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AN ECONOMIC ANALYSIS OF PAKISTAN'S INVESTMENT IN POPULATION CONTROL

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Abstract. This article aims at presenting an economic analysis of Pakistan Government's investment in population control programme during the period 1965-88. This period was selected because of its importance in the history of population control in Pakistan. Economic analysis in die context of this research implies an estimation of economic returns from public expenditure on the government's approved population control measures. A study focused on the calculations of the monitory benefits of averted births for an assessment of economic returns was completed in 1994. A new Averted Births Based (ABB) model was developed for this purpose. The set of assumptions were made largely to escape tricky issues like data inconsistency, and to isolate the influence of socio-economic variables which necessitate controlled experiments and surveys. The study concluded that benefits from population control programme in Pakistan far exceeded the costs.

I. OBJECTIVES

This paper has the following objectives:

1. To access and analyze the Government of Pakistan's investment in population control programmes and its economic returns.
2. To collect relevant quantitative data from secondary sources, consolidate and convert this data into specific format for calculating economic returns from population control programme of Pakistan.
3. To develop a sophisticated research tool, *i.e.* Averted Births Based (ABB) model which could isolate the influence of complex socio-economic variables to calculate economic returns from a population control programme for a given society.

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II. INTRODUCTION

Unchecked and rapid population growth has been a major stumbling block in the way of socio-economic development in most of the developing countries. Usually the positive impact of development initiatives is cancelled out due to corresponding increase in the number of individuals added to the society. Unbridled growth in population needs unlimited resources to maintain and improve its living standards. Since, resources are limited therefore we have no option but to control the population to a manageable extent.

Investment in population control programmes has been a hotly debated issue in the developing countries for the last five decades. Over the years, international financial institutions have been lending millions of dollars for population control programmes with the assumption that problems of under-development and poverty could be best addressed by decreasing the human fertility. Additionally, population control programmes are perceived to be the best approach to improve reproductive health, reduce the incidence of mother and infant morbidity and mortality. Nevertheless, this is a complex issue. Human fertility behaviour is regulated by socio-economic, cultural, ideological and institutional context of a society.

Notwithstanding these theoretical explications, policy planners are more interested to know the economic benefits of investment in population control. Without having exact answer to this question, political establishments in the developing countries may be reluctant to spend their scarce financial resources in this particular area. Additionally, result oriented donor agencies exert pressure on the recipient countries to provide quantitative figures regarding success of the population control programme.

The phrase economic return is vague and subject to various subjective interpretations, depending on the conceptual framework and intellectual background of the individual researcher. So the question is what precisely economic returns mean and how are they assessed? There could be various approaches to answer this question.

First, population control programme reduces the fertility rate and it would be easy for the society to improve the living standard of manageable number of individuals. However, it is a broad generalization and it is very difficult to pinpoint as to what extent population control programme actually reduces the fertility. Fertility behaviour is not exclusively influenced by population control programmes, but also with countless other variables. Further, decline in birth rate may be due to various socio-cultural factors, like migrations, age at marriage, women empowerment, norms regulating breast-feeding and gainful employment of women and their literacy rate. Admittedly, it is not possible to get sophisticated empirical data regarding the influence of all these variables.

Second, population control programmes improve the reproductive health by changing the knowledge, attitude and practice and thereby lowering the incidence of mother-child morbidity and mortality. The resultant economic impact would be more savings in the area of health care and disease management. But this method of assessing economic returns cannot accurately depict the contribution of population control programme because change in attitude and use of contraceptives cannot be ascribed merely to the efforts of population control network in the country. Other intermediate variables, *e.g.* education, audio-visual aids, exposure to western ways of life and the multiplicity of other factors can also be responsible for a change in attitude. So this type of assessment entails various methodological and empirical handicaps.

Third, owing to population control programmes, reduced population growth may lead to saving in public expenditure on social overheads like schools, hospitals, housing and transport. Theoretically, the argument is convincing but practically it is also very difficult to concretize the issue: how much society can save from social overhead expenditures by investing on population control programmes?

Fourth, averted births due to population control measures may bring monetary benefits like higher per capita income, more capital formation or reduced unemployment. This approach of assessing the returns of population control investment seems more amenable of scientific and mathematical investigation. Therefore, this paper focused on the calculation of monetary benefits of averted births for assessment of economic returns.

III. REVIEW OF LITERATURE

Over the years, social scientists from various disciplines have been trying to demonstrate that investment in population control programmes make good economic sense and ultimately rewarding for the well-being of society. Malthus (1798) warned that society would not be able to feed geometrical addition of individuals as the means of subsistence grow arithmetically. He feared that if unchecked growth was not arrested through planned efforts, population was bound to decrease by the operation of some automatic positive checks (like famine, wars and epidemics). Understandably, every society wants to avoid such 'positive checks'. Reduction of population through disease and hunger is universally acknowledged as 'human catastrophe' and therefore should be avoided.

