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EGYPTIAN FAMILY SIZE AND FAMILY EXPENDITURE A STATISTICAL INQUIRY

By

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I — Introduction :

The purpose of this paper is to provide a statistical inquiry into the impact of family size on family expenditure in Egypt. Needless to say that this is an important point of research as far as the implications to the family planning concept is concerned. Superficially, as family size increases, it appears that family expenditure increases at a decreasing rate, i.e. per capita family expenditure diminishes. It would be interesting to study the effect of family size upon family expenditure, distinguishing as between urban and rural areas separately. Specifically, the aims of this paper may be outlined as follows.

1. Estimating the rate at which per capita family expenditure diminishes as family size increases by one more member. The estimate is also given for various spending items.

2. Constructing an index of deterioration for per capita expenditure, taking a one member family as the base.

3. Answering the questions : Does the pattern of per capita expenditure (on different items) for the same family size differs as between urban and rural families ? If this is the case, at which size of family this is being so ? Taking the one-member family as the base, does the pattern of per capita expenditure (on different items) differ as family size increases ? At what family size this is being so ? Is this being the same for both urban and rural areas ?

4. Estimating, in absolute terms, the amount of decrease in expenditure as a result of increasing the family by one more member, after taking into consideration other factors.

The source of data is «Family Budget Survey in A.R.E.», published September 1978, by the Egyptian Central Office for Mobilization and Statistics, (80-12524/78), tables No. 2, 3, 10, 11, 38 and 39.

II — The Statistical Approach and Findings :

1. Estimating the rate at which per capita expenditure diminishes as family size increases.

We estimate this rate according to two different formulas. The first of which is given as follows,

$$A = \sum_{r=1}^{9} \frac{e^{-\lambda}\lambda^{r}}{r!} \left[100 \Sigma \left(\frac{L_{r+1}}{L_r} - 1\right) \frac{L_i}{\Sigma L_i}\right] \Big/ \sum_{r=2}^{9} \frac{e^{-\lambda}\lambda^{r}}{r!} \qquad (1)$$

where,

λ : the average size of the family. According to our source of data there have been (7993) families covering (43437) individuals for urban areas. As for rural areas, there have been (4002) families covering (22782) individuals. Therefore, λ is given as (5.434) for urban and (5.693) for rural families.

r : Family size. Data in tables (10) and (11) of our source of data is given for family expenditure on different items as for each of the following family size : 1, 2, ... 10 and over.

Lr : Per capita family expenditure on different items, for family size of (r) individuals.

L_{r+1} : Per capita family expenditure on different items, for family size of (r + 1) individuals.

L_i : Per capita expenditure of family of size (r + 1) on item (i). We have considered the following items : Food and Drink, Textile and Clothings, Housing and Furniture ... etc, Transportation, Amusement ... etc, Education, Medical care, Miscellaneous Itmes.

As a result measurment (1) may be considered as a weighted average of the ratio of per capita expenditure of family size (r + 1) to that of family size (r) minus one (over all items). The weights being used are the poisson probabilities of different family sizes. We have found (A) as follows;

	Urban	Rural
A	— 11.2%	— 6.5%

This indicates that as family increases by one more member, per capita share of family expenditure falls by 6.5% for the rural family while it falls by 11.2% for the urban family. There are at least two reasons for this discrepancy. Firstly, the level of per capita rural family expenditure is already lower than that of an urban family.

As family increases by one more member there seems to be a smaller possibility that the per capita ruarl family expenditures may be subjected to a further decrease. Secondly, as a rural family size increases extra members are more likely to be directed to work in fields and factories and therefore may be considered as a source of income rather than a source of expenditure pressure.

The other measure is to estimate the following exponential equation.

$$L = C\,(D)^r \qquad (2)$$

where,

L : is the per capita family expenditure.

r : is the family size : 1, 2, ... , 9.

C, D : are constants, $D < 1$.

As a result (L) is expected to be diminished by the following rate;

$$A = 100\,(D - 1)$$

as family increases by one more member. Equation (2) has been estimated for both urban and rural families, and the results are given as follows;

Urban	Rural
$L = 208\ (0.89)^r$	$L = 101\ (0.93)^r$
$A = -11\%$	$A = -7\%$

These are very close estimates to the values previously given. The two different estimates for (A) reinforce each other. Chart (1) demonstrates equation (2) for each of urban and rural families.

