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Does Foreign Aid to Social Sector Matter for Fertility Reduction? An Empirical Analysis for Pakistan

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It is generally observed that fertility determines different economic, social and programme input variables. This study investigates the impact of sector specific (health and education) foreign aid on fertility in the case of Pakistan. The empirical investigation using Auto Regressive Distributed Lag Model (ARDL) over the period of 1973-2012 shows that sector specific foreign aid to the health and education sector has negative impact on fertility rate in Pakistan. The results further highlight that family planning programme inputs are not adequate to control population growth in Pakistan.

Keywords: Foreign Aid, Fertility, Population Control Programmes
JEL Classification: F35, I31, J11

I. INTRODUCTION

Pakistan is an interesting case study on the relationship of foreign aid and fertility due to two reasons. First, Pakistan is receiving a significant amount of foreign aid, especially in education and health sector, under the shed of social reforms to improve economic and social well-being of the society. A large body of empirical studies focuses on better health and education reforms because both sectors play an important role in socio-economic performance of the society. Second, from last four or five epochs the Government of Pakistan has lunched different population control programmes. The most important among them is the Family Planning Programmes with the help of Lady Health Visitors (LHVs). For

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the success of family planning programmes, LHVs provide medicine, treatment, and knowledge sharing environment about population control at Basic Health Units (BHUs). Following the microeconomic household theory of fertility, people tend towards less number of children when they have better health and education facilities.

Schultz (1969, 1973) and Gertler and Molyneaux (1994) examined how socio-economic behavior and programme inputs impact on fertility. Foreign aid has dual impact on fertility: at micro level, it may have positive relationship with fertility, while, at macro level, it may have negative impact on fertility. On the one hand, foreign aid in education sector means improving the literacy level of the couples regarding demand for surviving children. On the other hand, foreign aid towards health sector can improve health infrastructure facilities and medication to increase child survival rate and couples' demand for less children. Developing countries like Pakistan have poor infrastructure in the health sector. The Government of Pakistan has allocated relatively less resource for education and health sector. If we review pervious literature on the relationship of foreign aid and its impact on fertility, we find limited research done in this regard (e.g. Sylwester 2008, Azarnert 2008, 2009 and Cuberes and Kevin 2011), which show positive relationship between population growth and foreign aid.

Malthus (1798) discussed first economic model regarding population growth and income behaviour in his population trap. The neo-classical ideas of fertility describe different variables such as income level, women employment, child bearing opportunity cost and price level. Most theoretical work on the child demand behaviour of consumers have been done by Becker (1960), Schultz (1973) and Easterlin (1976). Many economists such as Becker (1988, 1992), Becker and Barro (1988), Barro and Becker (1989), Ehrlich (1990), Becker *et al.* (1990), Ehrlich and Lui (1991), Wang *et al.* (1994), Zhang and Zhang (1997) and Yip and Zhang (1997) analyse the relationship between population growth and income growth. It is generally believed that foreign aid has positive impact on economic growth, especially in the case of developing nations. Moreover, some studies linked several conditions and environment (intensity of effectiveness with good public policy and favourable geographical conditions) for success of aid and growth (for example, Boone 1996, Burnside and Dollar 2000, Doucouliagos and Paldam 2008 and Rajan and Subramanian 2008). On the other hand, many less developed countries still face the Malthusian trap. So, high population growth has an adverse effect on their development process (Weil and Wilde 2009).

After reviewing the studies on sectoral foreign aid and fertility done by Rosenzweig and Evenson (1977), Behrman and Rosenzweig (2002), Thiele *et al.* (2006), Mishra and Newhouse (2009), Baldacci *et al.* (2008) and Azarnert (2008), it can be said that multiple factors are responsible for changes in fertility rate. This study empirically investigates the impact of sector specific foreign aid (education and health) on fertility in the case of Pakistan. Being a developing country with high population growth rate, sector specific foreign aid may have negative impact on fertility in Pakistan. We used time series data from 1973 to 2012 and employed Auto Regressive distributed Lag Model (ARDL) for co-integration among the variables of the model. Moreover, the paper investigates the effectiveness of programme input on fertility.

