AN AGGREGATIVE MODEL OF LABOR FORCE PARTICIPATION IN PAKISTAN*

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MOST GROWTH MODELS and even modern econometric models do not make adequate labor force assumptions. A very common but vulnerable one is of the form:

$$L(t) = L(O)\ e^{rt}$$

i.e., labor force grows at a constant exponential rate, r. (The same type of assumption is generally made for population.) Such assumptions stem from the common belief that the determinants of labor force participation do not change significantly at least in the short run. This may be true in developed countries,[1] but given the numerical importance of marginal workers, particularly women and children, in the less developed countries (LDCs) the supply of labor even in the short run cannot be taken as exogenous. For example, the rapid demographic, economic, social and cultural changes that are taking place in many developing regions, particularly in Asia, can rapidly alter female participation in labor activity.[2]

The flow diagram in Figure 1 outlines a simple model of the factors determining labor force dimensions. Demand for labor is taken as an implicit deter-

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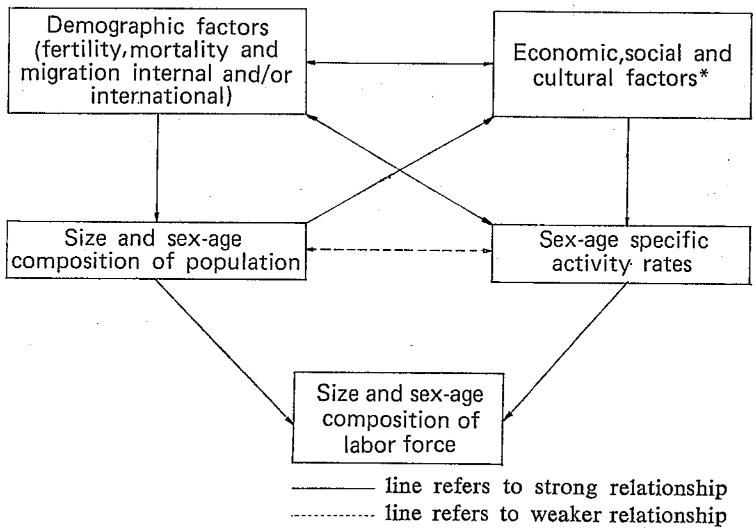
1 Given the great complexity of the developed economies, there is all the more pressing need for revising the assumptions of exogeneity for population and labor force in the models for these countries, particularly if these models are to be used for policy purposes. What is required is a sub-model of labor force divided into different segments which show the factors affecting each segment separately and how they do so. Generally, as put by Behrman and Klein, the inclusion of demographic variables in the Harrod growth model is "analogous to the extension of the simple Keynesian system to fit it to the real world" [1].

2 Throughout this paper, the terms labor force participation, participation in labor or economic activity, work participation, labor or economic activity rate are used synonymously and refer to the proportion of population in the labor force. We have used the 1961 Pakistani population census definition of labor force. The 1961 census included a person, ten years of age or over, in the labor force if he or she was working for profit or to earn wages or salary, or was helping any member of family on the farm or family enterprise, or was not working but looking for work.

minant of labor supply and can be measured in "economic factors" (technically from a labor requirements production function). The model disaggregates population into different sex-age segments and each segment is studied as a separate entity.[3] This is necessary as the size of each group is determined differently and each group contributes to the national product of economic goods and services to a different degree. The complexity of the model will vary with the particular segment of the labor force under consideration.[4]

A note of warning—there are significant interactions among the factors determining labor activity, as depicted by the flow diagram. For example, migration

Fig. 1. Flow Diagram of Basic Determinants of the Size of Labor Force



* Economic factors—GNP per capita, average earning level for workers, employment opportunities and their geographical distribution, industrial structure, occupational structure, organization of productions, etc.
Social factors—educational opportunities and educational attainment, urbanization, marital laws and characteristics, etc.
Cultural and other factors—traditional attitudes towards participation of different groups, particularly of women, in economic activity, religious influences on attitudes to work, etc.

3 The different sex-age segments suggested are: males between ten and nineteen, twenty and fifty-nine, sixty and over; females between ten and nineteen, married women twenty and over, single women twenty and over, and other women twenty and over.

4 For example, the quantitative determination of child labor can be expected to be relatively simple. A United Nations study, using data for thirty countries, found an almost one-to-one functional relationship between the activity rates for young persons and the combined factors of school attendance and the degree of industrialization; the latter measured as the percentage of active males in agriculture and related activities. Coefficients of determination were, respectively, 0.89 and 0.94 for males between ten and fourteen, and between fifteen and nineteen years of age [9, p. 55]. On the other hand, the determinants of female economic activity may be very complex.

is generally motivated by economic factors. Fertility and female participation rates in the middle adult age groups may form a cobweb type of relationship; fertility may affect the level of work participation and vice versa. Economic factors may have profound influences on social and cultural factors and the latter may affect the former, particularly in the initial stages of development.

However, if after taking account of interactions among different factors, the above framework is included in a growth model, the latter will be a greatly improved tool for economic strategy in long range development plans for LDCs. Given the necessary data, the relationships advanced in our model can be expressed in terms of mathematical equations. With the resulting matrix of coefficients and the application of simultaneous equation solutions (accounting for interactions), the complexity of which would depend on the data, projections of labor force dimensions and various sub-categories can be made.

I. SCOPE OF THE STUDY

Unfortunately, due to paucity of data, it is not possible to construct the above model for Pakistan. However, a simple version determining only male and female aggregate labor force participations can be estimated. Multiple regression techniques are used to determine some of the more important social, economic, cultural, and demographic factors within the framework suggested by Figure 1.

What follows is a cross-sectional study based on 1961 Pakistani census data. The unit of observation is a "district."[5] Male and female crude activity rates by district are taken as observations on the dependent variables of male and female aggregate labor force participation. Separate equations are also estimated using refined activity rates as dependent variables. Given the enormous discrepancies in the shares of area and population between East and West Pakistan (in 1961, East Pakistan, with one-sixth of total area, contained 56 per cent of the total population) as well as their differing economic structures, etc.,[6] separate estimates are made for the two provinces.

A word about the dependent variables—crude activity rate (i.e., percentage of total population engaged in labor force) is independent of the size of population over districts. This measure is not, however, independent of the age structure of the population. It is easy to see that a district with a relatively favorable age structure (i.e., relatively more persons in the working age span) *ceteris paribus* will report a larger activity rate. To avoid this bias, refined activity rate (i.e., percentage of population ten years and over engaged in labor force) is also included as a dependent variable. Note that refined activity rate is a "true" rate

5 A "district" has been recognized as the primary unit of administration. It also represents a relatively homogeneous area and has been used by the census reporting as the basic unit to cover regional variability. East Pakistan is divided into seventeen districts and West Pakistan into forty-five.