Further, we estimated equation (2) for each of different expenditure categories. The results are given in tables (I) and (II).

TABLE 1

	Urban	Rural
Food & Drink :	100.0 $(0.90)^r$	61.6 $(0.93)^r$
Textile & Clothing :	20.6 $(0.92)^r$	9.1 $(0.93)^r$
Housing & Furniture :	49.1 $(0.84)^r$	16.9 $(0.89)^r$
Medical Care :	6.1 $(0.82)^r$	1.4 $(0.90)^r$
Education :	8.0 $(0.88)^r$	———
Cigaretts and Tobacco :	19.3 $(1.08)^r$	12.6 $(1.10)^r$

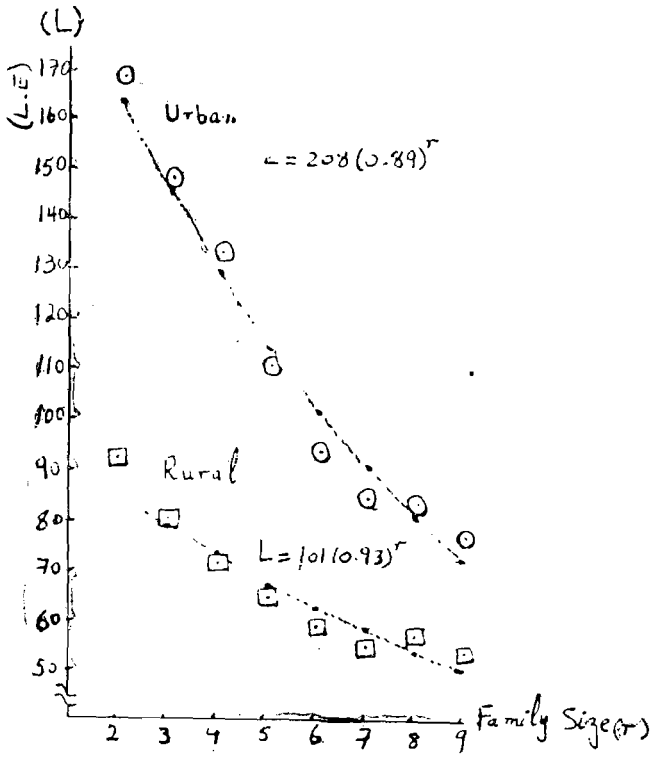

TABLE 2

As family size increases by one member per capita expenditure on the particular item decrease by

		Urban	Rural
Food & Drink	:	10%	7%
Textile & Clothing	:	8%	7%
Housing & Furniture	:	16%	11%
Medical Care	:	13%	10%
Education	:	12%	——
Cigaretts and Tobacco	:	(+8%)	(+10%)

As for education, data of expenditure on this item for rural family is negligible. As for the last item in table II, (Cigaretts and Tobacco), family expenditure on this item is not expessed as per capita since it is related to the head of the family.

It is interesting to note that the value of (A) given for this item is positive in contrary to other items, for each of urban and rural families. The reason for this, it seems, is that as family size increases this represents a cause for concern and worry for the head of the family and as a result expenditures on this item also increase. Table (II) reveals that expenditure on medical care is the first item which suffers from cutting down as family increases in size. This is true for both urban and rural families. Expenditures on both clothing and food are being the least as for as cutting down expenditure is concerned. This is also true for both urban and rural families. Generally, the rate of cutting down expenditure for a rural family is less than that for an urban family. This is being consistent with the previous finding.

2. *Constructing an index of deterioration for per capita expenditure.*

This index takes a one-member family as its base, and it takes the from,

$$M = 100 \left[1 - \sum_i \frac{L_{ri}/r}{L_{1i}} \cdot \frac{L_i}{\Sigma L_i} \right]$$

L_{ri} : Total expenditure of family of size (r) on item (i).

r : 2, 3, ... 9.

L_{ri} : Expenditure of a one-member family on item (i).

As a result, this index is given for each family size : 2, 3, ... 9. The results are given in table (III).

TABLE (III)

Family size	M (urban)	M (rural)
2	— 11.7%	(+ 10.9%)
3	— 24.4%	— 2.2%
4	— 30.7%	— 13.1%
5	— 43.3%	— 21.1%
6	— 51.6%	— 29.7%
7	— 55.8%	— 33.3%
8	— 53.8%	— 31.5%
9	— 59.4%	— 35.2%

The general conclusion deriven from this table is that per capita share of family expenditure deteriorates faster for urban than for rural families. For a rural family of size (2) this per capita family expenditure

actually increases. The reason for this may be that the wife in rural families is more likely to add to her husband's income through accepting a job an urban wife may not accept.