II. THEORETICAL MODEL AND DATA SOURCES

Following the theoretical contribution of Schultz (1969), Schultz (1973) and Gertler and Molyneaux (1994), it can be said that there are many socio-economic and cultural factors which are responsible for the fertility rate. For empirical analysis, it is difficult to measure or quantify some factors such as social and cultural factors in decision making behaviour of fertility. However, some important factors are used to achieve our objectives

$$F_t = f(D_t, S_t, Ae_t, Ah_t, L_t) \tag{1}$$

$$F_t = \alpha + \beta_1 D_t + \beta_2 S_t + \beta_3 Ae_t + \beta_4 Ah_t + \beta_5 L_t + \varepsilon_t \tag{2}$$

where F_t = Child per women as a proxy for fertility rate, D_t= Development level or per capita income, S_t = secondary enrollment as a proxy for education level which is considered as an important factor of fertility, Ae_t = Sector specific foreign aid for education, Ah_t = Sector specific foreign aid for health, L_t = Total number of lady health workers (LHVs) as proxy of family planning programme input. Data on foreign aid for health and education sectors are taken from OECD's online data base Creditor Reporting System (CRS) that contains information on the sectoral allocation of aid.[1] For development level, data have taken from the World Bank's World Development Indicator 2012. Data for fertility, primary enrolment and lady health workers have been taken from the Federal Bureau of Statistics, Pakistan.

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[1] Amount of aid at current prices in million US Dollar.
OECD, 2012. International Development Statistics. Online Database on Aid and Other Resource Flows. http//www.oecd.org/dataoecd/50/17/5037721.

III. ECONOMETRIC METHODOLOGY

This paper follows ARDL bounds testing approach for co-integration developed by Pesaran *et al.* (2001), to examine the long-run relationship among fertility, socioeconomic, sector specific foreign aid (health and education) and program input (number of lady health workers) variables in the case of Pakistan. This approach has advantage over the traditional approaches. First, the short and long-run coefficients are simultaneously estimated through simple reparametraization process. Second, it can be employed without limit of whether the variables are integrated of order zero *I(0)* or integrated of order one *I(1)*. Third, this method of co-integration is more appropriate for small sample data set. ARDL approach involves estimating the unrestricted error correction model as follows:

$$\Delta F_t = \phi_{y0} + \pi_{y1}D_{t-1} + \pi_{y2}S_{t-1} + \pi_{y3}Ae_{t-1} + \pi_{y4}Ah_{t-1} + \pi_{y5}L_{t-1} + \sum_{i=1}^{p}\lambda_{iy}\Delta F_{t-i} + \sum_{j=0}^{p}\gamma_{iy}\Delta D_{t-j} + \sum_{i=0}^{p}\alpha_{iy}\Delta S_{t-i} + \sum_{i=0}^{p}\beta_{iy}\Delta Ae_{t-i} + \sum_{i=0}^{p}\delta_{iy}\Delta Ah_{t-i} + \sum_{i=0}^{p}\theta_{iy}\Delta L_{t-i} + \varepsilon_{1t} \quad (1.1)$$

$$\Delta D_t = \phi_{k0} + \pi_{k1}F_{t-1} + \pi_{k2}S_{t-1} + \pi_{k3}Ae_{t-1} + \pi_{k4}Ah_{t-1} + \pi_{k5}L_{t-1} + \sum_{i=1}^{p}\lambda_{ik}\Delta D_{t-i} + \sum_{j=0}^{p}\gamma_{ik}\Delta F_{t-j} + \sum_{i=0}^{p}\alpha_{ik}\Delta S_{t-i} + \sum_{i=0}^{p}\beta_{ik}\Delta Ae_{t-i} + \sum_{i=0}^{p}\delta_{ik}\Delta Ah_{t-i} + \sum_{i=0}^{p}\theta_{ik}\Delta L_{t-i} + \varepsilon_{2t} \quad (1.2)$$

$$\Delta S_t = \phi_{l0} + \pi_{l1}F_{t-1} + \pi_{l2}D_{t-1} + \pi_{l3}Ae_{t-1} + \pi_{l4}Ah_{t-1} + \pi_{l5}L_{t-1} + \sum_{i=1}^{p}\lambda_{il}\Delta S_{t-i} + \sum_{j=0}^{p}\gamma_{il}\Delta F_{t-j} + \sum_{i=0}^{p}\alpha_{il}\Delta D_{t-i} + \sum_{i=0}^{p}\beta_{il}\Delta Ae_{t-i} + \sum_{i=0}^{p}\delta_{il}\Delta Ah_{t-i}\sum_{i=0}^{p}\theta_{il}\Delta L_{t-i} + \varepsilon_{3t} \quad (1.3)$$

