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Foreign Aid and Fertility: An Econometric Analysis for Pakistan

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Abstract: This paper analyses the impact of foreign aid, socioeconomic and family planning programmes input on fertility in Pakistan. Auto Regressive Distributed Lag (ARDL) model is used to investigate the dynamics of the connected variables. For this purpose, the time series data from 1973 to 2011 has been used. The results show that foreign aid, prices and literacy rate are negatively related with fertility in long run as well as short run. On the other hand, birth rate is positively related with fertility with relatively high proportion. The results of family planning programme input reveal that programme inputs are not capable to control population. This study suggests that government should enhance the number of lady health visitors in field fully equipped under an organised system.

Key words: Foreign aid · Lady Health Visitors · Family Planning Programme · Female Literacy Rate

INTRODUCTION

Pakistan provides a good case study for link between foreign aid and fertility due to two reasons. First, Pakistan received massive foreign aid for social reforms to improve economic and social well-being of the society. Secondly, government has launched different population control programmes with the help of foreign aid. Many less developed countries are still faced by the element of the Malthusian trap so their population has an adverse effect on their development process [1]. However, large literature on aid effectiveness pays no attention to the effects of aid on demographic transition [2].

In this paper we analyse the impact of foreign aid on fertility in Pakistan. The previous studies show different results regarding fertility and foreign aid for the developed and developing nations and still there is no consensus on the relationship of aid and fertility.

A number of studies are available in literature on the relationship of population and economic development and a lot of links are investigated to check the effect of population growth like social, economic, cultural effect and economic development. The importance of aid in this sector may be justified as in a developing country like Pakistan, the infrastructure is poor due to lack of resources and it is required to enhance the budget of the government to start an effective population control programme.

The rest of the paper is organized as follows: section 2 presents the literature review, section 3 explains the econometric model and methodology, Section 4 gives estimation and the results, whereas, the conclusion and policy implications are given in Section 5.

Literature Review: Mishra and Newhouse [3] estimated the relationship between aid for health and infant mortality rate. They performed a cross-country analysis using 118 countries. They used time series data from 1973 to 2004 and found that the relationship between these two variables was statistically significant.

Azarnert [4] examined the effect of aid on population growth and human capital accumulation. He found this relation consistent with empirical evidence from Sub Saharan Africa. He concluded that humanitarian aid has

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positive relation with fertility and has negative relation with recipient's incentive to invest in human capital. This study suggested that aid might lock the recipient economy in low income trap.

Wolf [5] examined the effectiveness of aid on education, health and water & sanitation. Although the study has found positive and significant relation between health aid and its outcomes, however, it concluded that aid has mixed impact so it could not be the only solution for improved social indicators to achieve the goals in the health sector.

Shehzad [6] estimated linear structural models and MIMIC models. He pointed out those factors that determine child health in Pakistan. The study addressed the issue of health unobservability and found out those variables which represent child health status. The result showed that parental education, socio-economic conditions and health care has significant role in the child health in Pakistan.

Thiele, Nunnenkamp and Dreher [7] used sectoral disaggregated aid data and discussed its impact on different variables reflecting these sectors in the recipient countries. Their results revealed that there was a considerable gap between desire of donor and actual aid allocation which lead to the conclusion that large amount of aid would not have the desired affects unless the targeting of aid is improved. They concluded that without allocating the aid in the right direction, it would be difficult to achieve the targets of MDGs.

Behrman and Rosenzweig [8] used the new data series collected through a survey on identical male and female twins from Minnesota Twin Registry (MTR). They suggested that the relation between the schooling of mothers and their children was positive and they observed it substantially biased upward. Their result showed that improving the schooling of mother would not affect the schooling of children. They also found that increased mother schooling lead to reduce home time for motherhood. However, it was possible to effect health of children positively.

Lam and Duryea [9] examined the effects of schooling on fertility and investment in children in Brazil. They analyzed retrospective fertility histories of over 100,000 Brazilian women and concluded that there was a strong negative relation between schooling for parents and fertility. Their results indicated a weak inverse relationship between fertility and women's labor force participation at lower levels of schooling. They found large positive effects of schooling on measures of child quality.

Rosenzweing and Schultz [10] used the data from 1970 National Fertility Survey. Their estimation indicated heterogeneity in variation in fertility with one third of the explained variation because of heterogeneity in supply. Their result related to the estimation of reproductive technology of contraceptives is more important especially in less developed countries where people are unaware about its usage.