3. *Per capita expenditures on different items and family size.*

In this section we make use of Kruskal/Wallis test (3). According to this test, assuming there are C samples, the number of observations in the i sample is n_i. The question is to test the hypothesis that the samples are drawn from the same population may be answered by ranking the observations from (1) to Σn_i (giving each observation in a group of ties the mean of the ranks tied for). The C sums of ranks is found and the (H) Statistic is calculated. Unless the samples are too small, this statistic is distributed approximately as $\chi^2(c-1)$ The value of (H) is determined as follows:

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{c} \frac{R_i^2}{n_i} - 3(N+1) \qquad (4)$$

where,

C : the number of samples,

ni : the number of observations in the i sample,

N the number of observations in all samples combined,

R_i : the sum of the ranks in the i^{th} sample.

Large values of (H) lead to rejection of the null hypothesis. If there are ties, each observation is given the mean of the ranks of which it is tied. In such a case the value of (H) so determined by (3) is then divided by;

$$\frac{N^3 - \Sigma N}{12} - 1 \qquad (5)$$

where the summation is over all groups of ties and T = (t — 1) t (t + 1) = t^3 — t for each group of ties, (t) being the number of tied observations in the group.

We are going to apply this test as regards;

1. urban and rural families for the same family size : 1, 2 ..., 9 (over (18) observations). The results of the (H) statistic are given in table (IV).

2. between a one-member family and per capita expenditure of the family of size 2, 3, ... 9 members, respectively, over the (18) items for each of urban and rural families separately. The results of (H) statistic are given in table V.

Since in each case we are dealing with only (2) groups (C = 2), the number of degrees of freedom is (1). The number of observations is (18), as pointed out before. These are : (grain), (vegetables), (fruits), (meat, fish and eggs), (milk and fat), (sugar and other foodstuffs), (tea and coffee), (drinks), (total expenditure on texile and clothing), (housing and fuel), (furniture and housing services), (total expenditure on transportation), total expenditure on amusement), (education), medical care), (personal and cleaning items), (tobacco and cigaretts), (other items). The source of data on these items is table (38) and table (39) of the foregoing publication. The χ^2 at the 5% is 3.84. Tables IV and V give the values of (H).

TABLE IV

The value of (H) statistic
(urban and rural families)

Family size	H
1	5.94*
2	4.23*
3	5.48*
4	5.63*
5	4.91*
6	3.85*
7	3.85*
8	3.85*
9	3.03
10 and over	1.37

TABLE V

The value of (H) statistic

Family size	urban families H	rural families H
2	0.12	0.20
3	0.32	0.06
4	0.53	0.01
5	2.60	0.004
6	3.72	0.06
7	4.49*	0.12
8	3.85*	0.05
9	5.84*	0.26

(*) significant at the 5%.

Tables (IV) and (V) reveal interesting results. Table (IV) suggests that only at very large family size (9, 10 and over) there is no significant difference between an urban a rural family as far as the allocation of family expenditure on different items is concerned. For an urban family table (V) reveals that unless the family size is larger than 6 members, there is no significant difference between the allocation of per capita family expenditure on different items and that of a one member-family. For a rural family, table (V)suggests that the pattern of allocationg per capita family expenditure over the different items for any family size is the same as that of a one-member family.

4. *Estimating in absolute terms the amount of decrease of per capite family expenditure as family size increases.*

In this section we consider family expenditure on less necessary items since the effect of family size may be relatively more influential. These items are : transportation, amusement, education, medical care and other items of less importance. We combined these items in one group and expressed expenditure on them (in L. E.) as per capita (E). The effect of the average gamily size (r) is being estimated using the following regression equation which is computed for each of urban and rural families separately.

$$E = a_0 + a_1, L + a_2\, r + a_3 \frac{E.I.}{T.E.} \qquad (6)$$

Where, in addition to previously defined variables,

L : per capita family expenditure on all items. This is a proxy for per capita family income. The sign of this variable is therefore expected to be positive.

r : the average family size. The sign of this variable is expected to be negative.