$$\Delta Ae_t = \phi_{g0} + \pi_{g1}F_{t-1} + \pi_{g2}D_{t-1} + \pi_{g3}S_{t-1} + \pi_{g4}Ah_{t-1} + \pi_{g5}L_{t-1} + \sum_{i=1}^{p}\lambda_{ig}\Delta Ae_{t-i} + \sum_{j=0}^{p}\gamma_{ig}\Delta F_{t-j} + \sum_{i=0}^{p}\alpha_{ig}\Delta D_{t-i} + \sum_{i=0}^{p}\beta_{ig}\Delta S_{t-i} + \sum_{i=0}^{p}\delta_{ig}\Delta Ah_{t-i} + \sum_{i=0}^{p}\theta_{ig}\Delta L_{t-i} + \varepsilon_{4t} \quad (1.4)$$

$$\Delta Ah_t = \phi_{q0} + \pi_{q1}F_{t-1} + \pi_{q2}D_{t-1} + \pi_{q3}S_{t-1} + \pi_{q4}Ae_{t-1} + \pi_{q5}L_{t-1} + \sum_{i=1}^{p}\lambda_{iq}\Delta Ah_{t-i} + \sum_{j=0}^{p}\gamma_{iq}\Delta F_{t-j} + \sum_{i=0}^{p}\alpha_{iq}\Delta D_{t-i} + \sum_{i=0}^{p}\beta_{iq}\Delta S_{t-i} + \sum_{i=0}^{p}\delta_{iq}\Delta Ae_{t-i} + \sum_{i=0}^{p}\theta_{iq}\Delta L_{t-i} + \varepsilon_{5t} \quad (1.5)$$

$$\Delta L_t = \phi s_0 + \pi_{s1}F_{t-1} + \pi_{s2}D_{t-1} + \pi_{s3}S_{t-1} + \pi_{s4}Ae_{t-1} + \pi_{s5}EAh_{t-1} + \sum_{i=1}^{p}\lambda_{is}\Delta L_{t-i} + \sum_{j=0}^{p}\alpha_{is}\Delta D_{t-j} + \sum_{i=0}^{p}\alpha_{is}\Delta S_{t-i} + \sum_{i=0}^{p}\beta_{is}\Delta F_{t-i} + \sum_{i=0}^{p}\delta_{is}\Delta Ae_{t-i} + \sum_{i=0}^{p}\theta_{is}\Delta Ah_{t-i} + \varepsilon_{6t} \quad (1.6)$$

where Δ is the difference operator; φ_{j0} is the constant; π_s explains the long-run impact; $\lambda, \gamma, \alpha, \beta, \delta, \theta$ represent short-run dynamics and ε_t is the white noise error term. The optimal lag structure under ARDL approach is determined by estimating $(p+1)^k$ regressions for each equation, where p is the maximum number of lags and k is the number of variables in the equation. The optimal lag structure is determined by the minimum value of Schwartz-Bayesian Criteria (SBC). This study uses SBC lags structure method to confirm the optimal lag order.

The asymptotic distributions of the test statistics are non-standard regardless of whether the variables are *I(0)* or *I(1)*. Two separate bounds tests are available to examine the presence of long-run relationship among the variables of interest: a Wald or *F*-test for the joint null hypothesis $\pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 = 0$, (referred to as $F_F(F/D, S, Ae, Ah, L)$ for Equation 1.1) and Wald or *F* statistics for asymptotic distribution, for the critical bounds values provided by Pesaran *et al.* (2001). They computed two asymptotic critical values for lower and upper bounds. If F statistics value exceeds the upper bound, then there is evidence of a long-run association. On the other hand, if the F statistic value is below or less than the lower bound, conclusion is the long run linear combination among variables. In addition, if the sample test statistic falls between these two bounds, then the result is inconclusive. On the other hand, error correction method is used to investigate the short run relationship among the variables of the model (Bannerjee *et al.* 1998). To examine the stability of the ARDL, bounds testing approach to cointegration, stability tests, namely CUSUM and CUSUMSQ have been applied (Brown *et al.* 1975).

The same process can be used when other variables are used as dependent variable. Given the existence of long-run relationship among variables, an error correction representation can be developed as follows:[2]

$$(1-L)\begin{bmatrix} F \\ D \\ S \\ Ae \\ Ah \\ L \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ \alpha_5 \\ \alpha_6 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} b_{11i}b_{12i}b_{13i}b_{14i}b_{15i}b_{16i} \\ b_{21i}b_{22i}b_{23i}b_{24i}b_{25i}b_{26i} \\ b_{31i}b_{32i}b_{33i}b_{34i}b_{35i}b_{36i} \\ b_{41i}b_{42i}b_{43i}b_{44i}b_{45i}b_{46i} \\ b_{51i}b_{52i}b_{53i}b_{54i}b_{55i}b_{56i} \end{bmatrix} + \begin{bmatrix} \theta \\ \vartheta \\ \phi \\ \psi \\ \sigma \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \quad (1.7)$$

where $(1-L)$ is the difference operator; ECT_{t-1} is the lagged error-correction term derived from the above ARDL equations; and $\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}$ and ε_{4t} are serially independent error terms having mean zero and finite covariance matrix.