Malthus was the first social scientist who linked economic prosperity with population growth. The underlying assumption of his theory was that the society has to incur a cost on the birth and upbringing of a child. If society produces children disproportionate to its resource base, it would be an over taxation on its resources on the one hand and lowering the quality of life of its members on the other hand. Hence, Malthus pleaded that population growth must be based on rational economic calculations. Recently, Lee and Feng (1999) argued that it was Malthus, who for the first time, traced a relationship between industrialized developed countries' affluence and their rational demographic behaviour. According to Lee and Feng (1999),

> "Lesser number of children not only encouraged individual savings and discouraged poverty, but also kept the prices of labour high and assured general prosperity. What we today term family planning required a uniquely Western ability to calculate concisely the cost and benefits of having children, and to decide deliberately to delay or abstain marriage. Prosperity, in other words, was a product of Western individualism and Western rationality."

Hence, the conclusion is that it is logical to control population to improve the quality of life. Society must invest in population control so that unchecked and ever-increasing numbers of births disproportionate to the resources of society may not convert the society into a hub of underprivileged human beings who live with inadequate facilities of education, health care and civic amenities. However, economic planners need hard facts before allocating budget for increasingly competitive development priorities, *i.e.* how much monetary benefits society gets if it invests in population control programme. Donors, too, may be interested to know the benefits with some mathematical precision.

Given the complexity of the issue, it is challenging to develop a model which could estimate the costs and benefits of investment in population control programme with precision. For the last five decades, various efforts have been made to develop such a model by isolating the influence of intervening variables to measure the return of investment in population control programme. Coale and Hoover (1958) tried to measure the economic benefits from a slower rate of population growth. They constructed an economic model of Indian economic growth. Assuming a given decline in fertility, they calculated its effects on aggregate and per capita incomes. Their model assumed that size and quality of the labour force were constant regardless of the fertility. Only monetized investment was considered and constant income was assumed to be spent on welfare to meet the needs of existing population. Evidently, Coale and Hoover's (1958) model neglected the cost of population control programme. Despite limitations, their model set a style and many prominent economists, *e.g.* Demeny (1961), Enke (1960, 1961, 1962, 1966), Ohlin (1967), Leibenstein (1969), Simon (1969) contributed significantly to the economic consequences of fertility reduction and related issues. Thus Coale and Hoover's analysis proved to be a 'search light' for further explorations in this field.

Enke (1957) presented the issue of investment in population control programmes in a different but innovative perspective. His analysis was based on the economic theory that a policy of maximizing per capita income would call for balancing the returns from all forms of investment at the margin. His study was a one-sector model containing a demographic sub-model and attempted direct calculations of the benefits of a prevented birth. Applying a rate of discount of 10%, he showed that since an individual does not begin producing during, at least, the first fifteen years of his/her life, the discounted present value of his/her production is almost zero. But he/she would start consuming as soon as he/she is born. Enke (1957) further refined his calculation by introducing the possibility that money saved from an averted birth may be re-invested which would enhance its value. Despite the fact that Enke's model has all the merits of being precise, predictable and consistent, it suffered two major weaknesses: first, his contention that transfer was simply a 'monetary operation' could not be accepted and second, his idea that per capita income was the sole welfare criterion may also be seriously questioned on valid grounds.

Based on Dublin and Lotka's (1945) framework, Meier (1959) developed a model for calculating benefits and cost of family planning programme and arrived at three conclusions. First, the net value of a prevented birth varied directly with per capita income; second, the value of medical innovation which reduced infant mortality would be negative in underdeveloped countries; and third, the economic value of an effective programme of family limitation was much greater for more developed societies. Overall, if one analyzes the merits of Meier's model, it seems more general and has least relevance with the realities in developing countries. In a nutshell, his model had a general applicability to health programme of developed countries.

Demeny (1965) investigated another relevant and crucial question that if cost and effectiveness of a birth control programme were known, what price would be worth paying for it? In his model, Demeny employed Coale and Hoover's 'saving function'. He assumed that the sole effect of population change was on per capita saving and thus on per capita investment. However, Demeny's approach has been criticized as being too narrow in the social and development contexts. It is argued that having a child is not just an economic liability, but an addition of family's productive capacity. A child has various non-economic advantages. Simon (1967) too had almost similar approach to look at the population issue. He estimated the increase in family saving due to fewer children. He also calculated the resulting increase in capital/labour ratio and the final rise in per capita income.

Zaidan (1967) refined Enke's model and applied it to measure economic returns of family planning programmes of Egypt. Despite various limitations, this model showed a clear net advantage of reduction in fertility rate in Egypt. Robinson (1968) presented a dynamic macro model to evaluate benefits of a population control programme. His model is unique in allowing only a possible relationship between the rise in per capita income and savings without specifying the direction of change. Simmons (1969) modified earlier models and applied his own model to calculate economic benefits of averted births in India during 1956-67. The benefits thus calculated were about fourteen times the per capita income of the base year.