6 For more details, see [4, pp. 4–5]. Recent political events have resulted in the emergence of these two provinces as two separate countries. Also, West Pakistan was recently subdivided into four provinces. However, for the present analysis, East Pakistan and West Pakistan are treated as provinces, as was the case in the 1961 Pakistani population census.

in the sense that it refers to the population at risk of participating in economic or labor activity and hence is a better measure of labor force participation. However, an earlier study on Pakistan found age reporting quite erroneous in younger age groups and concluded that the crude rates were closer to their true rates than were the refined ones [4, pp. 37–39]. But if age misreporting can be assumed to be fairly consistent across regions, the regional pattern of reported rates would be similar to that of true refined rates and will represent a relevant picture of regional variability. The best course is to use both rates as dependent variables.

II. INDEPENDENT VARIABLES AND THEIR PROBABLE INFLUENCES ON LABOR FORCE PARTICIPATION

Following is a list of measurable independent variables along with a discussion of *a priori* notions concerning their effects on propensities to participate in economic activity. These *a piori* notions are gathered from the findings of relevant theoretical and empirical research. We have also depended on background knowledge of special features of the social, economic, and cultural setups in East and West Pakistan for inclusion of some of the following independent variables and for explanations of the results obtained.

The level of industrialization: This is measured in two ways: (1) percentage of male workers in non-agricultural sector, and (2) employees (i.e., wage earners or salaried workers) in non-agricultural sector as a percentage of total labor force.

It is now a well recognized fact that labor force participation (taking age structures of populations as constant) is lower in more industrialized economies than in less industrialized and agricultural ones. This is particularly true for male labor activity; mainly because of much larger labor force participation in younger and older age spans in the latter countries.[7] We, therefore, expect a negative association between the level of industrialization and male (and female) participation in economic activity.[8]

The degree of urbanization: This is measured as the percentage of population living in urban areas. For Pakistan a negative relationship has been observed between urbanization and activity rates (both male and female) [4, Section 3.2]. Actually this variable may behave in a manner very similar to the industrialization variable and, in fact, these two variables may themselves be significantly

[7] For example, see [8, Table 5.1].

[8] In this context, it would also be important to use the "level of real per capita income" by district. This variable measures the level and geographical variation in the economic achievement level. There may be, however, a close relationship between per capita income and the level of industrialization, and only one of the two variables may be sufficient. (We selected the latter as data on income at the district level are not available.) Due to data limitations, another important economic variable, namely "average earning level for workers" by district, could not be included. Earning level has substantial positive net effect upon the propensity to participate in economic activity.

correlated. Any such fixed relationship between independent variables is technically referred to as the "multicollinearity" problem. This problem is discussed in a later section.

Male (and female) industry mix index: Based on the men (or women) to total employment ratio in each industry for the whole province and the industrial structure of the working labor force (i.e., excluding unemployed) of the districts of the province, this index measures the percentage of jobs in a district expected to be held by men (or women).[9]

The concentration of women workers in a relatively few industries is a worldwide phenomenon; the nature of such a concentration varies among cultures. For example, in Pakistan as in most other Muslim countries, there is marked antipathy to the employment of women in commerce [3, pp. 7–10]. The same set of factors, leading to sex-segregated schooling and the medical treatment of women being limited to women medical practitioners, is responsible for large female employment in education and medical services. Textiles and personal services are the only other non-agricultural industries open to women workers. On the whole, women workers in Pakistan seem to be largely restricted to the agricultural sector.[10] Hence, an industrial structure relatively favoring the above industries will generate more jobs for women and will lead to a relatively larger women work participation (and a relatively lower male labor activity). A recent very comprehensive study of one hundred "standard metropolitan statistical areas" (SMSAs) in the United States found the respective industry mix indexes as important explanatory variables for male and female labor force participations [2, Chapters 4 and 6].

However, note that agriculture is the single most important source of employment (accounting for 85 per cent of the total employment in East Pakistan and 60 per cent in West Pakistan) and an industry mix index including agriculture may not reveal more than does the industrialization variable.[11] (Correlation coeffi-

9 The method of construction of the industry mix index for women, for example, is as follows:

Multiply the total employment in each industry in a district by the ratio of female to total employment in that respective industry for the province as a whole and sum over all the industries. This gives the expected number of female type jobs available in that district. The value of the female industry mix index is the percentage this expected number of jobs is of the total working labor force of the district. The value of the male industry mix index is 100 minus the female industry mix index. For more details on calculation of the industry mix index, see [2, pp. 772–74]. For construction of the above industry mix indexes, total employment was distributed among 34 two and three digit industry groups using the industrial classification developed at the Population Studies Center, University of Pennsylvania. This classification seems to bring out the distinction between male dominated industries, i.e., industries closed to women workers, and industries relatively open to them. For an outline of this classification, see [4, Table IV–1].

10 For more details, see [4, Section 4.2].

11 Since the female share of total employment in agriculture is much larger than its share in the non-agricultural sector (16 versus 9 per cent in East Pakistan and 10 versus 6 per cent in West Pakistan), the female industry mix variable ends up being negatively correlated to the industrialization variables. By the same token, industrialization is positively related to the male industry mix index.

cients between the two variables are very high. See Appendix Tables II–V.) A more appropriate variable may be the industry mix index excluding agriculture (i.e., taking non-agricultural total employment as 100).

Unemployment: This is measured as the percentage of total labor force unemployed. Whereas the industry mix index measures the structural aspects of the economy of a region, which are directly related to the relative job opportunities for men (or women) and are of a long-run character, the overall unemployment rate measures job opportunities in general and more or less reflects the current state of local labor market conditions.

The "discouraged-worker" effect, i.e., lack of job opportunities which deters a person from even looking for a job, is now a well recognized hypothesis. In the case of women, however, it is quite possible that with high overall unemployment, many of them may seek jobs to compensate for their unemployed husbands and/or other male family members. This is usually referred to as the "additional-worker" effect. If the latter effect is stronger than the discouraged-worker effect, there will be a positive association between unemployment and female labor force participation. Generally, however, unemployment is observed to have a negative net effect upon both male and female labor activity.