E.I/T.E : the ratio of family expenditure on all items excluding the less necessary ones, to total expenditure of the family on all items, expressed in percentage terms. Thus the sign of this variable is expected to be negative since the two categories of items (necessary and less necessary items) in the family budget are considered to be alternatives as far as marginal spending is concerned.

Equation (6) is being estimated by the method of least squares as follows; (table (V) in the appendix provides the relevant data).

(A) *Urban families*

$$E = 452.987 + 0.144\,L - 12.300r - 4.585\,\frac{E.I.}{T.E.} \qquad (6.1)$$

$$(0.070) \quad (2.135) \quad (0.973)$$

$$n = 16 \quad R^2 = 0.987$$

(B) *Rural families :*

$$E = 105.362 + 0.253\,L - 2.004\,r - 1.144\,\frac{E.I.}{T.E.} \qquad (6.2)$$

$$(0.011) \quad (0.164) \quad (0.134)$$

$$n = 16 \quad R^2 = 0.997$$

Standard errors are given in parentheses. The coefficient of (L) in (6.1) is about to be significant while all other coeffients in both (6.1) and (6.2) are significant at the 5%. All signs in both equations are as expected a priori, and R^2 is very high. About 99% of variations in per capita family expenditure on the present category of items are allowed for by the variables (L,r and $\frac{E.I.}{T.E.}$) in each of (6.1) and (6.2).

Examination of equations (6.1) and (6.2) reveal the following interesting results.

1. A one (L.E) increae in total family expenditure results in 0.14 (L.E) increase in (E) of an urban family while it results in nearly tewice as much (0.25) increase in (E) of a rural family . The reason is obvious. Since the level of spending on this group of items is only moderate for a rural family as compared to an urban family, therefore a marginal increase in family income is expected to be associated with a higher increase in expenditure on this group of items a rural family than for an urban one.

2. As family size increases by one more member, (E) is cut down by only (2.0 L.E.) for a rural family while it is cut down by more than six times as much (12.3 L.E.) for an urban family. This finding, in addition to the provious finding in percentage estimate, lead to the following conclusion. As family size increases, per capita family expenditure decreases faster both in absolute and in percentage terms for an urban family than for a rural family. That is to say, per capita family expenditure is cut down more for an urban family and less for a rural family, whether it is taken in percentage or in absoulte terms.

3. As the percentage (E.I/T.E) increases, (E) is cut down by a relatively more amount in case of an urban family as compared to a rural family. The reason for this finding may be that expenditures on this group of items are already too low for a rurl family that it is unlikely to be subjected to a further decrease.

Summary of main findings

1. As family size increases total family expenditures increase at a decreasing rate. Therefore per capita share of family expenditure diminishes. Increasing family size by one more member is associated with about 11% decrease of per capita share of an urban family expenditure, while this rate is only about 7% for a rural family. We have used two different methods for estimating these rates. Thus per capita share of family expenditure deteriorates faster as regards an urban family than as for a rural family. This is true whether changes are measured in absolute or in percentage terms.

2. Expenditure on cigaretts and tobacco, increase at the rates of 8% and 10% for urban and rural families respectively as family size increases by one more member.

3. per capita expenditure on medical care is the first item which suffers from cutting down as family increases in size. This is true for both urban and rural families.

4. Per capita expenditure on food and clothing are being the least as far as cutting down expenditure is concerned in response to increasing family size. This is true for both urban and rural families.

5. For a rural family of size (2 persons) per capita family expenditure increases, as compared to a one-member family. On the contrary, for an urban family, this per capita expenditure falls.

6. Only at very large family size (9, 10 and over) there is no significant difference between an urban and a rural family, as far as the allocation of family expenditure on different items is concerned.

We recommend carrying out the statistical approach which we have followed in this paper as new data become available. Such data, on family budget, we hope, should be more comprehensive and the sample should cover more families.