Despite data scarcity problem, some notable studies have been done to analyze the costs and benefits of population control programmes in Pakistan. Khan (1969) calculated the value of preventing a birth due to vasectomy (benefit/cost ratio ranged between 24:1 to 52:1), IUD programme (benefit/cost ratio ranged between 13.4:1 to 27.4:1) and combining the vasectomy and IUD (both gave a minimum of 18:1 and maximum of 38:1 as the benefit cost ratio). Qureshi (1974) attempted to quantify public savings due to Pakistan's investment in population control programme. Another notable study was done by Rukanuddin, Soomro and Farooqi (1985). The study was based on data sets generated by the PGE (1962-65) and PFS (1975). It comprised of cross sectional enumeration and a longitudinal registration system of measuring various population related vital events. The researchers used the four techniques of evaluation: (1) standardization approach, (2) component projections, (3) prevalence model, and (4) multivariate Areal analysis, including Path analysis technique which was applied to areal data for measuring the programme impact only on fertility by controlling other socio-economic and demographic factors. Despite relative methodological sophistication, the study obviously suffered from data deficiency problems.

After having a cursory look at the methods and approaches of the above stated researchers, it can be concluded that models have been improved, revised and enlarged. Nevertheless, all point out the same conclusion that such type of models at their best can be 'good guess work' to assess quantum of costs and benefits of population control programmes. The most important factor is that such models need fairly precise data as their input, which has not been possible in Pakistan.

IV. THE ABB (AVERTED BIRTHS BASED) MODEL

The model interconnects the basic macro economic variables in a causal way. The mathematical form of the definitional and behavioural equations comprising the model is linear. As far as the author knows, the conceptual framework of the model is different from any of the models reviewed in this study or being developed by researchers world-wide. Application of the ABB model to Pakistan's population control programme (1965-68) has been attempted. Number of averted births have been calculated each year from 1965 to 1988. The year 1965-66 has been taken as the starting year in this study because government run population control programme had gained momentum by that year. Total money benefits each year due to net averted births which could have been added to the population that year in the absence of any programme of population control, have been calculated. These yearly series of money benefits have been converted in terms of constant price level of 1980-81 which has been assumed to be the base year. Similarly, cost of population control programme has been calculated as sum of the yearly expenditure incurred on population control programme and converted into constant price level of 1980-81. Other types of costs, *e.g.* opportunity costs or indirect costs have been ignored.

SPECIFICATION AND DEFINITION OF VARIABLES

A comprehensive definition of costs and benefits was not possible because diverse components such as personal, psychological, ecological and spill-overs could not be quantified. So in the ABB model, definition of costs and benefits was by no means precise or comprehensive but conformed to convenience and availability of data.

Variables and parameters used in ABB model are given below:

TC = Total cost of the programme in constant price level of 1980-81.

TB = Total benefits of the programme in constant price level of 1980-81.

C_t = Cost of the programme in year t.

G_0 = General price index of the base year (1980-81 = 100).

G_t = General price index of year t.

t = Time period starting $t = 1 = 1965\text{-}66$.

Y_t = National income of year t in price level of year t.

LP_t = Actual population in year t.

HP_t = Hypothetical population in the absence on any expenditure on population control by the government in year t.

s_{ti} = Hypothetical survivors of age i out of averted births in the year t.

a_{ti} = Averted births of age i in year t.

d_{ti} = Death rate of age i in year t or age specific death rate.

$$1 \leq t \leq 23 \ldots. (t \in Z)$$

Data for C_t, G_0, Y_t, LP_t were taken from various yearly Economic Surveys of Pakistan and cross checked with Statistical Yearbooks as well as Five Year Plans of Pakistan. In some cases where discrepancies were found, data published in Pakistan Economic Surveys was considered as final. Data on d_{ti}, G_t, HP_t has been generated as explained in Tables 1 and 2.[1]

ASSUMPTIONS

1. Size of national income and level of induced savings and investment remained constant with or without averted births.
2. Per capita consumption and hence level of productivity remained constant.
3. Money cost of an averted birth revealed the true scarcity of the resources and hence shadow pricing was not needed.

[1]For more details about these adjustments and calculations, *see* Chaudhary (1994).

4. Non-monetary benefits and costs of a smaller family were ignored.
5. Abortions were ignored.
6. All averted births were unwanted.
7. All averted births during the period under analysis were due to the Population Control Programme by the Government of Pakistan.
8. Time-lag between actual birth and averted birth was ignored.
9. Previous expenditures incurred during 1955-65 did not yield any significant spill-overs and substitution of private population control devices by the government run population control programme did not occur.
10. Productivity per capita remained constant with or without averted births.

The above sets of assumptions were made for precision of calculations. Lifting of most of the assumptions would enhance the sum total of monetary benefits.

FORMULATION OF THE MODEL AND ESTIMATION

The following set of equations interlinking the variables explained above constitute the ABB model.