The level of educational attainment and schooling: A set of three variables is involved here: (1) percentages of males and females ten years and over attending school, (2) percentages of males and females ten years and over literate, and (3) percentages of males and females fifteen years and over with education of eighth grade and more and not in school.

The influence of the first variable is obvious. It is negatively related with activity rates—the persons attending school are generally supposed not to be engaged in economic activity. Our choice of the other two, literacy and high educational attainment, stems from a curvilinear form of relationship sometimes observed between the education variable and female activity rates. Sinha's findings for India show female work participation declining with literacy but increasing with female education above matriculation level (tenth grade) [7, p. 337]. The probability of obtaining a job is usually higher for an educated person than for an illiterate one. Also he or she is more likely to have a job pleasant in nature, more durable and better paying. In other words, education increases the propensity to participate in economic activity. We expect a positive association between at least male work participation and variables (2) and (3).

Marital status: *Ceteris paribus*, marital status influences both male and female participation in economic activity. A married man, usually head of a family, is more likely to be responsible for earning a living for his family than is an unmarried man. On the other hand, a married woman is less likely to be in the labor force than is an unmarried one for whom a job is often an economic necessity. Here, however, the attitude of the society may have an important bearing. In Pakistan, for example, single women are not usually allowed to participate in labor activity, particularly if it involves working outside their homes.

The marital status variable is calculated separately for males and females (ten years and over), as percentage married.[12]

The geographical mobility of the population: Two variables are considered here.

(1) Immigration rate: This is measured as the percentage of immigrants in the total enumerated population of a district. Almost the entire immigration is from India. Very substantial in magnitude, this migration is of an involuntary type, though its spread across districts certainly may be economically motivated. Thus we hypothesize a positive relationship between labor force activity and immigration.

(2) Net internal migration:[13] Usually motivated by economic opportunity, this variable may be expected to be positively related to male work participation. The relationship with female labor activity may be different as most of the female migration in both India and Pakistan is associated with marriage (usually to the place of residence of the groom).

The density of the population: This is measured as population per square mile within a district. Given the importance of agriculture in a developing country, the higher the population pressure on the land (which may lead to out-migration), the lower the activity rate. The proper variable in this context may be the ratio of rural population to cultivable land area in square miles or acres, weighted by an index of land fertility and the average number of croppings per year. However, in the absence of data in these dimensions, we have used population density as the population pressure variable.

12 The very low age of ten years is taken as the limit due to the fact that 22 per cent of the females between the ages ten and fourteen were reported as married.

13 Using the census information on "place of birth" and "place of enumeration," net internal migration rate is computed as follows:

$$\text{Number of net internal migrants} = (P_{En} - P_b{}^{En}) - (P_b - P_b{}^{En}) = I - O.$$

P_{En} = total enumerated population of district born in Pakistan.

P_b = population born in district.

$P_b{}^{En}$ = population born and enumerated in district, i. e., non-migrants.

I = number of in-migrants.

O = number of out-migrants.

In the calculation of net in-migration rate, note that if "reported population" of a district is taken as the base then the following types of bias occur. In cases where there is substantial in-migration into a district, the base is inflated and the migration rate is deflated. The bias will be in the other direction if out-migration from the district has been substantial. To take care of this, we have used the following average base, suggested by Dr. Hope T. Eldridge.

$$\text{Average base} = P_b{}^{En} + {}^1/_2 I + {}^1/_2 O = P_b{}^{En} + I - {}^1/_2 I + {}^1/_2 O = P_{En} - {}^1/_2(I-O).$$

So the formula for the net in-migration rate is:

$$\frac{I-O}{P_{En} - {}^1/_2(I-O)]} \times 100.$$

Percentage of nuclear families: The 1961 census classifies a family as nuclear if it consists of husband and wife with or without offspring. The importance of the family composition variable in a developing socioeconomic structure is made explicit by the usual argument that a greater prevalence of extended families and tribal systems allows persons to retire at an earlier age, as their dependency is readily shared by the other family members. However, it can be argued that if nuclear families are more prevalent among the higher socioeconomic groups, which seems to be the case in Pakistan, there is a greater probability of support for the older members and hence their terminating of employment[14] and, similarly, a greater probability for the younger members to remain comparatively longer in school and out of labor activity. It appears that the family composition variable may only be an intermediate one in the sense that its effect on labor force participation reflects the influence of some more primary factors.

The following variable is relevant for females only.

The child-woman ratio: Computed as (children 0–4 years) / (women 15–49 years) × 1,000, this variable measures in rough terms the fertility level and the burden of child rearing. A negative association between the child-woman ratio and female work participation is an obvious hypothesis.

III. SOME PROBLEMS ASSOCIATED WITH A CROSS-SECTIONAL SINGLE EQUATION MODEL

An important problem with a single equation model like the present one is its additive character. There may be significant interactions among independent variables which are not accounted for. As mentioned before, this is the multicollinearity problem. An extensive use of correlation coefficient r matrices among the independent variables was made to gauge the degree of this problem and to establish reasonable statistical independence among the independent or exogenous variables.[15] Highly intercorrelated exogenous variables (depending on their nature) were usually not used in the same equations. For example, urbanization and the two industrialization variables are highly intercorrelated (see Appendix Tables II and III). In this instance, parallel equations were run using industrialization and urbanization, and the one giving the better results was reported.[16]

Another problem is the ambiguous nature of certain exogenous variables, for example, family composition (nuclear or extended), marital status and migration variables with the latter two concerning only women. We do not know *a priori* the direction of their influence on labor activity. When any such variable is found to be significant, the explanation must include a whole set of other varia-

[14] This point was suggested by Dr. Lee L. Bean of the Population Council.

[15] Some of these matrices are given in Appendix Tables II–V.

[16] It is important to note that one should not always rule out, *a priori*, any regression estimate containing two highly intercorrelated exogenous variables. The nature and specification of the variables should be carefully scrutinized. For a detailed discussion of the multicollinearity problem, see [6, pp. 46–52].

bles which may be affecting this variable. For example, as mentioned before, marriage is usually regarded as a deterrent factor to female work participation. But in the case of a traditional society like Pakistan it may just be the opposite; women may not be allowed to join the labor force until they are married.

A more general problem with single equation models is that many of the exogenous variables should really be endogenously explained, as was suggested in our case in Figure 1. This implies a multi-equation model which, as we stated earlier, was not feasible here due to data limitations.

These limitations should be kept in mind in the discussion of the equations in the following section.