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[2]If cointegration is not detected, the causality test is performed without an error correction term (*ECT*).

IV. EMPIRICAL RESULTS AND DISCUSSION

For finding the long run and short run co-integration among the variables of the model, unit root test is a pre-condition. For this we use Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Dickey-Fuller Generalized Least Squares (DF-GLS) tests. The results of unit root tests are presented in Table I. The results show that only economic development is stationary at level and all other variables are stationary at first difference. The same is repeated for PP unit root test, but when we use DF-GLS all variables are stationary at first difference. So following the first two unit root tests, we find there is mix order of integration among the variables of the model and most variables have 5 per cent level of significance.

TABLE I

RESULTS OF UNIT ROOT TESTS

Variables	ADF	PP	DF-GLS
F_t	1.7165(3)	1.3690(4)	–1.4571(5)
ΔF_t	–2.4817(2)**	–2.5013(3)**	–4.2141(5)**
D_t	–6.9021(0)***	–4.2165(4)***	–1.3123(3)
ΔD_t	–1.2369(2)	–1.2059(3)	–2.6260(3)**
S_t	1.6921(0)	1.2007(3)	1.2340(1)
ΔS_t	–3.5831(1)**	–5.1045(3)**	–3.6530(1)**
Ae_t	0.5890(1)	0.9825(2)	1.0085(1)
ΔAe_t	-3.3309(1)**	-3.7479(1)**	-3.378(1)**
Ah_t	2.1923(1)	0.6046(4)	1.7360(1)
ΔAh_t	-6.1554(1)***	-2.3018(4)**	-3.9119(1)**
L_t	1.3674(2)	2.4096(2)	1.5020(1)
ΔL_t	-3.6974(1)**	-3.6983(2)**	-1.7340(1)

Note: *** and ** denote the significance at %1 and 5% levels, respectively. Figures in parentheses are the optimal lag structure for ADF and DF-GLS tests; bandwidth for the PP unit root test is determined by the Schwarz Bayesian Criterion.

The results for ARDL are presented in Table II, Panel I. The results show that in the case of equations 1.1 and 1.2 F-statistic is greater than the upper bound, so there is co-integration among the variables of equations 1.1 and 1.2. But in the case of equations 1.3 and 1.4 F-statistic is less than both lower bound and upper bound, so there is no co-integration among the variables. For equations

1.5 and 1.6 F-statistic is greater than the upper bound, hence there is co-integration among the variables. The results show that all the equations which have co-integration among their variables have the same 1 per cent level of significance. Panel-II, Table II shows the results of diagnostic tests for all six equations. The results show that for all equations except equations 1.3 and 1.4 data are normally distributed and there is no problem of autocorrelation and heteroscedasticity. The results show that CUSUM and CUSUMSQ are stable, which further verifies the validity of the data.

TABLE II

RESULTS OF COINTEGRATION TEST

Panel I: Bounds Testing to Cointegration						
Estimated Eqs.	1.1	1.2	1.3	1.4	1.5	1.6
Optimal Lag	[1,0,0,1,1,0]	[1,0,0,0,1,0]	[1,0,0,0,0,0]	[1,1,1,0,0,0]	[1,1,1,0,1,0]	[1,0,0,1,0,0]
F-Statistics	32.4815	42.697	2.4098	1.9447	71.8786	9.210
	Critical values (*T*,39)#					
	Lower bounds *I*(0)	Upper bounds *I*(1)				
99 % level	7.397	8.926				
95 % level	5.296	6.504				
90 % level	4.401	5.462				
Panel II: Diagnostic tests						
R^2	0.998	0.997	0.990	.995	.996	0.996
Adjusted- R^2	0.993	0.996	0.987	.994	.995	0.995
F-statistics	1725.0917***	3603.014***	512.200***	804.92***	242.173***	1419.1800***
J-B Normality	1.6330[.442]	11.3550[.003]	27.2419[.000]	3.8681[.049]	3.421[.148]	13.3535[.001]
LM (B.G)	1.7735 [0.1901]	.17251[.678]	3.3571[.067]	6.258[.002]	5.431[.034]	.38096[.537]
ARCH LM	0.8053 [0.4465]	1.420 [0.1241]	1.0689 [0.435]	8.325[.001]	7.001[.001]	1.2047 [0.1953]
White Heteo	.49977[.480]	.71086[.399]	2.8787[.090]	.0400[.841]	.54703[.460]	3.2130[.073]
RESET	17.5192[.000]	10.0494[.002]	1.3383[.247]	.6723[.412]	.62605[.731]	5.6322[.018]
CUSUM	Stable	Stable	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Unstable	Unstable	Stable	Stable