Input data is represented by the following equation:

$$TC = \sum_{i=1}^{23} \frac{C_t}{G_t} G_0 \qquad (1)$$

Output data is represented by the following set of equations:

$$TB = \sum_{i=1}^{23} \left(\frac{Y_t}{LP_t} - \frac{Y_t}{HP_t} \right) HP_t \times \frac{G_0}{G_t} \qquad (2)$$

$$HP_t = LP_t + \sum_{i=1}^{t} S_{ti} \qquad 1 \leq t \leq 14 \qquad (3)$$

$$HP_t = LP_t + \sum_{i=1}^{t} S_{ti} - \sum_{i=1}^{t-14} S_{ti} \qquad 15 \leq t \leq 23 \qquad (4a)$$

OR

$$HP_t = LP_t + \sum_{i=t-13}^{t} S_{ti} \qquad 15 \leq t \leq 23 \qquad (4b)$$

Generalizing equation (3) and (4*a*)

$$HP_t = LP_t + \sum_{i=1}^{t} S_{ti} - \sum_{i=1}^{t-14} S_{ti}\, u[t-15] \qquad (5)$$

$$S_{ti} = A_{ti} - d_{ti} \times A_{ti}$$

OR

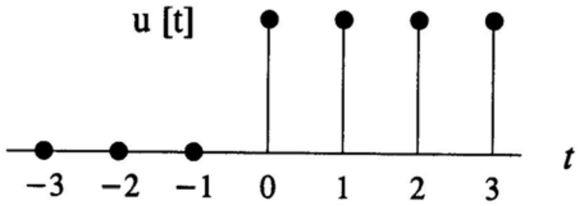
$$S_{ti} = a_{ti}(1 - d_{ti}) \qquad (6)$$

Where u[t] is discrete-time unit step function[2] defined as under:

$u[t] = 1$ if $t \geq 0$

$u[t] = 0$ if $t < 0$

Geometrically the above restrictions imply the following:



$$1 \leq t \leq 23 \; .... \; (t \in Z)$$

Equation (5) allows tracing the time path through successive hypothetical survivors of averted births of each year. In any given year, hypothetical survivors of averted births can be calculated provided the exogenous variables and relevant coefficients, *e.g.* survival rates, initial population and data concerning averted births are known.

Thus, the ABB model can be applied to calculate the benefit/cost ratio of any family planning programme. The age at which people enter the labour market and its effects on per capita income may vary from country to country thus necessitating minor adjustments but equations (1) to (6) can still be used for calculations by replacing the changed magnitudes of *t* or *i* or age at which people enter labour market and other such minor changes. Fertility surveys, health and demographic surveys are conducted internationally after regular intervals and so projected data on most of the exogenous variables required in the model can be available for future years.

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[2]For details, *see* Oppenheim *et al.* (1983).

So future benefits out of anticipated costs or extrapolated costs can be estimated and used for policy making or target setting.

BENEFIT/COST CALCULATIONS ACCORDING TO ABB MODEL

Before applying the ABB model to find out benefits and costs of the Government of Pakistan's investment in population control during 1965-88, it is essential to explain data sources and justify of choice of the base year.

SOURCES AND USE OF DATA

Data on variables used in this model have been collected through a variety of sources. Some items have been taken directly from officially published sources without any attempt at adjustment. In a few cases, adjustments have been made to bring about greater precision. These adjustments, too, were based on authenticated sources. Some of the variables used in this model did not exist in the present form in any standard publication but have been derived by manipulation of the data available with authenticated data generating agencies.[3]

CHOICE OF BASE YEAR

This study relates to the period 1965-88. Choice of a representative base year involved many factors. War with India and resulting separation of East Pakistan in 1972 had destabilized the economy. Indiscreet nationalization of the mid-seventies and later attempts at reversing it aggravated the economic, social and political chaos. 1980-81 has been chosen as the base year because the economy had somewhat stabilized by that time.

CONVERSION INDEX

Calculations of averted births have been done by using the following index:[4]

One birth averted = {
Sale and use of 833.33 condoms
OR
Sale and use of 97.38 cycles of oral pills
OR
5.76 new insertions of IUDs
OR
3.4 new cases of contraceptive surgeries performed

[3]See the Appendices B, C, D, E, F, G and H of the doctoral dissertation of A. R. Chaudhary (1994).

[4]This index was developed by the Population Welfare Division, Government of Pakistan, as cited in Zaidi (1987).

TABLE 1

Details of Index of Averted Birth

	I	II*	III**	IV****
Contraceptive method	Units	Effective CYP	Units of Averted Birth	Units of contra-ceptive methods required for single birth aversion
Condoms	100	0.45	0.1200	833.33
Cycles	13	0.50	0.1335	97.38
IUD	1	0.65	0.1735	5.76
Contraceptive Surgery	1	1.00	0.2670	3.74

Source: Zaidi (1987)

* It was calculated by making allowances for dropouts, failures and partial use of contraceptives as stated by Zaidi (1987).

** $(\text{Col III})_i = (\text{Col II})_i \times 0.267$***

*** $$0.267 = \frac{\text{Percentage of crude birth rate}}{\text{Percentage of married women of age 15-44 in the total population}} = \frac{4\%}{15\%} = \frac{4}{15} = 0.267$$

**** $$(\text{Col IV})_i = \frac{(\text{Col I})_i}{(\text{Col III})_i}$$

The basic data used for developing this index has been the crude birth rates, the percentage of married women of the reproductive age group (15-44) and the marital fertility ratio. These have been taken from the PGE project (1963). Application of Chandre-Deming (CD) formula gave marital fertility ratio as 0.311 and application of Longitudinal Registration[5] (LR) gave this ratio as 0.240 and so 0.275 as the average of the two was taken for use in the above index. This index has taken into account all the

[5]Longitudinal Registration (LR) system was based on registration data kept by a registrar resident in the sample area.

intermediate factors like dropouts, failures, partial use, etc. It has also considered other related factors such as the fact that births do not take place every year (even in the absence of contraceptive devices) to women of varying ages within the reproductive age groups (15-44 years). It transpires that the basis of calculation of the above index has been Table 1 given by Zaidi (1987).