Rosenzweig and Evenson [11] applied household time allocative model to study the contribution of children in agriculture sector. They studied the rural population of India. They empirically examined the joint family decisions which were related with fertility and allocation of child time on the basis of gender. They found that one of the conditions that motivated Indian families to bear large families was high earnings through child labour inspite the discouraging policies of the government regarding child labour.

Heckman [12] generated the probability of women labor force such as woman works, her hours of work, her asking wage and her offered wage etc. This study assumed that the individual faced a parametric wage that did not depend on the number of hours worked and this assumption might not be realistic. Gertler and Molyneaux [13] examined the Indonesian economy and studied the women's status of fertility declining from 1982 to 1987. They concluded that 75 percent of the decline in fertility was due to use of contraceptives and, according to them, this used has been increased because of improved education and economic opportunities.

Schultz [14] presented a model of family planning in Puerto Rico which explained the differences in birth rates over time. He explained the determinants of birth rates that affect the goals of parents regarding children. Using a cross-sectional data, this study concluded in terms of strong support for three hypothesis in the family formation process i.e. goal regarding size of the family, incidence of death and uncertainty.

Becker [15] employed an economic framework and analyzed the factors determining fertility. He explored some implications like rise in fertility in Western Nations after war, relatively low fluctuations in fertility as compare to other durables and the comparison between fertility of women in rural and urban areas. He concluded that there was negative relation between number of children and income. But this relation appeared positive when the contraceptive knowledge assumed to be constant.

After reviewing the studies on foreign aid and fertility, we conclude that many factors are responsible. This study will contribute in an important way that it will capture the short run and long run behaviour of foreign aid on population through modern estimation methods.

Econometric Model and Methodology

The Model: The literature shows that the factors which are responsible for fertility rate are GDP per capita, foreign aid, female literacy rate, prices, birth rate and Lady Health Visitor (LHV) for family program input. In Pakistan, family planning program provides the knowledge, treatment, input and health care medicine through Basic Health Units (BHUs) to control the population growth. LHVs provide services to females by visiting them door to door under the supervision of BHUs.

In this study, the data for the period of 1973 to 2011 is used. Data for all the variables except foreign aid has been taken from various issues of Pakistan Economic Survey [16]. While the data on foreign aid for health sector is taken from Organisation for Economic Co-operation and Development (OECD) database [17]. This study used the amount of aid commitments at constant prices, based on 2010 prices, in million US Dollar. The model is written as follows:

$$F_t = f(A_t, B_t, P_t, E_t, L_t)$$
$$LF_t = \alpha + \beta_1 LA_t + \beta_2 LB_t + \beta_3 LP_t + \beta_4 LE_t + \beta_5 LL_t \quad (1)$$

where:

F_t = Fertility rate; Child per woman,

A_t = Foreign aid for health per capita,

B_t = Crude birth rate,

P_t = Consumer price index; as a proxy for prices,

E_t = Female Literacy rate,

L_t = Number of LHVs; as family planning program inputs.

MATERIALS AND METHODS

Autoregressive Distributed Lag Model (ARDL) for Co-Integration: We apply ARDL bounds testing approach for cointegration to examine the long run bound among related variables introduced by Pesaran *et al*., (2001). This method is more appropriate than other classical methods. For example, the ARDL bounds testing is more applicable to analyse the cointegration if chronic variables are integrated with different order of integration such as I(0) or I(1) or mix order of integration. It also suggests that unit root testing is not necessary for ARDL bounds testing. Moreover, The ARDL bounds testing approach to cointegration presents better and reliable results for small samples. This approach combines long and short run analysis without losing information regarding long run relationship. ARDL approach involves estimating the following unrestricted error correction model as follows:

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

$$\Delta A_t = \phi_{k0} + \pi_{k1}F_{t-1} + \pi_{k2}B_{t-1} + \pi_{k3}P_{t-1} + \pi_{k4}E_{t-1} + \pi_{k5}L_{t-1} + \sum_{i=1}^{p}\lambda_{ik}\Delta A_{t-i} + \sum_{j=0}^{p}\gamma_{ik}\Delta F_{t-j}$$
$$+ \sum_{i=0}^{p}\alpha_{ik}\Delta B_{t-i} + \sum_{i=0}^{p}\beta_{ik}\Delta P_{t-i} + \sum_{i=0}^{p}\delta_{ik}\Delta E_{t-i} + \sum_{i=0}^{p}\theta_{ik}\Delta L_{t-i} + \varepsilon_{2t} \quad (1.2)$$