IV. CROSS-SECTION RESULTS FOR LABOR FORCE PARTICIPATION

Tables I–V provide the parameters and test statistics for the regression equations explaining the male and female labor force participations in East and West Pakistan. Given are β parameters or regression coefficients along with their t ratios, which show their statistical significance; R^2, the coefficient of determination, which measures the proportion of total variance of the labor force participation explained by the equation, and *SE*, the standard error of estimate, which is a measure of the scatter of the actual values around the estimated regression line and hence provides a rough indication of the accuracy of the explanation. The unweighted average and the standard deviation of the two dependent variables are also reported.

The equations in Tables I–V are selected from a rather large number of alternative equations as those which best explain quantitatively the sensitivity of labor activity with respect to different factors.

A. *Male Labor Force Participation Equations*

Among the regression equations for West Pakistan, we have included a set of equations (Regression II) which exclude the Karachi district from the observations. With its very high degree of industrialization, urbanization, and educational level, Karachi is a rather extreme unit of observation. Exclusion of Karachi, as can be observed in Tables I and II, does seem to give improved results.

In general, the results for male crude and refined activity rates (from here on referred to as MCAR and MRAR, respectively) in Tables I and II are consistent with our hypotheses. The education variable, "attending school" emerges as a very important variable for both East and West Pakistan. The marginal or net regression coefficient of MCAR with respect to this variable is -0.68 in East Pakistan and -0.44 in West Pakistan (-0.52 including Karachi). This implies that MCAR will be lower by respectively a little less than seven-tenths and less than one-half of one per cent in an East Pakistani and a West Pakistani district, which are "typical" in all other variables but have the proportion of males (ten years and over) attending school larger by one percentage point than their respective all-district averages. And an increase of one per cent in the proportion

TABLE I
MULTIPLE REGRESSION EQUATIONS EXPLAINING MALE CRUDE ACTIVITY RATE (MCAR) IN EAST PAKISTAN (17 Districts) AND WEST PAKISTAN (45 Districts)

Independent Variables	East Pakistan Regression I β	t	West Pakistan Regression I β	t	West Pakistan Regression II[a] β	t
Per cent employees in labor force			−0.091	1.79*	−0.172	2.44*
Male non-agriculture industry mix index	0.322	1.51†	0.447	1.06	0.666	1.57†
Density	−0.004	5.44**				
Males attending school	−0.681	4.37**	−0.517	2.71**	−0.439	2.27*
Males with education of eighth grade and over	0.623	2.18*				
Male immigration rate	0.361	2.79**	0.158	3.50**	0.136	2.91**
Male net in-migration rate			0.057	1.75*	0.055	1.71*
Per cent nuclear families	0.259	3.25**	−0.214	3.21**	−0.198	3.00**
Constant	19.696		26.619		6.095	
R^2	0.929		0.526		0.554	
SE	0.89		2.58		2.53	
Dependent variable (MCAR)						
Mean	56.55		54.65		54.60	
Standard deviation	2.56		3.44		3.47	

** Significant at the 1 per cent level.
* Significant at the 5 per cent level.
† Significant at the 10 per cent level.
[a] Excluding Karachi district.

TABLE II
MULTIPLE REGRESSION EQUATIONS EXPLAINING MALE REFINED ACTIVITY RATE (MRAR) IN EAST PAKISTAN (17 Districts) AND WEST PAKISTAN (45 Districts)

Independent Variables	East Pakistan β	t	West Pakistan Regression I β	t	West Pakistan Regression II[a] β	t
Urbanization	−0.356	2.63*	−0.163	3.64**	−0.251	4.69**
Male non-agriculture industry mix index			0.496	1.09	0.581	1.44†
Density	−0.002	1.65†				
Males attending school	−0.905	3.34**	−0.848	3.58**	−0.719	3.18**
Males with education of eighth grade and over	0.834	1.34				
Male immigration rate	0.459	2.42*	0.170	2.84**	0.157	2.78**
Male net in-migration rate			0.092	2.28*	0.090	2.41*
Per cent male married	0.451	2.94**				
Per cent nuclear families	0.196	1.84*	−0.178	2.21*	−0.162	2.15*
Constant	54.955		50.434		42.505	
R^2	0.870		0.648		0.701	
SE	1.32		3.12		2.91	
Dependent variable (MRAR)						
Mean	87.71		81.36		81.44	
Standard deviation	2.66		4.84		4.87	

[a] Excluding Karachi district.

of males (fifteen years and over) with educational attainment of eighth grade and more will inflate MCAR by a little more than six-tenths of one per cent in an otherwise typical East Pakistani district. However, the latter education variable is not statistically very powerful ($t = 2.18$) and is not an important explanatory variable in the case of West Pakistan. Here, note that such effects on MCAR are brought primarily through their influence on a limited range of ages. The school attendance variable affects only the specific activity rates of the younger age span. It is likely that a similar age span would show sensitivity to the other education variable, "percentage of males age fifteen and over with education of eighth grade or more." This shows, as mentioned before, the necessity of separately estimating equations for sex-age sub-groups.

An interesting though not surprising result is that "population density" is the statistically most powerful variable ($t = 5.44$) in East Pakistan. In contrast to West Pakistan, the districts in East Pakistan are quite homogeneous in terms of the geographical distribution of the population. With agriculture being almost the sole source of livelihood and with a very high density of population (among the highest in the world), this variable does seem to be an approximation of population pressure for East Pakistan. Note that here density is almost independent of urbanization (correlation coefficient, r, is only 0.21; see Appendix Table II) and is not reflecting the effect of the latter. (Such is not the case in West Pakistan, where $r = 0.71$ between the two variables; see Appendix Table III.) With a regression coefficient of only -0.004, however, only substantial changes in density influence the activity rate.