Statistical Appendix

TABLE (I)

The poisson probabilities

$$(e^{-\lambda}\lambda^{r}/r!)$$

r	Urban	Rural
1	0.0233	0.0192
2	0.0645	0.0546
3	0.1168	0.1036
4	0.1586	0.1475
5	0.1724	0.1679
6	0.1561	0.1593
7	0.1212	0.1296
8	0.0823	0.0922
9	0.0497	0.0583

TABLE (II)

Per capita family expenditure L.E.) (Urban)

Item NO \ r	1	2	3	4	5	6	7	8	9
1	97.8	85.0	73.7	65.1	54.9	48.2	44.8	42.7	40.4
2	15.5	17.6	15.2	15.6	13.3	11.7	10.5	10.1	10.1
3	48.5	35.8	30.3	23.7	20.0	15.5	13.1	11.8	11.3
4	5.6	6.5	6.8	7.2	5.1	3.4	2.9	5.8	2.4
5	3.6	2.7	2.3	2.4	1.6	1.1	0.9	1.1	0.9
6	5.2	4.4	3.0	4.1	1.9	1.8	1.7	1.2	1.2
7	-	-	5.2	5.4	4.4	3.9	3.3	2.9	2.7
8	17.7	16.5	15.9	13.3	11.5	10.2	9.1	8.8	8.4
9	-	20.2	25.8	28.4	30.4	31.7	31.7	37.0	37.9

Items are, respectively, as follows; Food & Drink, Textile & Clothing, Housing & Furniture, Transportation, Amusement, Medical care, Education, Other, Cigaretts & Tobacco.

As for eduction, starting from r = 3, 5.2 (L.E.) is assumed to be for the third member (i.e. son), for r = 4 original figure (10.8) is assumed to be devoted for both the third and fourth members (excluding parents) and hence per capita share is 5.4; and so on.

As for cigaretts and tobacco, data represent original figures in accordance with previous reasoning.

TABLE (III)

Per capita family expenditure (L.E.) (Rural)

Item No. \ r	1	2	3	4	5	6	7	8	9
1	58.8	57.5	49.5	44.7	39.9	37.2	35.0	35.3	34.2
2	6.3	8.6	8.9	7.3	6.7	6.5	6.6	6.9	6.5
3	18.3	14.4	12.3	10.4	9.1	7.9	7.1	6.9	6.8
4	0.7	1.1	1.2	1.1	1.6	0.6	0.6	0.8	0.6
5	0.2	0.3	0.4	0.2	0.3	0.2	0.2	0.2	0.2
6	1.2	1.5	1.0	0.7	0.7	0.7	0.6	0.8	0.5
7	-	-	1.2	1.0	1.0	0.8	0.9	0.9	0.8
8	4.2	9.0	7.7	7.2	5.8	5.4	4.9	5.0	4.6
9	-	14.0	16.9	20.1	20.9	23.0	23.4	26.4	29.6

TABLE (IV)

Per capita total expenditure (L.E.)

r	Urban	Rural
2	169.3	92.5
3	149.0	81.4
4	134.1	72.0
5	111.0	64.7
6	94.3	58.9
7	85.3	55.4
8	83.5	56.5
9	76.7	54.0

Col. (1) Per capita family expenditure on (Transportation + Amusement + Education + Medical care + Other items), L.E.
(2) Per capita total family expenditure., L.E.
(3) Average family size.
(4) (E.I/T.E) %.

Class of family Expenditure(L.E)	Urban				Rural			
	Col.(1)	Col(2)	Col(3)	Col(4)	Col(1)	Col(2)	Col(3)	Col(4)
less than 50	0.5	28.4	1.2	98.3	0.7	31.3	1.2	97.6
50-	2.2	49.7	1.3	95.5	2.0	38.2	1.6	94.9
75-	2.4	41.9	2.1	94.3	2.4	35.2	2.4	93.3
100-	4.9	47.7	2.6	89.8	3.0	39.1	3.2	92.4
150-	5.0	48.6	3.6	89.7	3.9	42.4	4.1	90.7
200-	6.4	52.1	4.3	87.7	5.0	45.0	5.0	89.0
250-	8.3	58.6	4.7	85.8	5.5	49.2	5.6	88.8
300-	8.8	61.6	5.3	85.7	6.1	52.0	6.2	88.3
350-	10.4	67.4	5.5	84.6	7.3	57.3	6.4	87.3
400-	12.7	76.9	5.8	83.4	8.5	65.2	6.8	87.0
500-	15.7	88.8	6.1	82.4	10.0	70.8	7.5	85.9
600-	20.1	106.7	6.4	81.1	11.8	84.0	8.1	86.0
800-	29.7	143.6	6.1	79.3	14.0	94.6	9.1	85.2
1000-	39.1	172.5	6.5	77.3	18.9	120.6	9.4	84.3
1400-	63.7	247.7	6.4	74.3	21.3	133.2	11.1	84.0
2000-	182.0	421.8	6.2	56.9	56.7	219.9	9.9	74.2

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