$$\Delta B_t = \phi_{l0} + \pi_{l1}F_{t-1} + \pi_{l2}A_{t-1} + \pi_{l3}P_{t-1} + \pi_{l4}E_{t-1} + \pi_{l5}L_{t-1} + \sum_{i=1}^{p}\lambda_{il}\Delta B_{t-i} + \sum_{j=0}^{p}\gamma_{il}\Delta F_{t-j}$$
$$+ \sum_{i=0}^{p}\alpha_{il}\Delta A_{t-i} + \sum_{i=0}^{p}\beta_{il}\Delta P_{t-i} + \sum_{i=0}^{p}\delta_{il}\Delta E_{t-i}\sum_{i=0}^{p}\theta_{il}\Delta L_{t-i} + \varepsilon_{3t} \quad (1.3)$$

$$\Delta P_t = \phi_{g0} + \pi_{g1}F_{t-1} + \pi_{g2}A_{t-1} + \pi_{g3}B_{t-1} + \pi_{g4}P_{t-1} + \pi_{g5}L_{t-1} + \sum_{i=1}^{p}\lambda_{ig}\Delta P_{t-i} + \sum_{j=0}^{p}\gamma_{ig}\Delta F_{t-j}$$
$$+ \sum_{i=0}^{p}\alpha_{ig}\Delta B_{t-i} + \sum_{i=0}^{p}\beta_{ig}\Delta A_{t-i} + \sum_{i=0}^{p}\delta_{ig}\Delta E_{t-i} + \sum_{i=0}^{p}\theta_{ig}\Delta L_{t-i} + \varepsilon_{4t} \quad (1.4)$$

$$\Delta E_t = \phi_{q0} + \pi_{q1}F_{t-1} + \pi_{q2}A_{t-1} + \pi_{q3}B_{t-1} + \pi_{q4}P_{t-1} + \pi_{q5}L_{t-1} + \sum_{i=1}^{p}\lambda_{iq}\Delta E_{t-i} + \sum_{j=0}^{p}\gamma_{iq}\Delta F_{t-j}$$
$$+ \sum_{i=0}^{p}\alpha_{iq}\Delta B_{t-i} + \sum_{i=0}^{p}\beta_{iq}\Delta P_{t-i} + \sum_{i=0}^{p}\delta_{iq}\Delta A_{t-i} + \sum_{i=0}^{p}\theta_{iq}\Delta L_{t-i} + \varepsilon_{5t} \quad (1.5)$$

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

where, Δ show the first difference operator; φ_{j0} is the constant, while π_s explain the long-run impact; λ, γ, α, β, δ, θ represent short-run dynamics and ε_t is the random variable which is assumed to be white noise. 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 making use of Schwartz-Bayesian Criteria (SBC). The ARDL bounds testing approach for cointegration calculates number of regressions following $(p + 1)^k$ formula which helps in choosing appropriate lag order. The optimal lag order clears the model from serial correlation problem and provides appropriate F-statistics to take decision about the existence of cointegration between the series. Where "*p(k)*" is the total number of lags to be used in the above equations.

To test the existence of cointegration, Pesaran *et al*., (2001) generated two critical bounds i.e. Upper Critical Bound (UCB) and Lower Critical Bound (LCB). F-test was developed by Pesaran *et al*., (2001) to analyze the joint significance of the parameters. In equation 2, the significance of null hypothesis H_0: $\lambda = \gamma = \alpha = \beta = \delta = \theta = 0$ shows no cointegration between the series while cointegration exists if alternative hypothesis H_1: $\lambda \neq \gamma \neq \alpha \neq \beta \neq \delta \neq \theta \neq 0$ is found to be significant. The hypothesis of cointegration between the variables is accepted if calculated F-calculated value more than UCB which suggests that long run relationship exists among variables. We may accept null hypothesis indicating no cointegration if F-statistic does not cross LCB. The conclusion will be inconclusive if F-statistic lies between LCB and UCB.

Error Corretion Model for Short Run Analysis: Once long run relationship between the series is found then next step is to estimate short run behavior of forcing variables on dependent variable by using error correction model. The estimable equation of error correction model is as following:

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

where $(1 - L)$ is the difference operator and ECT_{t-1} is the lagged Error-Correction Term derived from the long-run cointegrating relationship and ε_{1t}, ε_{2t}, ε_{3t} and ε_{4t} are serially independent random errors with mean zero and finite covariance matrix. *ECT* indicates speed of adjustment.