Male non-agriculture industry mix index, though only statistically significant at the 10 per cent level, does have substantial impact on MCAR, particularly in West Pakistan. A one percentage point difference in the value of this index among otherwise similar districts in West Pakistan results, on the average, in a difference of two-thirds of a per cent in MCAR. It is important to note that the industry mix variable also enters into the MRAR equation and the female activity rate equations for West Pakistan (though again it is not statistically very significant), but not into the corresponding equations for East Pakistan. This signifies that, with the present rapid industrialization of the already semi-industrialized province of West Pakistan, the accompanying structural changes (changing the industry mix) are altering the relative levels of male and female propensities to participate in economic activity, while in the agrarian province of East Pakistan, the industry mix variable does not seem to be important.[17]

The only perplexing variable and one worth an explanation is the family composition variable, "per cent nuclear families," which appears with regression coefficients of opposite signs in the two provinces and with high statistical significance. In an East Pakistani district, otherwise alike to all other districts, a one per cent increase in the proportion of nuclear families will inflate MCAR by more than one-fourth of a point, but the same conditions would contract MCAR by one-fifth of a point in a West Pakistani district. As mentioned before, the

[17] For discussion of the structural changes in the two provincial economies, see [5].

relationship between this variable and work participation may not be a direct one. Probing into the correlation coefficient matrices in Appendix Tables II and III, we find a set of determinants of labor activity correlated in turn with the family composition variable in opposite directions in the two provinces. For example, "per cent nuclear families" is negatively correlated with "urbanization" and "industrialization" in East Pakistan. It has been observed that non-agricultural activity in East Pakistan is relatively traditional and that there is greater scope for extended family operated industries. On the other hand, in West Pakistan there is a positive relationship between "per cent nuclear families" and "urbanization" and "industrialization," which in turn are negatively correlated with the activity rate. Similarly, note the inverse relationships and the different sizes of the correlation coefficients of this variable with "literacy," "immigration," etc., in the two provinces. In the case of females, the observations are similar to those for males in their respective province. All this suggests that the family composition variable is really portraying the influence on the propensity to participate in labor activity of a set of variables, which are inversely related with this variable itself in the two provinces, and that it has different economic and social roles to play in these areas.

Table II provides regression fits for MRAR.[18] There are some differences between these equations and the equations of Table I. "Urbanization," not an important determinant of MCAR, is picked up as an important variable in the MRAR equation for East Pakistan. And in the corresponding equation for West Pakistan, it emerges as statistically most significant ($t = 4.69$) and replaces the industrialization variable "per cent employees in labor force"—a determinant of MCAR. ("Urbanization" and "per cent employees in labor force" are, however, highly niter-correlated, $r = 0.87$. See Appendix Table III.) The school attendance variable remains important and highly significant in both provinces. The regression coefficients with respect to this variable are much higher in the MRAR equations than those observed for MCAR. The reason is statistical—now the dimensions of both dependent and independent variables are the same (males ten years and over) and the extra population of persons under ten years which was included in crude activity rates is excluded.

In East Pakistan, family composition, high educational attainment and density, important determinants of MCAR, are statistically not very significant for MRAR (particularly "males with education of eighth grade and over," which is significant only at the 15 per cent level).

Finally, a brief note on the impact of migration (immigration and net internal migration) on male labor activity. Statistically significant in both provinces, immigration, which has been quite substantial in magnitude, seems to carry a larger

18 Note that by excluding Karachi a better equation (Regression II) is obtained for West Pakistan. R^2 is improved by 5.3 percentage points and SE is reduced.

impact on labor force participation in East Pakistan. (Net regression coefficients are, respectively, 0.36 and 0.46 for MCAR and MRAR. Corresponding coefficients in the case of West Pakistan are 0.14 and 0.16.) Part of the explanation may be that immigration to West Pakistan has been more involuntary in nature than that to East Pakistan and hence has not, perhaps, significantly altered the age structure and/or the age-specific propensity to participate in economic activity. We have, however, no relevant statistics with which to prove this empirically. Another factor may be that relatively more immigrants in West Pakistan settle in urban areas. This is substantiated by a high simple correlation found in West Pakistan between the immigration rate and urbanization ($r = 0.60$ compared to only 0.18 in East Pakistan). And, since the propensity to participate in labor activity is lower in urban areas, much of the immigration to West Pakistan may not have a positive influence on labor activity. On the other hand, internal migration seems to be relevant only in West Pakistan. This is not surprising. Whereas East Pakistan has remained more or less a homogeneous, predominately agrarian area, West Pakistan has been experiencing rapid economic growth and industrialization with the result that certain geographical regions have been developing much faster than others and hence offering better job opportunities. Such regions have been attracting substantial migration from relatively depressed areas. These migrants are usually in the prime adult age span with high propensity to participate in economic activity. A one percentage point increase or decrease in "net in-migration rate" (i.e., in-migration minus out-migration) to a typical district in West Pakistan will cause, on the average, an increase or decrease of one-tenth of a per cent in its MRAR (and a little more than one-twentieth of a per cent in its MCAR).

Overall, seen in terms of both the proportion of total variance explained and the standard error of the estimate, we have obtained very good fits for crude and refined participation rates, particularly for East Pakistan.

B. *Female Labor Force Participation Equations.*

A correlation coefficient of 1.0 between female crude activity rate (FCAR) and female refined activity rate (FRAR) makes them perfect substitutes for each other. Hence, we expect the same set of explanatory variables with similar t-ratios; the only difference being higher values of the β's for FRAR, which by definition is of larger dimension. However, for general reference, regression equations for both FCAR and FRAR are provided. Because of the different sets of determinants of female work participation and of the converse roles of some factors operating within the two provinces, we will discuss the results for each province separately.

Tables III and IV give respectively FCAR and FRAR equations for West Pakistan. It is important to note that, in comparison to males, the range of female activity rates across districts is very wide, part of which is probably due to reporting biases. There are five districts in West Pakistan which reported relatively very high female activity rates.[19] Appendix Table I provides equations including these five districts. Plots of actual and fitted values from these equations showed very large residual values for these districts. This explains why the *SE* for these equations are about twice as large as those for the corresponding equations in Tables III and IV.[20]

Besides these five districts, the equations were also estimated excluding Karachi district. This does not improve the equations, and either of the regression sets, including or excluding Karachi, can be used. However, with only a little more

TABLE III
MULTIPLE REGRESSION EQUATIONS EXPLAINING FEMALE CRUDE ACTIVITY RATE (FCAR) IN WEST PAKISTAN (45 Districts)

Independent Variables	Regression I[a] β	Regression I[a] t	Regression II[a] β	Regression II[a] t	Regression III[b] β	Regression III[b] t	Regression IV[b] β	Regression IV[b] t
Per cent employees in labor force	−0.168	2.11*	−0.238	4.06**	−0.174	2.03*	−0.244	3.78**
Female non-agriculture industry mix index	0.584	1.30†			0.528	1.21		
Female literacy rate	0.385	2.21*	0.522	3.74**	0.385	2.14*	0.515	3.55**
Female immigration rate	−0.090	1.60†	−0.102	1.84*	−0.093	1.62†	−0.104	1.82*
Per cent females married	0.122	2.50**	0.156	3.76**	0.125	2.56**	0.156	3.70**
Per cent nuclear families	−0.120	1.98*	−0.088	1.58†	−0.117	1.87*	−0.086	1.50†
R^2	0.430		0.402		0.424		0.398	
SE	2.41		2.43		2.45		2.46	
Dependent variable (FCAR)								
Mean	4.75				4.79			
Standard deviation	2.94				2.97			

[a] Excluding five districts with extremely high FCAR.
[b] Excluding Karachi district and five districts with extremely high FCAR.