Note: ***denotes the significance at 1% level. The optimal lag structure is determined by AIC. The values in parentheses are the prob-values of diagnostic tests. # Critical values bounds computed by surface response procedure developed by Turner (2006).

After finding the co-integration among the variables of the study, we examine the long run results of the variables. The results are presented in Table III. The results show that while economic development has negative and significant relationship, secondary school enrolment has negative and statistically insignificant relationship with fertility rate in Pakistan. For sector specific foreign aid, results reveal that there is negative relationship between foreign aid to health sector and fertility rate. This suggests that foreign aid towards the health and education sectors improves health infrastructure and couples' decision regarding demand for children in Pakistan. The number of lady health workers has positive and significant relationship with fertility rate in Pakistan, revealing that family planning program is not doing well in reducing fertility rate for Pakistan.

TABLE III

LONG RUN RESULTS

Dependent Variable = F_t			
Variable	Coefficient	Standard Error	T statics [prob]
Constant	-5.3392	2.0750	2.5731[.016]
D_t	-0.84504	.23214	-3.6408[.001]
S_t	-0.45705	.27063	-0.0168[.987]
Ae_t	-0.59380	2.3207	-2.5588[.016]
Ah_t	-0.47155	5.5922	-0.8432[.406]
L_t	0.17233	.51204	3.3644[.002]
R-squared		0.9978	
Adjusted R-squared		0.9967	
F-statistics		1897.0738*	
Durbin-Watson		1.4635	
J-B Normality Test		1.9432 [0.3748]	
Breusch-Godfrey LM Test		0.3830 [0.4948]	
ARCH LM Test		1.4190 [0.2135]	
White Heteroskedasticity Test		1.6440 [0.1582]	
Ramsey RESET		0.6922 [0.4119]	

Note: * indicates significance at 1% level and Prob-values are shown in parentheses.

The short run dynamics of the study are presented in Table IV. The results show that fertility rate has negative relationship with economic development, secondary school enrollment and foreign aid in Pakistan. On the other hand, foreign aid in the health sector and lady health workers have positive and significant relationship with fertility rate in Pakistan. The value of ECM is negative and statistically significant. The negative value of ECM is theoretically correct, which shows the speed of convergence of the short run to the long run. The value of ECM shows that short run needs 7.1 years to converge in the long run in the case of Pakistan.

TABLE IV

ERROR CORRECTION REPRESENTATION FOR THE SELECTED ARDL MODEL

Dependent Variable = ΔF_t			
Variable	Coefficient	Standard Error	T statics [prob]
ΔD_t	-.11654	.54975	-2.1192[.042]
ΔS_t	-.63016	.37374	-0.0168[.987]
ΔAe_t	-.37133	.14568	-2.5490[.016]
ΔAh_t	1.73483	.77299	2.4774[.024]
ΔL_t	.23754	.53705	4.4225[.000]
ecm(-1)	-.13786	.043266	-3.1864[.003]
R-squared		0.8970	
Adjusted R-squared		0.8676	
F-statistics		40.0738*	

Note: * indicates significance at 1% level and Prob-values are shown in parentheses.

V. CONCLUSIONS

This study investigates the impact of sector specific foreign aid on fertility in Pakistan over the period of 1973-2011. The results show that economic development and foreign aid for education have negative and significant impact on fertility rate in Pakistan. The results also reveal that secondary school enrollment and foreign aid in health sector have negative and statistically insignificant relationship with fertility rate. The number of Lady Health Workers

(LHVs) has positive and significant relationship with fertility rate in Pakistan, revealing that family planning programme is not effective to control fertility rate in Pakistan. The overall short run results show that foreign aid for health and family planning programme have positive relationship with fertility, highlighting that family planning programme inputs are not adequate to control population growth in Pakistan. The study suggests that for improving the situation, the government should improve the programme inputs as well as ensure the transparent use of foreign aid in both sectors.

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