The stability and diagnostic tests are carried out to test the goodness of fit of the model. In diagnostic test, we apply to find out serial correlation between error terms, specification problem, normality of residual term and white heteroscedasticity. The cumulative sum of recursive residuals (CUSUM) is applied to test the constancy of ARDL parameters. This is another way to find out prediction error which indicates the reliability of the ARDL model. The model presents the best fit if difference between real and estimated value is minimal.

RESULTS AND DISCUSSION

In this section, we present the empirical results of the estimated model. For unit root testing we employed Augmented Dickey Fuller (ADF), Phillip-Perron (PP) and Augmented Dickey-Fuller Generalized Least Squares (ADF-GLS). The results are presented in Table 1 as below. Our results show that some variables are stationary at I(0) and some are at first difference I(1) so we conclude that variables have different or mixed order of stationary levels.

The Long-run Function: A Co-integration Analysis: The long-run relationship between the variables is examined through the ARDL bound testing approach using equations 1.1 to 1.6 [18]. The results are described in Table 2, panel I. The intended F-statistics (44.93) is higher than UCB at 5% level of significance when F_t is taken as the dependent variable. It proposes that D, S, Ae, Ah and L are long-run driving variables in equation 1.1. For the equation 1.2, 1.3, 1.4 and 1.6, the UCB is lower than computed F-statistics i.e. (5.59), (5.68), (5.40) and (4.45) respectably. However, in equation 1.5, when we consider

Table 1: Test Results for Unit Root

Variables	ADF	PP	ADF-GLS
LF_t	2.0704(6)	0.6649(5)	-6.5848(3)**
ΔLF_t	-3.5043(5)**	-2.7946(4)*	-1.7215(5) **
LA_t	-4.4261(0)**	-4.4261(0)**	-4.6321(0)**
ΔLA_t	8.6342(1)**	-6.1241(2)**	-6.1124(1)**
LB_t	-0.2401(0)	-0.5026(3)	-0.4677(0)
ΔLB_t	-4.4757(1)**	-5.5648(3)**	-3.6752(1)**
LP_t	2.4571(2)	2.3640(0)	2.4137(1)
ΔLP_t	-3.4873(1)*	-3.4891(1)*	-3.6638(1)**
LE_t	2.4130(0)	4.2474(8)	0.5989(6)
ΔLE_t	-3.7476(1)**	-5.4702(1)**	-4.2173(1)**
LL_t	1.3674(2)	2.4096(2)	1.5020(1)
ΔLL_t	-3.6974(1)**	-3.6983(2)**	-1.7340(1)*

** denote significant at 5 percent

* denote significant at 10 percent

Table 2: Results of Cointegration Test

Panel I: Bounds Testing for Cointegration						
Estimated Equations	1.1	1.2	1.3	1.4	1.5	1.6
Optimal Lag	1,0,0,1,0,1	1,0,0,0,0,1	1,0,1,0,0,1	1,0,0,0,1,1	1,1,0,0,0,1	1,1,1,0,0,0
F-Statistics	[44.93]	[5.59]	[5.68]	[5.40]	[2.14]	[4.45]
	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	0.9967	0.50498	0.96740	0.99791	0.99923	0.99927
Adjusted-R^2	0.9945	0.4012	0.9580	0.9967	0.9980	0.99642
F-Statistics	105.09***	5.1002**	103.8781***	997.5***	4517.7***	756.1***
J-B Normality	1.22[0.54]	2.09[0.352]	0.727[0.695]	5.15[0.076]	7.91[0.000]	1.382[0.501]
LM (B.G)	1.93[0.17]	0.045[0.832]	3.357[0.067]	0.343[0.56]	8.45[0.003]	0.015[0.985]
ARCH LM	1.15[0.34]	0.128[0.721]	0.069[0.972]	0.34[0.559]	3.089[0.04]	0.252[0.219]
White Test	1.26[0.34]	1.168[0.367]	0.465[0.495]	3.213[0.07]	2.98[0.015]	1.13[0.286]
RESET	0.519[0.5]	0.966[0.325]	1.091[0.296]	5.632[0.02]	4.71[0.038]	1.0206[0.37]
CUSUM	Stable	Stable	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Unstable	Unstable	Stable

