to 1981) from 1981 to 2010 under the new FPE level to those under the constant 5 Baht level, one can derive a measure of the economic profitability of that additional spending for the NFPP. Table 10 summarizes the calculated marginal return to NFPP for different levels of increase in FPE.

Table 10

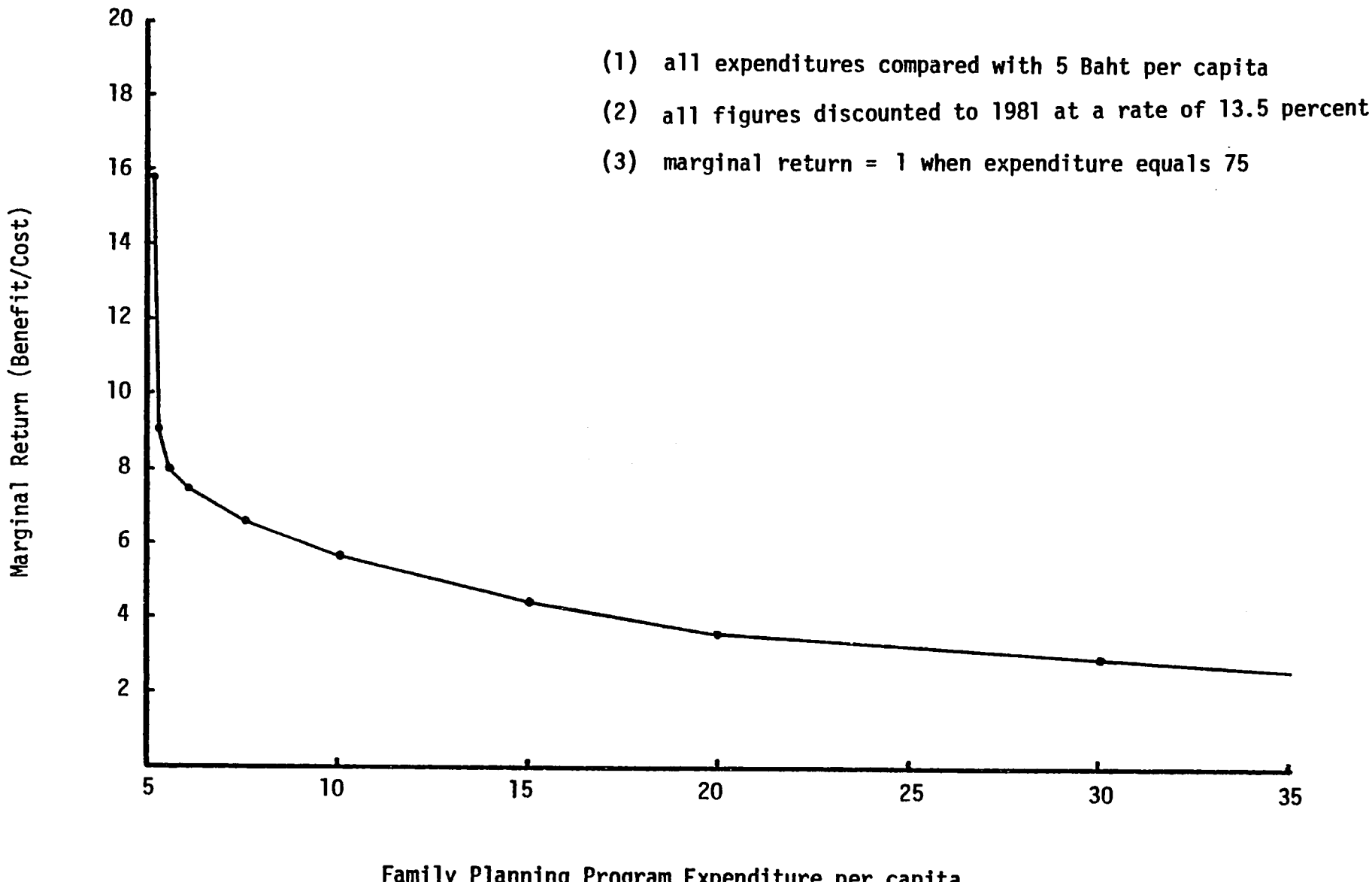
Marginal Return to Family Planning Program