CONVERSION INTO NET AVERTED BIRTHS

For calculation of averted births, data on IUDs, contraceptive surgeries and conventional contraceptives has been obtained and tabulated as in appendices D, E, F and G. These data sets have been brought down by 41% in accordance with a study by Farooqui and Soomro (1984) on the extent of over-estimation of service statistics generated by the Pakistan Government's population control network.

For further refinement of these data sets, figures of yearly averted births were converted into net averted births by applying relevant survival rates obtained from a study by Blacker (1990). Table 2 shows relevant survival rates and the mechanism of converting Blacker's (1990) survival coefficients for Pakistan into its present form as shown in Table 2 below.[6]

TABLE 2

Survival Rates of Averted Births During 1965-1988

0	I	II	III	IV
Age	Mortality Rate*	Age	Mortality Rate** (d_t)	Survival Rate*** (s_t)
0	0.11040	0 - 1	0.059725	0.940275
1	0.00905	1 - 2	0.008125	0.991875
2	0.00720	2 - 3	0.006275	0.993725
3	0.00535	3 - 4	0.004425	0.995575
4	0.00350	4 - 5	0.002575	0.997425
5	0.00165	5 - 6	0.001610	0.998390
6	0.00157	6 - 7	0.001530	0.998470
7	0.00149	7 - 8	0.001450	0.998550
8	0.00141	8 - 9	0.001370	0.998630
9	0.00133	9 - 10	0.001290	0.998710

[6]*See* Appendix B (p. 256) of doctoral dissertation of A. R. Chaudhary (1994).

10	0.00125	10 - 11	0.001335	0.998665
11	0.00142	11 - 12	0.001505	0.998495
12	0.00159	12 - 13	0.001675	0.998325
13	0.00176	13 - 14	0.001845	0.998155
14	0.00193	14 - 15	0.002015	0.997985
15	0.00210	15 - 16	0.002175	0.997825
16	0.00225	16 - 17	0.002325	0.997675
17	0.00240	17 - 18	0.002475	0.997525
18	0.00255	18 - 19	0.002625	0.997375
19	0.00270	19 - 20	0.002775	0.997225
20	0.00285	20 - 21	0.002870	0.997130
21	0.00289	21 - 22	0.002910	0.997090
22	0.00293	22 - 23	0.002950	0.997050
23	0.00297	23 - 24	0.002990	0.997010
24	0.00301	24 - 25	0.003030	0.996970
25	0.00305			

Source: Chaudhary (1994)[7]

* (Col I) is derived from Chaudhary (1994), p. 256.

$$** \quad (\text{Col III})_i = \frac{(\text{Col I})_i + (\text{Col I})_{i+1}}{2}$$

$$*** \quad (\text{Col IV})_i = 1 - (\text{Col III})_i$$

The data generated in Table 2 has been used for calculation of yearly net births averted by the population control programme after giving due allowance to the fact that even if there had been no programme of population control during 1965-66 to 1987-88, all births taking place during this phase would not have survived because of the influence of mortality rate of the relevant age groups.

The overall picture with respect to Net Averted Births becomes vivid in Table 3 which presents a summary statement of the findings. Many interesting inferences can be drawn by scrutinizing its various columns, *e.g.* the high extent of success of conventional contraceptives as against surgical methods of conception control, *i.e.* IUDs and contraceptive surgeries.

[7]In this paper all the tables bearing reference "Source: Chaudhary (1994)" are available in the Appendices of A. R. Chaudhary's doctoral dissertation (1994).

TABLE 3

Yearly Net Births (A_{ti}) Averted by the Population Control Programme

0	I	II	III	IV	V	VI
Year	Birth averted by IUDs	Birth averted by sertilization	Birth averted by oral pills	Birth averted by condomes	Total births averted*	Survivors** (S_t)
1965-66	23024.52	311.75	–	23489.45	46826	44029
1966-67	41603.13	345.89	326.69	53361.91	95638	89926
1967-68	52446.80	2760.27	146.30	81702.45	147056	128870
1968-69	53973.10	10513.14	39.16	86808.84	151334	142296
1969-70	42228.13	1952.44	35.30	86808.84	131025	123200
1970-71	29249.41	902.45	79.15	58565.09	88796	83493
1971-72	15314.84	628.25	433.69	21447.87	37825	35566
1972-73	13158.12	599.99	1186.92	25324.61	40270	37865
1973-74	11313.41	783.37	9210.45	41865.44	63173	59400
1974-75	16929.42	1466.80	8880.52	70668.86	97946	92096
1975-76	27974.78	2795.73	37371.06	126688.25	194830	183194
1976-77	19678.51	2783.02	30022.20	86485.75	138964	130669