19 These five districts with their respective FCAR and FRAR are as follows:

	FCAR	FRAR
Kohat	14.40	22.64
Tharparkar	15.43	22.63
Campbellpur	17.29	25.17
Larkana	18.11	26.92
Jacobabad	26.95	41.94

20 Also the parameters of the equations in Appendix Table I with respect to female literacy, industry mix and industrialization variables (Regressions I) show that including industry mix gives too large a net regression coefficient for this variable (1.58 for FCAR and 2.32 for FRAR) and makes industrialization and female literacy statistically insignificant. Exclusion of non-agricultural industry mix index improves the equations (Regressions II), but with a very high correlation between this variable and "female literacy rate" ($r=0.77$; note that this is reduced to 0.02 when these five districts are excluded; see Appendix Table V), the regression coefficient with respect to the latter variable becomes too large (0.74 for FCAR and 1.07 for FRAR).

TABLE IV
MULTIPLE REGRESSION EQUATIONS EXPLAINING FEMALE REFINED ACTIVITY RATE (FRAR) IN WEST PAKISTAN (45 Districts)

	Regression I[a]		Regression II[a]		Regression III[b]		Regression IV[b]	
Independent Variables	β	t	β	t	β	t	β	t
Per cent employees in labor force	−0.251	2.01*	−0.356	3.87**	−0.268	1.99*	−0.370	3.67**
Female non-agriculture industry mix index	0.869	1.23			0.784	1.14		
Female literacy rate	0.558	2.04*	0.761	3.48**	0.551	1.95*	0.743	3.28**
Female immigration rate	−0.132	1.50†	−0.151	1.73*	−0.140	1.55†	−0.156	1.74*
Per cent females married	0.198	2.59**	0.248	3.82**	0.203	2.64**	0.248	3.77**
Per cent nuclear families	−0.193	2.04*	−0.146	1.67†	−0.187	1.90*	−0.140	1.56†
R^2	0.419		0.393		0.414		0.391	
SE	3.79		3.81		3.84		3.86	
Dependent variable (FRAR)								
Mean	7.29				7.36			
Standard deviation	4.58				4.62			

[a] Excluding five districts with extremely high FRAR.
[b] Excluding Karachi district and five districts with extremely high FRAR.

than two-fifths of the total variance explained by the equations and still very high *SE* (2.41 and 3.79 for FCAR and FRAR respectively in Regressions I), particularly given the low mean values of FCAR and FRAR, the value of these results is limited. Possibly, the results might be improved by considering some other variables. The trouble, however, may not be that we have too few independent variables (or not the right ones), but, as shown by an earlier study, that the measurement of the dependent variable itself is poor [4, Section 2.4].

It is important to realize that there is a multicollinearity problem involved in Regression sets II and IV. There is a high correlation between "female literacy rate" and "per cent employees in labor force" ($r = 0.76$ including Karachi and 0.49 excluding Karachi), which seems to be partly responsible for their large regression coefficients, particularly for the former variable. The inclusion of the industry mix variable seems to improve the equations (Regression sets I and III). Coefficients for the above two variables are reduced to more reasonable size and R^2 is improved. Both literacy and industry mix variables have a positive influence on the female propensity to participate in economic activity (with industry mix variable significant only at the 10 per cent level, as was the case in the equations for males). The industrialization variable, as expected, enters with a negative coefficient. Statistically, the most significant determinant of female labor activity is, however, "per cent females married." This finding is unexpected but not hard to explain. In rural areas it is a common observation that unmarried women are usually inhibited from working in the field. Such may not be the case for married women—they may be relatively free to share the farm work. (This reasoning does not apply to industrial and urban areas.) This factor also seems to be responsible for a higher female labor activity in rural areas than in urban ones. The family composition variable is also important and works in the same direction as for males in West Pakistan. The negative marginal coefficients of the activity rates with respect to "female immigration rate" justify our suspicion that migration and its spread are not economically motivated for females, at least in the case of West Pakistan.

In the case of East Pakistan, we are confronted with the very difficult problem of an extreme divergence of activity rates across districts. Using the "range of variation" as a criterion, the seventeen districts can easily be bifurcated into eleven districts with an activity rate range of 1.0 to 6.0 per cent and six districts with a range of 16.3 to 46.8 per cent.[21] Obviously the inclusion of this group of six districts will be statistically incorrect. In Table V we have given the equations for FCAR and FRAR based on the observations of only the first group of eleven districts. Of course, the coefficients of these equations should only be used in the context of these eleven districts and not of the province as a whole.

For these eleven districts, a very high correlation was found between "per cent

TABLE V

MULTIPLE REGRESSION EQUATIONS EXPLAINING FEMALE CRUDE ACTIVITY RATE (FCAR) AND FEMALE REFINED ACTIVITY RATE (FRAR) IN EAST PAKISTAN (11 Districts)

	FCAR				FRAR			
	Regression I		Regression II		Regression I		Regression II	
Independent Variables	β	t	β	t	β	t	β	t
Child-woman ratio	−0.006	1.87†	−0.007	1.62†	−0.010	1.84†	−0.011	1.59†
Female immigration rate	0.322	2.74*	0.313	2.42*	0.534	2.75*	0.505	2.44*
Female net in-migration rate	0.238	2.26*	0.215	1.85†	0.377	2.24*	0.340	1.83†
Per cent females married			0.108	1.97*			0.171	1.95*
Per cent nuclear families	0.136	2.34*			0.216	2.31*		
R^2	0.776		0.744		0.775		0.742	
SE	0.80		0.86		1.29		1.38	
Dependent variable								
Mean	2.31				3.75			
Standard deviation	1.35				2.16			

21 Five of these six districts constitute Chittagong division and the sixth district is Mymensingh in Dacca division. Note that Assam State in India borders with all these six districts and seems to carry the influence of its high female labor participation across the border. It was observed that most of the simple correlation coefficients between female labor activity and the independent variables were of opposite signs and/or were of very different sizes when these six districts were included in the province. This implies that different factors are operating in these districts, perhaps making them more homogeneous with Assam State in India than with the rest of the districts in East Pakistan.

nuclear families" and "per cent females married" ($r = 0.79$) and, *a priori*, we could not decide which one was a more important variable. So in Table V, Regressions I includes the former variable and Regressions II, the latter. Both these exogenous variables emerge as significant in their respective equations. However, it seems that the marital status variable pulls down the value of the other variables as well as R^2 and slightly increases the *SE*.