FPE	Percentage Increases from 1980 Level of FPE	Marginal Benefit Cost Ratio
5.05	1%	15.85
5.25	5%	8.99
5.50	10%	8.05
6.0	20%	7.44
7.50	50%	6.63
10.00	100%	5.67
15.00	200%	4.38
20.00	300%	3.52
75.00	1400%	.99

Figure 12 demonstrates the general shape of a marginal return curve. The curve reflects diminishing impact on fertility of additional expenditure for the family planning program. The marginal benefit-cost ratio drops off quickly at the beginning but decreases at a very low rate after the expenditure is increased to 6 baht per capita.

The marginal benefit-cost ratio of an expenditure level of 5.5 baht per capita is 8.05. It is substantially lower than the average benefit-cost ratio of the 1972-1980 period but still high enough to justify further expansion of the national family planning program. It does not necessarily follow that the government should expand the program to the level (75 Baht) at which the marginal benefit-cost ratio equals one. How much expansion should be attempted

Figure 12 Marginal Return Curve of Family Planning Program Expenditure



depends upon the amount of resources available to the government and the importance or the profitability of other competing activities.

5.3 Marginal Return to the Proposed 1982-1986 NFPP Expenditure Level

In the Fifth Five Year Plan, it is projected that the annual total expenditure on NFPP will increase from 308 million baht (6.36 Baht per Capita) in 1982 to 470 million baht (8.95 baht per Capita) in 1986.[1] Planners may wish to know the marginal return to this projected increase in family planning expenditure over the 1980 level. It can be calculated in the same way as in Section 5.2. However, because of the five-year population projection nature of the programmed model, we have to assume this new expenditure pattern started in 1981 instead of 1982 and that per capita expenditure reaches 8.95 in 1985 and remains constant thereafter. The newly calculated marginal benefit-cost ratio turns out to be 6.04 to 1 and a high economic return to the proposed new budget of NFPP is thus confirmed.

5.4. Required Level of NFPP Expenditure to Achieve the Demographic Goal Set in the Fifth Five Year Plan

One of the main population objectives in the Fifth Five Year Plan is to reduce the population growth rate to approximately 1.5% by the end of 1986.[2] Again, planners will need to know how much it will cost the government during those five years to achieve this ambitious goal.

The procedure of obtaining an estimate of the required level of expenditures is as follows. First, from the target population growth rate

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[1]Project Paper: Thailand, Population Planning II. July, 1981, USAID/Bangkok.

[2]Population Plan: 1982-1986. The National Economic and Social Development Board, August 1981.

and assumed death rate in 1986, we calculate the target birth rate in 1986. By assuming that the birthrate in Thailand declines linearly from the present level in 1980 to the target rate in 1986, we can calculate annual birth rates from 1981 to 1986. With these target birth rates, corresponding total fertility rates can also be calculated. Utilizing the estimated fertility equation in Section 2 and the projected increases of GDP per capita, the required annual level of family planning expenditure per capita to achieve those target fertility rates can finally be calculated. Table 11 reports the final results. The required cumulative total family planning program expenditure for the 1982-86 period, according to our model, is 2,769 million Baht. The official projected budgets for the NFPP during those five years add up to only 1,897 million Baht. The implication is quite clear; if our model is correct, the government has to increase its planned NFPP expenditure substantially for the next five years by 872 million baht in order to achieve the demographic goal it has set for itself.

Table 11.

Required Level of Family Planning Expenditure to Reduce Thailand's Natural Growth Rate to 1.5 in 1986 Versus Actual NFPP Budget

Year	Required NFPP Expenditure Per Capita (baht)	Required Total Expenditure (Million baht)	Actual NFPP* Budget (Million baht)
1982	7.28	351.41	308.24
1983	8.79	432.29	334.30
1984	10.61	531.35	368.72
1985	12.81	652.93	415.78
1986	15.46	801.29	470.09
Total		2,769.27	1,897.13

* Project Paper: Thailand, Population Planning II. July, 1981, USAID/Bangkok.