0	I	II	III	IV	V	VI
1977-78	8713.67	1335.38	10280.33	42164.71	62494	58762
1978-79	9516.84	2537.64	13685.95	56860.00	82600	77667
1979-80	12255.59	4719.16	25382.27	27248.78	114606	107761
1980-81	11340.50	4696.02	8819.38	22306.12	47162	44345
1981-82	9628.03	4830.85	1700.11	23070.36	39229	36886
1982-83	11899.01	5372.25	2912.60	35364.21	55548	52230
1983-84	18113.06	7155.91	5941.43	49107.13	80318	75521
1984-85	24070.99	9939.13	6711.21	69331.91	110053	103480
1985-86	31685.87	13033.15	9237.84	71674.53	125631	118128
1986-87	38731.03	13093.07	10517.10	85021.85	147363	138562
1987-88	62534.97	14674.78	14195.39	20967.58	112373	105662

Source: Chaudhary (1994)

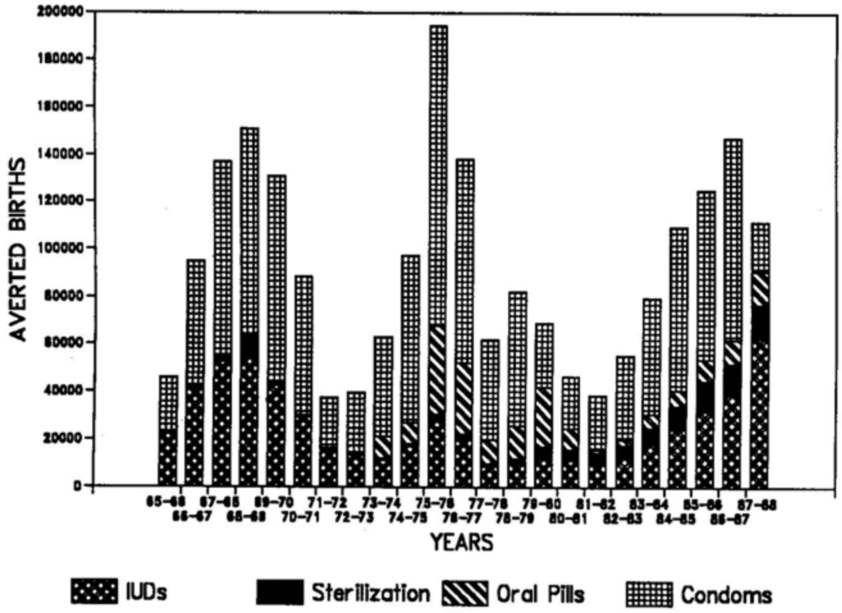
* $(\text{Col V})_i = (\text{Col I})_i + (\text{Col II})_i + (\text{Col III})_i + (\text{Col IV})_i$

** $(\text{Col VI})_i = (\text{Col V})_i$, s_{ti} where s_t is Col IV of Table 2.

Figure 1 below gives a graphic picture of the magnitude of success of each method.

FIGURE 1

Births Averted by Various Methods



The high level of achievement of condoms is a very conspicuous feature as compared with all other methods put together. Surgical methods like IUDs and Contraceptive Surgeries (CS) are more reliable as use and distribution are synonymous. On the contrary, distribution of condoms is only a necessary but not a sufficient condition for use of condoms. Similarly, regularity of their use is another precondition for their success in averting births. All these factors make the number of averted births through the use of condoms given in Figure 1 very doubtful in spite of all the refinements of data as done in this study. However, in the absence of any study which could reveal the extent and regularity of use of condoms, nothing more could be done in this respect.

CALCULATIONS OF HP_t (HYPOTHETICAL POPULATION)

Figures of actual population (LP_t) for the year 1965-66 to 1987-88 were taken from Pakistan Statistical Yearbooks. Total hypothetical survivors (TS_t) and hypothetical population (HP_t) have been calculated according to the rationale of equations (5) and (6) of the ABB model. Details of calculations are available in Table 4 which gives a summary of the results.

TABLE 4

Survivors of Averted Births and Hypothetical Population

0	I	II	III
Time Period	Actual Population (LP_t) (Millions)	Total Hypothetical Survivors (TS_t)*	Hypothetical Population (HP_t)** (Millions)
1965-66	53.26	44,029	53.30
1966-67	54.79	133,598	54.92
1967-68	56.37	261,463	56.63
1968-69	58.00	401,961	58.40
1969-70	59.70	522,697	60.22
1970-71	61.49	603,446	62.09
1971-72	63.34	636,411	63.98
1972-73	65.89	672,172	66.58
1973-74	67.90	729,764	68.63
1974-75	69.98	820,011	70.80
1975-76	72.12	1,000,973	73.12
1976-77	74.33	1,128,338	75.46
1977-78	76.60	1,183,401	77.78
1978-79	78.94	1,257,680	80.20
1979-80	81.36	1,319,724	82.68
1980-81	83.84	1,273,944	85.11
1981-82	86.44	1,183,528	87.62
1982-83	89.12	1,095,924	90.22
1983-84	91.88	1,050,281	92.93
1984-85	94.37	1,070,829	95.44
1985-86	97.67	1,151,867	98.82
1986-87	100.70	1,250,657	101.95
1987-88	103.82	1,295,294	105.15

Source: *Pakistan Economic Surveys* and *Statistical Yearbooks*.