As expected, in comparison to West Pakistan, there is a somewhat different set of explanatory variables for female labor force participation in East Pakistan. The equations have substantial, positive and statistically significant parameters for both migration variables along with the family composition variable—a phenomenon similar to that which was found in the case of East Pakistani males, but quite different to that which is observed for females in West Pakistan. The fertility variable, "child-woman ratio" (not a significant determinant of female labor force participation in West Pakistan) enters with the expected negative sign, though it is significant only at the 10 per cent level.

V. CONCLUSION

The above model has academic value as an explanation of the regional patterns of economic activity and intermediate practical value for policy guidelines. We have been able to obtain good fits for male labor force participation in both provinces.[22] The immediate usefulness of the results obtained here is their capacity to point out ways of making improvements. Such equations, improved in line with the theoretical model suggested earlier, are necessary in order to project labor force at different points in time.

We must admit the inadequacy of our results for female labor force participation. The situation can best be improved by better measurement of female labor activity, now admitted to be very poor. The equations for West Pakistan are, however, somewhat encouraging in the sense that we were able to get a set of statistically significant parameters for female work participation, particularly with respect to industrialization, industry mix, education and marital status. These variables, though they leave a large unexplained variance, are meaningful in terms of policy implications. The situation is quite different in the case of East Pakistan. We obtained good statistical fit in terms of variance explained but the variables included such as migration and family composition are likely to be only intermediate variables and are not very suitable for policy applications. So here the need is to improve both the type of explanatory variables included and the quality of reporting of economic activity.

22 These are encouraging results considering that we expect lower R^2 from cross-section data than from time series as there is no time trend factor present in the former.

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APPENDIX TABLE I

MULTIPLE REGRESSION EQUATIONS EXPLAINING FEMALE CRUDE ACTIVITY RATE (FCAR) AND FEMALE REFINED ACTIVITY RATE (FRAR) IN WEST PAKISTAN (45 Districts)

	FCAR				FRAR			
	Regression I		Regression II		Regression I		Regression II	
Independent Variables	β	t	β	t	β	t	β	t
Per cent employees in labor force	−0.116	0.80	−0.321	2.96**	−0.173	0.78	−0.474	2.87**
Female non-agriculture industry mix index	1.584	2.05*			2.322	1.96†		
Female literacy rate	0.332	1.05	0.737	2.86**	0.479	0.99	1.074	2.74**
Female immigration rate	−0.158	1.56†	−0.207	2.03*	−0.234	1.52†	−0.307	1.98*
Per cent females married	0.186	2.28*	0.283	4.07**	0.300	2.40*	0.442	4.18**
Per cent nuclear families	−0.299	2.97**	−0.214	2.25*	−0.463	3.02**	−0.339	2.34*
R^2	0.403		0.339		0.402		0.342	
SE	4.42		4.60		6.76		7.00	
Dependent variable								
Mean	6.27				9.58			
Standard deviation	5.33				8.14			

** Significant at the 1 per cent level.
* Significant at the 5 per cent level.
† Significant at the 10 per cent level.

APPENDIX
MATRIX OF CORRELATION COEFFICIENTS *r* AMONG
AND DEMOGRAPHIC VARIABLES FOR

	MCAR	MRAR	MLFNA	TEMPL	URBAN	DENST	NUCLE
MRAR	.68						
MLFNA	−.17	−.66					
TEMPL	−.09	−.62	.96				
URBAN	−.03	−.48	.93	.95			
DENST	−.75	−.42	.21	.17	.21		
NUCLE	.13	.19	−.22	−.19	−.10	.32	
MASCH	−.71	−.53	−.03	.02	−.10	.42	−.02
MLITE	−.32	−.46	.10	.24	.15	.21	.10
M8YSC	−.43	−.68	.57	.61	.50	.49	−.03
MIMM	.28	.34	.11	.12	.18	−.21	−.23
MNINM	.79	.28	.17	.25	.32	−.69	−.16
MMAR	−.01	.57	−.63	−.62	−.43	.09	.12
UNEMP	−.43	−.67	.67	.68	.49	.25	−.16
MTMIX	−.09	−.63	.96	.98	.94	.14	−.27
MNAMIX	.50	.25	−.29	−.13	−.16	−.33	.32

Note: The variables in order of appearance are:
MCAR=Male crude activity rate.
MRAR=Male refined activity rate.
MLFNA=Per cent male workers in non-agricultural sector.
TEMPL=Employees in non-agricultural sector as a percentage of total labor force.
URBAN=Per cent population living in urban areas.
DENST=Number of persons per square mile.
NUCLE=Per cent nuclear families.
MASCH=Per cent males (ten years and over) attending school.

APPENDIX
MATRIX OF CORRELATION COEFFICIENTS *r* AMONG ACTIVITY
VARIABLES FOR MALES IN WEST

	MCAR	MRAR	MLFNA	TEMPL	URBAN	DENST	NUCLE
MRAR	.82						
MLFNA	−.17	−.53					
TEMPL	−.17	−.45	.85				
URBAN	−.15	−.48	.90	.87			
DENST	.01	−.27	.74	.51	.71		
NUCLE	−.36	−.22	.13	.08	.06	.02	
MASCH	−.36	−.63	.60	.35	.49	.65	−.08
MLITE	−.26	−.64	.74	.55	.66	.64	−.23
M8YSC	−.29	−.60	.87	.74	.82	.71	−.02
MIMM	.22	−.10	.62	.39	.60	.71	.04
MNINM	.37	.31	.07	.18	.21	.09	−.09
MMAR	.00	.29	−.62	−.50	−.49	−.55	.06
UNEMP	−.37	−.49	.52	.38	.41	.51	.02
MTMIX	−.09	−.37	.88	.91	.82	.53	.14
MNAMIX	.15	.17	.19	.42	.17	−.10	−.02
MMIX-K[a]	.16	.07	.49	.73	.54	.24	−.02

[a] MMIX-K is male non-agriculture industry mix index calculated excluding Karachi

TABLE II
ACTIVITY RATES AND SELECTED SOCIO-ECONOMIC
MALES IN EAST PAKISTAN (17 Districts)

MASCH	MLITE	M8YSC	MIMM	MNINM	MMAR	UNEMP	MTMIX
.77							
.52	—.56						
—.14	—.17	—.25					
—.62	—.22	—.27	.27				
.04	—.14	—.48	.15	—.14			
.45	.33	.60	.09	—.29	—.62		
.00	.21	.50	.07	.30	—.62	.60	
—.29	.05	—.16	—.36	.49	—.10	—.31	—.09

MLITE=Per cent males (ten years and over) literate.
M8YSC=Per cent males (fifteen years and over) with education of eighth grade and more and not in school.
MIMM=Male immigration rate.
MNINM=Male net in-migration rate.
MMAR=Per cent males (ten years and over) married.
UNEMP=Per cent of total labor force unemployed.
MTMIX=Male industry mix index.
MNAMIX=Male non-agriculture industry mix index.