6. Summary and Conclusion

In this study we have analyzed the cost and the benefit of Thailand's National Family Planning Program from the government's point of view, with a consistent focus on the public expenditures for family planning purposes. First, a new set of regional data were used to apply a multivariate regression technique which estimated the net effect of Thailand's public family planning program on its recent fertility decline. By controlling the level of income, the marginal effect of the family planning program was more accurately identified. The empirical result was statistically significant and confirmed the belief that the NFPP in Thailand contributes substantially to the reduction of the fertility rate. The calculated percentage decrease in the total fertility rate which is attributable to the NFPP effort is an impressive sixty-eight percent. Furthermore, because of the high and increasing family planning program expenditure elasticity, the family planning program will remain an effective way of controlling population growth. The government should strongly consider increasing its family planning program budget if an early date for reaching the replacement level of fertility is desired.

The effect of the fertility reduction, brought about by the NFPP effort between 1972 and 1980, to future government savings in terms of expenditures averted is equally impressive. Even with a high discount rate, the calculated average monetary return to a baht invested in the NFPP is 22.36 baht. The high internal rate of return of about 110 percent makes public spending for the NFPP an investment opportunity that few others can match in terms of yields.

We also found that the marginal return to additional expenditure on family planning program above the current level is still very high. Thus on a purely economic ground, the Royal Thai Government has every reason to step up its support of the program. After examination of the projected budget of the NFPP for the period 1982-1986 we conclude that, on the one hand, the proposed total expenditure for future family planning program is well justified because of the high returns it generates; but on the other hand, the proposed budget is not sufficient to achieve the demographic goal that the government has set for itself.

Overall, our findings unequivocally suggest that the National Family Planning Program in Thailand is a very effective tool for reducing the fertility rate and an extremely attractive investment opportunity for reducing future government spending on social services. Since the magnitudes of various measure of returns are so large, even if there is some degree of overestimation involved in the calculation procedure, the basic conclusion reached here would probably not be substantially altered.

Appendices

A. Data and Data Sources

TABLE A1. DEMOGRAPHIC AND SOCIOECONOMIC INDICES OF THAILAND BY REGION FOR VARIOUS YEARS

Year and Region	Total Fertility Rate	Income per Capita (INP) (1972 prices in Baht)	Family Planning Expenditure per capita (FPE) (in Baht)
1962			
North	6.36	2300	0.0
Northeast	6.97	1540	0.0
Central	6.06	4240	0.0
South	6.52	2900	0.0
1967			
North	5.71	2800	0.0
Northeast	7.20	1860	0.0
Central	5.32	5820	0.0
South	6.48	3400	0.0
1972			
North	4.39	3280	1.03
Northeast	6.32	2100	1.03
Central	3.63	7220	1.03
South	6.17	4140	1.03
1975			
North	3.74	3680	1.83
Northeast	6.25	2360	1.83
Central	3.93	8320	1.83
South	6.12	4360	1.83
1978			
North	3.35	4180	3.87
Northeast	4.18	2560	3.87
Central	3.60	10280	3.87
South	5.29	5540	3.87

Sources:
(1) Fertility and Mortality Changes in Thailand, 1950-1975. Report No. 2 of the Committee on Population and Demography. National Academy of Sciences, Washington, D.C. 1980.
(2) Income, Consumption and Poverty in Thailand, 1962-63 to 1975-76. World Bank Staff Working Paper No. 364. November 1979.
(3) Internal tabulations from the Department of Health, Ministry of Public Health, RTG.
(4) Internal tabulations from the National Statistical Office of the RTG.

TABLE A2. STATISTICAL DESCRIPTION OF THE DATA

Variable	Maximum Value	Minimum Value	Mean	Standard Deviation
TFR	7.20	3.35	5.38	1.26
INP	10,280	1,540	4,144	2,288
FPE	3.87	-0-	1.35	1.47

Appendix B.