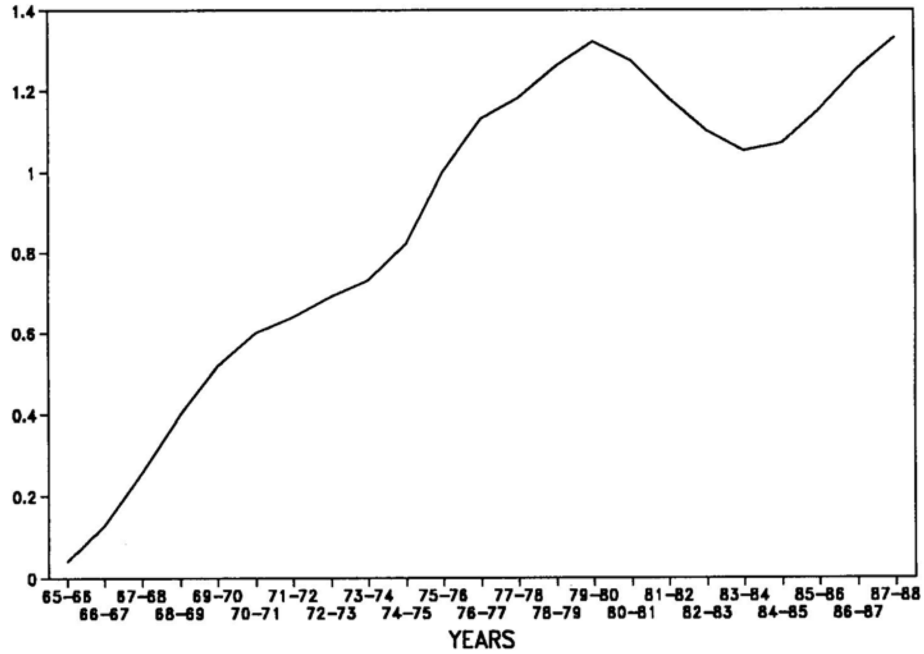
* $(\text{Col II})_i = (\text{Col XXIV})_i$ of Appendix H in Chaudhary (1994).

** $(\text{Col III})_i = (\text{Col I})_i + (\text{Col II})_i$

The bumps and humps of the curve in Figure 2 is a picture of the woeful state of affairs regarding up and downs in the yearly allocation of funds to population control programme by the government. Ideally speaking, the curve in Figure 2 should have been without such ups and downs and more steep, getting steeper with the passage of time. This type of curve showing dampened and erratic behaviour is a corollary of ups and downs in our political and economic policies.[8]

FIGURE 2

Difference Between Hypothetical and Actual Population



SUMMARY OF BENEFITS (OUTPUT)

Equation (2) of the ABB model was formulated on the rationale that per capita income of Pakistan during the year 1965-66 till 1987-88 was higher due to averted births than in the absence of the programme. Hypothetical per capita income in constant price level YC_t/HP_t is subtracted from actual per capita income YC_t/LP_t (where YC_t is defined as $Y_t \times G_0/G_t$ to find money benefit per capita of government's investment in population control programme. This benefit per capita is converted into total benefits by multiplying with hypothetical population (HP_t), *i.e.* the population which

[8]For detailed treatment of the subject, please see Chapters 6 and 7 of doctoral dissertation of A. R. Chaudhary (1994).

would have been there had there been no investment in population control programme in Pakistan. Table 5 gives a summary of yearly benefits in constant price level.

TABLE 5

Benefits in Constant Price Level of 1980-81

	I	II	III	IV
Year	Actual Population (LP_t) (Million)	Hypothetical Population (HP_t) (Million)	National Income in constant price level of 1980-81* (Million Rs.)	Benefits in constant price level of 1980-81** (Million Rs.)
1965-66	53.26	53.30	116891.67	87.79
1966-67	54.79	54.92	120510.54	285.93
1967-68	56.37	56.63	128832.06	617.08
1968-69	58.00	58.40	137170.22	969.65
1969-70	59.70	60.22	150730.18	1338.14
1970-71	61.49	62.09	152267.90	1510.55
1971-72	63.34	63.98	156471.14	1581.02
1972-73	65.89	66.58	167597.51	1704.21
1973-74	67.90	68.63	180024.06	1935.46
1974-75	69.98	70.80	187339.42	2195.17
1975-76	72.12	73.12	195489.09	2710.61
1976-77	74.33	75.46	203688.98	3096.56
1977-78	76.60	77.78	225398.43	3472.20
1978-79	78.94	80.20	238978.64	3814.44
1979-80	81.36	82.68	255863.18	4151.17
1980-81	83.84	85.11	269721.00	4085.71
1981-82	86.44	87.62	288322.96	3935.92
1982-83	89.12	90.22	312625.76	3858.81
1983-84	91.88	92.93	325793.73	3723.15
1984-85	94.37	95.44	352334.38	3994.89
1985-86	97.67	98.82	377129.97	4440.46
1986-87	100.70	101.95	394968.46	4902.79
1987-88	103.82	105.14	414330.76	5307.84

Source: Chaudhary (1994)

* $(\text{Col III})_i = (\text{Col V})_i$ of Appendix C

** $$(\text{Col IV})_i = \left(\frac{(\text{Col III})_i}{(\text{Col I})_i} - \frac{(\text{Col III})_i}{(\text{Col II})_i} \right) \times (\text{Col II})_i$$

These total benefits are the output of population control programme as defined in this study.