TABLE III
RATES AND SELECTED SOCIO-ECONOMIC AND DEMOGRAPHIC
PAKISTAN (45 Districts)

MASCH	MLITE	M8YSC	MIMM	MNINM	MMAR	UNEMP	MTMIX	MNAMIX
.92								
.81	.89							
.37	.43	.49						
—.17	—.08	.05	.19					
—.61	—.60	—.67	—.40	—.03				
.76	.72	.72	.14	—.09	—.43			
.32	.50	.70	.49	.13	—.58	.25		
—.24	—.13	.05	—.03	.16	—.27	—.21	.58	
—.05	.12	.34	.23	.25	—.37	.05	.76	.83

district.

APPENDIX

MATRIX OF CORRELATION COEFFICIENTS *r* AMONG ACTIVITY VARIABLES FOR FEMALES IN

	FCAR	FRAR	MLFNA	TEMPL	URBAN	DENST	NUCLE
FRAR	1.00						
MLFNA	−.10	−.10					
TEMPL	.05	.06	.94				
URBAN	.11	.11	.92	.97			
DENST	−.30	.30	.59	.57	.59		
NUCLE	.29	.30	−.20	−.13	−.03	.23	
FASCH	−.58	−.59	.40	.28	.27	.20	−.13
FLITE	−.36	−.37	.43	.47	.39	.14	−.16
F8YSC	−.11	−.10	.75	.68	.79	.54	.13
FIMM	.65	.65	.05	.08	.07	−.33	.03
FNINM	.66	.65	−.35	−.18	−.16	−.43	−.07
FMAR	.37	.37	−.46	−.32	−.21	−.14	.79
CHILD	−.40	−.38	.28	.04	.04	.23	−.45
UNEMP	−.07	−.07	.76	.66	.59	.11	−.43
FTMIX	.05	.05	−.94	−.97	−.94	−.63	.22
FNAMIX	−.17	−.18	.57	.35	.30	.07	−.37

[a] The six districts excluded are Mymensingh, Sylhet, Comilla, Noakhali, Chittagong and Chittagong Hill Tracts.

Note: New variables in order of appearance are:
FCAR=Female crude activity rate.
FRAR=Female refined activity rate.
FASCH=Per cent females (ten years and over) attending school.
FLITE=Per cent females (ten years and over) literate.
F8YSC=Per cent females (fifteen years and over) with education of eighth grade

APPENDIX

MATRIX OF CORRELATION COEFFICIENTS *r* AMONG ACTIVITY VARIABLES FOR FEMALES IN

	FCAR	FRAR	MLFNA	TEMPL	URBAN	DENST	NUCLE	FASCH
FRAR	1.00							
MLFNA	−.17	−.20						
TEMPL	−.32	−.33	.85					
URBAN	−.18	−.19	.90	.86				
DENST	−.09	−.12	.74	.50	.70			
NUCLE	−.28	−.27	.06	.04	.04	−.01		
FASCH	−.00	−.03	.88	.72	.86	.83	−.04	
FLITE	−.01	−.04	.90	.76	.89	.82	−.08	.98
F8YSC	−.11	−.12	.89	.85	.93	.78	−.01	.95
FIMM	−.06	−.08	.62	.37	.60	.72	−.02	.64
FNINM	.10	.10	.10	.11	.19	.14	.02	.12
FMAR	.20	.24	−.59	−.34	−.41	−.63	−.04	−.56
CHILD	−.01	.05	−.32	−.09	−.25	−.40	.10	−.47
UNEMP	.32	.29	.52	.39	.42	.52	−.04	.64
FTMIX	.39	.40	−.88	−.91	−.83	−.52	−.07	−.69
FNAMIX	.46	.45	−.15	−.40	−.14	.14	.06	−.00
FMIX-K[b]	.40	.39	−.48	−.73	−.53	−.22	.05	−.37

[a] The five districts excluded are Kohat, Tharparkar, Campbellpur, Larkana and Jacobabad.

TABLE IV

Rates and Selected Socio-Economic and Demographic

East Pakistan (11 Districts)[a]

FASCH	FLITE	F8YSC	FIMM	FNINM	FMAR	CHILD	UNEMP	FTMIX
.80								
.58	.34							
−.51	−.47	−.03						
−.56	−.31	−.38	.33					
−.43	−.46	−.06	.27	.14				
−.02	−.30	.20	.15	−.30	−.23			
.24	.24	.50	.47	−.31	−.31	.49		
−.38	−.54	−.68	.07	.16	.48	−.06	−.57	
.35	.13	.41	.27	−.53	−.28	.45	.78	−.29

and over and not in school.
FIMM=Female immigration rate.
FNINM=Female net in-migration rate.
FMAR=Per cent females (ten years and over) married.
CHILD=Child-woman ratio.
FTMIX=Female industry mix index.
FNAMIX=Female non-agriculture industry mix index.

TABLE V

Rates and Selected Socio-Economic and Demographic

West Pakistan (40 Districts)[a]

FLITE	F8YSC	FIMM	FNINM	FMAR	CHILD	UNEMP	FTMIX	FNAMIX
.96								
.69	.64							
.13	.13	.18						
−.53	−.46	−.39	.10					
−.46	−.32	−.35	−.04	.47				
.60	.54	.15	.05	−.52	−.31			
−.71	−.79	−.46	−.04	.43	.09	−.25		
.02	−.12	.10	.10	−.00	−.24	.22	.55	
−.41	−.55	−.21	−.01	.11	−.14	−.06	.76	.82

[b] FMIX-K is female non-agriculture industry mix index calculated excluding Karachi district.