Variables Contained in the Program Which Can be Changed by the Operator

SECTOR	VARIABLE
1. Demographic Calculation	A. Type of Analysis to be Performed 1. Average Return 2. Marginal Return
	B. Case to be Examined Case One: Births Averted 1972-1980, Costs 1972-1980, Benefits 1972-1980 Case Two: Births Averted 1972-1980, Costs 1972-1980, Benefits 1972-2010 Case Three: Births Averted 1972-2010, Costs 1972-2010, Benefits 1972-2010
	C. Total Fertility Rate
	D. Life Expectancy at Birth
	E. Rate of Annual Increase in Gross National Product Per Capita
	F. Per Capita Expenditure on Family Planning
	G. Percentage Increase in Future Per Capita Family Planning Program Expenditure
	H. Family Planning Expenditure Coefficient
	I. Gross National Product Per Capita Coefficient
2. Education	A. Annual Current Cost Per Primary Student (1980, 1169 baht)
	B. Annual Capital Cost Per Primary Student (1980, 15716.5 baht)
	C. Primary Enrollment Rate (1970, 83%; 1975, 83%; 1980, 89.41%; 1985, 96.32%; 1990, 100%)
	D. Annual Current Cost Per Secondary Student (1980, 1133.7 baht)
	E. Annual Capital Cost Per Secondary Student (1980, 19034.4 baht)
	F. Secondary Enrollment Rate (1970, 27%; 1975, 27%; 1980, 29.81%; 1985, 32.91%; 1990, 36.34%; 1995, 40.12%; 2000, 44.3%; 2005, 48.91%; 2010, 54%)

3.	Health	A. Annual Current Cost Per Person (1980, 6.7 baht) B. Annual Capital Cost Per Person (1980, 952.4 baht)
4.	Housing Infrastructure	A. Annual Current Cost Per Person (1980, 8.5 baht) B. Annual Capital Cost Per Person (1980, 4083 baht)
5.	Other Social Services	A. Annual Current Cost Per Person (1980, 63.1 baht) B. Annual Capital Cost Per Person (1980, 330.3 baht)
6.	Total Costs	A. Year to Which the Savings and Expenditures Should be Discounted B. Discount Rate to be Applied C. Year in Which the Calculation of the Return is to Begin D. Level and Year Crude Birth Rate Target is to be Achieved E. Level and Year Rate of Natural Increase Target is to be Achieved

DATABASE PROGRAM

1. Population in 1965
2. Population in 1970 by 5-year age groups
3. Total population in 1970
4. Total fertility rate in 1970
5. Fertility age distribution (%) by 5-year age groups (15-44) in 1970
6. Percent of 15-44 age group of that is female in 1970
7. Life expectancy in 1970
8. % of 5-14 age group of primary school age in 1970
9. % of 10-19 age group of secondary school age in 1970
10. Population per physician in 1970
11. Average household size in 1970

TOTAL POPULATION
MILLIONS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	36.83	36.83
1971	37.86	37.86
1972	38.95	38.81
1973	40.06	39.77
1974	41.19	40.73
1975	42.35	41.68
1976	43.54	42.63
1977	44.77	43.58
1978	46.03	44.54
1979	47.32	45.51
1980	48.62	46.48
1981	49.94	47.47
1982	51.29	48.47
1983	52.68	49.47
1984	54.09	50.47
1985	55.51	51.49
1986	56.95	52.53
1987	58.4	53.6
1988	59.87	54.69
1989	61.36	55.8
1990	62.85	56.92
1991	64.35	58.05
1992	65.88	59.2
1993	67.43	60.38
1994	69	61.58
1995	70.57	62.78
1996	72.15	63.97
1997	73.74	65.17
1998	75.34	66.37
1999	76.96	67.58
2000	78.57	68.77
2001	80.18	69.95
2002	81.8	71.11
2003	83.43	72.28
2004	85.08	73.45
2005	86.75	74.61
2006	88.42	75.77
2007	90.09	76.91
2008	91.72	78.01
2009	93.28	79.04
2010	94.81	80.03