***denotes the significant at 1% level.

Note: The optimal lag structure is determined by AIC. The values in parenthesis are the probability values of diagnostic tests. # Critical values bounds computed by surface response procedure developed by Turner (2006)

Table 3: Long Run ARDL Cointegration

Variables	Coefficient	Standard Error	T statics [prob]
C	44.5187	8.4059	5.2960[0.000]
LA_t	-0.2435	0.1364	-1.8237[0.040]
LB_t	0.3145	0.0330	9.5221[0.000]
LP_t	-0.1104	0.0091	-12.1270[0.000]
LE_t	-0.3543	0.1127	-3.1441[0.003]
LL_t	0.0147	0.0044	3.3141[0.002]
R-square	0.9930		
Adjusted R-square	0.9912		
F-statistics	794.7538*		
Durbin-Watson	1.2635		
J-B Normality Test	0.3823 [0.8260]		
Breusch-Godfrey LM Test	0.1560 [0.2087]		
ARCH LM Test	0.9308 [0.3420]		
White Test	1.0604 [0.4243]		
Ramsey RESET	0.1298 [0.7214]		

* indicates significance at 1% level

Note: Probability values are in parentheses

Table 4: Results of Short Run Dynamic of ARDL (1,0,0,0,1,0)

Dependent Variable = ΔF_t			
Panel-I			
Variable	Coefficient	Standard Error	T statics [prob]
ΔLAt	-0.1025	0.1016	-1.009[.326]
ΔLBt	-0.0274	0.0326	-0.8387[.409]
ΔLPt	-0.0461	0.0149	-3.0806[.005]
ΔLEt	-0.0461	0.0149	-5.3634[.000]
ΔLLt	0.0006	0.0001	3.4402[.002]
ECT(-1)	-0.2610	0.1175	-2.220[.003]
Panel-II Diagnostic Test			
R-Square	0.777		
Adjusted R-Square	0.717		
F-Statistics	14.09597*		

* indicates significance at 1% and probability values are in parentheses

LHV as the dependent variable, we cannot reject the null hypothesis of no cointegration because the estimated F-statistics is (2.14).

Diagnostic Tests: The results of standard diagnostic tests like heteroscedasticity, normality, model specification and residual test CUSUM and CUSUM square are presented in Table 2, panel II. The results of different tests for heteroskedasticity and serial correlation demonstrate that these problems do not exist. Similarly, other tests show that the model is stable.

The results presented in Table 3 show that foreign aid is positively and significantly related with fertility and the price level is inversely related with fertility rate. Our results support the idea by Becker [15] as price level causes to reduce the real income of the family that may provoke the female labour force. When a female allocates more time for working hours she spends less time to child. On the other hand, when female education level increases, they spend more time to get education then jobs that may cause to enhance the opportunity cost of the female time to spend on more children. The result shows that, in Pakistan, female education has significant impact on fertility. The empirical result regarding family planning program and birth rates have positive impact on fertility and it is statistically significant.

The Short-Run Dynamic Model: The empirical results in Table 4 explain that there exists a short run relationship between fertility rate and its determinants. The results show that the estimated value of ECT is -0.26 with t = -2.22 which is significant with theoretically correct sign. It indicates 26 percent of the dis-equilibrium converges towards the long run equilibrium condition. Aid, prices, education and birth rate are inversely related with fertility and are statistically significant except foreign aid. As for as the family planning program input is concerned, we use LHV as its proxy which is positively related with fertility rate.

CONCLUSION AND POLICY IMPLICATIONS

This study attempt to analyze the relation between foreign aid and fertility in Pakistan. Keeping in view the theoretical framework and empirical literature, an econometric model is developed. For estimation purposes, we employ ARDL technique to find the long run cointegration and then ECM is used to study the short run analysis. These econometric models are estimated for Pakistan over the period of 1973 to 2011 using annual time series data. The cointegration analysis shows that foreign aid significantly causes to reduce fertility rate. Women literacy rate is negatively related with fertility in the long run as well as in the shorts run. When female spend more time to get education than jobs then it increases the opportunity cost of the time for a woman to spend it on children bearing or carrying. The results reveal that family planning program inputs are not capable to control population in the short run as well as in long run. This study suggests that government of Pakistan should enhance women empowerment regarding size of the family and it can be done through female education. For a successful family program, the lady health visitors should be fully equipped under the control of an organized health care system.

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