CALCULATIONS OF COSTS (INPUTS)

Costs have been calculated according to equation (1) of the ABB model. Yearly actual expenditure on population control during 1965-66 to 1987-88 has been converted into constant price level of 1980-81 to bring homogeneity between inputs and outputs. This is shown in Table 6.

TABLE 6

Calculation of Programme Costs

Year	I Yearly Costs in current price level (C_t) (Million Rs.)	II Yearly Costs in constant price level of 1980-81 (CC_t)* (Million (Rs.)
1965-66	14.72	58.95
1966-67	15.23	56.34
1967-68	28.83	104.57
1968-69	41.27	149.15
1969-70	44.71	155.46
1970-71	42.47	140.82
1971-72	25.70	80.61
1972-73	41.91	113.52
1973-74	103.34	226.03
1974-75	145.00	260.84
1975-76	187.81	299.16
1976-77	202.00	290.86
1977-78	105.00	137.61
1978-79	114.00	141.62
1979-80	127.00	142.19
1980-81	131.00	131.00
1981-82	174.00	159.20
1982-83	178.00	151.50
1983-84	202.00	158.43
1984-85	346.00	257.56
1985-86	456.00	324.02
1986-87	483.00	327.57
1987-88	513.00	327.44

Source: *Pakistan Economic Survey 1990-91*.

$$* \quad (\text{Col II})_i = \frac{(\text{Col I})_i}{(\text{Col IV})_i \text{ of Appendix C}} \times 100$$

These total yearly costs (in constant price level of 1980-81) are the inputs into the programme.

TABLE 7

Yearly Costs and Benefits of Population Control Programme

0	I	II	III
Year	Benefits in constant price level (BC_t) (Million Rs.)	Cost in constant price level (CC_t) (Million Rs.)	Benefit/Cost Ratio (R_t)
1965-66	87.79	58.95	1.49
1966-67	285.93	56.34	5.07
1967-68	617.08	104.57	5.90
1968-69	969.65	149.15	6.50
1969-70	1338.14	155.46	8.61
1970-71	1510.55	140.82	10.73
1971-72	1581.02	80.61	19.61
1972-73	1704.21	113.52	15.01
1973-74	1935.46	226.03	8.56
1974-75	2195.17	260.84	8.42
1975-76	2710.61	299.16	9.06
1976-77	3096.56	290.86	10.65
1977-78	3472.20	137.61	25.27
1978-79	3814.44	141.62	26.94
1979-80	4151.17	142.19	27.19
1980-81	4085.71	131.00	31.19
1981-82	3935.92	159.20	24.72
1982-83	3858.81	151.50	25.47
1983-84	3723.15	158.43	23.50
1984-85	3994.89	257.56	15.51
1985-86	4440.46	324.02	13.70
1986-87	4902.79	327.57	14.94
1987-88	5307.84	327.44	16.21
Total	63719.45	4194.45	

Source: Column I derived from Table 5.
Column II derived from Table 6.
Column III author's calculations.

CALCULATION OF YEARLY BENEFIT/COST RATIOS

To discuss the economics of population control, yearly costs and benefits of population control programme in Pakistan have been tabulated in Table 7 above.

V. CONCLUSION

The aim of this study has been to develop a model to quantify economic returns of investment in population control. Data was collected from published sources, consolidated, refined or deflated according to requirements of the model. Benefit cost ratio was calculated which showed that benefits out-weighed costs of investment in population control. This implies that marginal returns are more than marginal costs and so, there is need to expand the programme in order to maximize total welfare of the society. By and large, the objectives of this study were achieved.

Conclusion may be summarized as follows:

1. The high returns of investment in population control imply that there is economic justification for further expansion of the programme. A rupee invested in this programme yields fifteen times in terms of constant price level which far exceeds returns from investment in any other physical capital projects.

2. The overall benefit cost ratio calculated in the present study of 1:15 appears to be conservative but still quite near the earlier study by Khan (1968) for Pakistan over a different period and with different methodology which ranged from 1:18 to 1:38.

3. Throughout the study, the dire need of a more effective and efficient system of data availability/collection was felt. There was also need for better liaison among various data generating agencies. These organizations should not in anyway be linked up with the agencies who set targets and do the evaluation of performance because it would lead to fictitious and inflated data. These agencies should be totally independent autonomous bodies working without any pressures from the government.

4. Yearly benefit/cost ratios show wide fluctuations ranging from 1.49 in 1965-66 to 31.19 in 1980-81 and again going down to 16.21 in 1987-88 which could be due to variations in yearly

allocation of funds, organizational lapses, or political upheavals resulting in inconsistent policies over the years. However, the long term rising trend of benefit cost ratio implied better cost effectiveness during the period under reference.

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