TOTAL BIRTHS
THOUSANDS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	1412.86	1412.86
1971	1445.56	1445.56
1972	1491.99	1391.26
1973	1517.16	1376.22
1974	1542.75	1361.34
1975	1568.76	1346.62
1976	1607.12	1351.85
1977	1650.68	1352.06
1978	1695.43	1352.28
1979	1741.39	1352.5
1980	1788.59	1352.71
1981	1784.08	1368.94
1982	1807.17	1382.78
1983	1830.57	1396.76
1984	1854.26	1410.87
1985	1878.27	1425.14
1986	1882.29	1465.24
1987	1900.04	1486.68
1988	1917.96	1508.44
1989	1936.04	1530.51
1990	1954.3	1552.9
1991	1979.18	1581.98
1992	1995.16	1596.72
1993	2011.28	1611.6
1994	2027.53	1626.63
1995	2043.91	1641.79
1996	2048.97	1636.68
1997	2060.08	1637.97
1998	2071.25	1639.26
1999	2082.48	1640.54
2000	2093.77	1641.83
2001	2101.97	1623.44
2002	2111.3	1618.67
2003	2120.67	1613.91
2004	2130.09	1609.17
2005	2139.55	1604.45
2006	2146.34	1600.99
2007	2154.94	1596.7
2008	2163.59	1592.42
2009	2172.26	1588.15
2010	2180.98	1583.9

BIRTHS AVERTED
THOUSANDS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	0	0
1971	0	0
1972	100.73	100.73
1973	140.94	140.94
1974	181.41	181.41
1975	222.15	222.15
1976	255.27	255.27
1977	298.62	298.62
1978	343.15	343.15
1979	388.89	388.89
1980	435.88	435.88
1981	415.14	415.14
1982	424.4	424.4
1983	433.81	433.81
1984	443.39	443.39
1985	453.13	453.13
1986	417.04	417.04
1987	413.35	413.35
1988	409.52	409.52
1989	405.53	405.53
1990	401.4	401.4
1991	397.2	397.2
1992	398.44	398.44
1993	399.68	399.68
1994	400.91	400.91
1995	402.12	402.12
1996	412.29	412.29
1997	422.12	422.12
1998	432	432
1999	441.94	441.94
2000	451.94	451.94
2001	478.53	478.53
2002	492.63	492.63
2003	506.76	506.76
2004	520.92	520.92
2005	535.1	535.1
2006	545.35	545.35
2007	558.25	558.25
2008	571.17	571.17
2009	584.11	584.11
2010	597.08	597.08

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TOTAL ANNUAL EDUCATIONAL EXPENDITURES
BILLIONS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	6.42	6.42
1971	7.26	7.26
1972	7.19	7.19
1973	6.51	6.51
1974	6.3	6.3
1975	9.07	9.07
1976	11.61	11.61
1977	14.15	12.41
1978	14.62	12.78
1979	14.41	12.41
1980	16.7	14.12
1981	17.1	14.36
1982	17.84	14.63
1983	18.82	14.8
1984	19.64	13.97
1985	20.13	14.15
1986	20.4	14.44
1987	20.81	14.67
1988	21.45	14.69
1989	21.99	14.71
1990	22.2	14.98
1991	22.26	15.42
1992	22.33	15.84
1993	22.23	16.17
1994	22.07	16.47
1995	22.13	16.83
1996	22.43	17.23
1997	22.8	17.75
1998	23.13	18.48
1999	23.36	19.13
2000	23.58	19.37
2001	23.85	19.39
2002	24.18	19.52
2003	24.56	19.86
2004	24.92	20.21
2005	25.23	20.36
2006	25.54	20.42
2007	25.79	20.34
2008	25.84	19.8
2009	25.77	19.19
2010	25.89	19.19

TOTAL ANNUAL HEALTH EXPENDITURES
MILLIONS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	1552	1552
1971	1959	1959
1972	1822.93	1770
1973	1693.32	1623
1974	1523.3	1444
1975	2184.71	2061
1976	3629.23	3400
1977	4370.06	3957
1978	3988.2	3633
1979	4296.43	3880
1980	4550.2	4086
1981	4666.68	4163.21
1982	4790.32	4234.77
1983	4909.96	4306.4
1984	5018.72	4387.13
1985	5125.99	4476.19
1986	5239.63	4569.79
1987	5355.46	4665.79
1988	5466.39	4758.78
1989	5574.09	4846.23
1990	5686.6	4932.93
1991	5809.05	5027.49
1992	5937.48	5131.93
1993	6058.82	5230.24
1994	6168.88	5310.76
1995	6279.13	5385.01
1996	6398.81	5468.32
1997	6523.31	5560.67
1998	6639.18	5644.52
1999	6744.06	5711.04
2000	6850.62	5774.15
2001	6968.62	5846.46
2002	7096	5926.06
2003	7222.19	6004.11
2004	7342.64	6078.06
2005	7464.43	6154.06
2006	7577.2	6221.14
2007	7650.83	6251.33
2008	7698.48	6259.08
2009	7774.62	6297.88
2010	7878.36	6365.2

TOTAL ANNUAL EXP. FOR HOUSING
MILLIONS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	1810	1810
1971	1412	1412
1972	1231.08	1230
1973	1076.95	1075
1974	870.45	868
1975	1337.34	1332
1976	1194.38	1188
1977	1566.65	1556
1978	1645.67	1632
1979	1630.01	1614
1980	1607.23	1589
1981	1655.65	1634.65
1982	1707.57	1683.57
1983	1761.1	1733.85
1984	1837.13	1806.43
1985	1783.12	1748.97
1986	1835.63	1798.1
1987	1889.51	1848.68
1988	1944.83	1900.74
1989	1992.7	1945.43
1990	1987.08	1936.67
1991	2070.8	1753.2
1992	2084.64	1775.5
1993	2102.9	1789.3
1994	2141.28	1792.63
1995	2196.34	1798.2
1996	2263.34	1805.11
1997	2341.66	1798.77
1998	2410.95	1788.01
1999	2455.45	1795.1
2000	2489.62	1820.52
2001	2531.18	1843.96
2002	2581.8	1848.99
2003	2632.85	1853.11
2004	2679.94	1881.53
2005	2728.59	1927.35
2006	2780.87	1775.15
2007	2828.9	2019.58
2008	2864.23	2054.56
2009	2884.59	2072.79
2010	2897.61	2081.24

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TOTAL ANN. EXP. FOR SOCIAL SERVICES
MILLIONS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	1980	1980
1971	2534	2534
1972	2239	2239
1973	1858	1858
1974	1698	1698
1975	2165	2165
1976	2276	2276
1977	2322	2322
1978	2532	2532
1979	2444	2444
1980	3257	3257
1981	3597.19	3324.71
1982	3693.55	3369.02
1983	3789.87	3453.53
1984	3883.49	3521.35
1985	3977.15	3592.59
1986	4073.47	3666.24
1987	4171.23	3741.69
1988	4268.01	3817.1
1989	4364.15	3891.38
1990	4462.25	3965.91
1991	4564.28	4043.62
1992	4669.25	4125.5
1993	4772.8	4206.34
1994	4873.12	4281.79
1995	4973.67	4355.03
1996	5077.65	4431.13
1997	5183.83	4510.48
1998	5287.72	4587.35
1999	5388.1	4658.3
2000	5488.87	4727.44
2001	5593.5	4799.03
2002	5701.77	4872.85
2003	5810.36	4946.17
2004	5917.61	5018.02
2005	6025.68	5090.37
2006	6131.01	5159.52
2007	6222.75	5215.41
2008	6303.84	5261.54
2009	6392.19	5315.67
2010	6488.89	5378.42

TOTAL ANNUAL COSTS
BILLIONS

YEAR	PROJECTION	
	EXPECTED	ACTUAL
1970	11.76	11.76
1971	13.17	13.17
1972	12.48	12.43
1973	11.14	11.07
1974	10.39	10.31
1975	14.76	14.63
1976	18.71	18.48
1977	22.41	20.25
1978	22.78	20.58
1979	22.78	20.34
1980	26.11	23.05
1981	27.02	23.48
1982	28.03	23.94
1983	29.28	24.29
1984	30.38	23.68
1985	31.01	23.97
1986	31.55	24.48
1987	32.22	24.92
1988	33.13	25.16
1989	33.92	25.39
1990	34.33	25.82
1991	34.71	26.25
1992	35.02	26.87
1993	35.16	27.39
1994	35.25	27.85
1995	35.58	28.37
1996	36.17	28.94
1997	36.85	29.62
1998	37.46	30.5
1999	37.95	31.29
2000	38.41	31.69
2001	38.94	31.88
2002	39.56	32.17
2003	40.23	32.66
2004	40.86	33.18
2005	41.45	33.53
2006	42.03	33.77
2007	42.49	33.82
2008	42.71	33.38
2009	42.82	32.87
2010	43.15	33.02

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