Investigating the Causality between Female Labour Force Participation and Fertility: Turkey 1968-2006

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Abstract:

The classical literature on female work force participation and fertility suggests an inverse relationship between the two, for developed countries. In contrast, evidence from the developing countries shows an ambiguous picture and, in general, fertility declines in these countries have been rather slower than those of developed countries, if not negligible. In Turkey, fertility rates have been declining accompanied with decreasing female labour force participation (LFP) rates. However it is not possible to determine the way of relationship or causality between fertility and working among women by just looking at the trends since there are more mechanisms affecting each variable in various ways. To the authors' knowledge, no macro-level studies have yet been undertaken on Turkey to investigate the causal link between female LFP and fertility. This study applies the Johansen-Juselius Maximum Likelihood Error Correction Modelling, in conjunction with the 'general to specific modelling', for examining the existence of long-run relationship as well as the causal link between female LFP and fertility in Turkey using macro-level data over the period: 1968-2006. The specified multivariate model, consisting of total fertility rate (TFR), female LFP, infant mortality rate, and female illiteracy rate, is indicative of the existence of an inverse long-run relationship between fertility and female LFP. All the long-run estimates of other variables have the theoretically anticipated signs. LFP is negatively related to fertility. The elasticity of the fertility rate is around -0.5, suggesting that a 1% increase in female LFP rate reduced fertility by 0.5%. This finding supports the "role incompatibility theory". The direction of causality is two-way for fertility and female labour force participation, i.e. there is a feedback relationship between TFR and female LFP rate. The causality exists both in the long-run and the short-run provided that infant mortality and female illiteracy are also included in the model.

1. Introduction

The literature on female work force participation and fertility suggests an inverse relationship between the two. With increasing female labour force participation (LFP), developed industrialized countries have experienced massive declines in fertility rates over time. This shift in the fertility rates is largely attributed to the increasing workforce participation of the women in the prime age group of 25-54. In contrast, evidence from the developing countries shows a mixed picture and, in general, fertility declines in these countries have been rather slow, if not negligible. In Turkey, within time, both TFR and LFP rates for females have been declining. However it is not possible to determine the way of relationship or causality between fertility and working among women by just looking at these trends. There can be more mechanisms affecting each variable in various ways.

The mainstream theoretical framework proposes a negative relationship between fertility and female LFP. The most influential hypothesis in the area is "the role incompatibility hypothesis" emphasizing the conflict between women's productive and reproductive roles. Recently, in Europe this relationship has been weakening due to changing attitudes towards working women, availability of child care and paid maternity leave, which led to "societal response hypothesis". These theories lack support from evidence in developing countries in cross-sectional studies. The differences in the industrial structure, where labour force is mostly employed in -which is agricultural sector in developing countries- may be one of the reasons of this ambiguity of findings of empirical studies for these countries.

Moreover theory does not clearly indicate the direction of causality between female LFP and fertility. Fertility may interrupt with mother's working status, but also more children may require more need for more income in the family. Weller (1977) lists four possibilities: 1. Family size affects labour force participation; 2. Labour force participation affects family size; 3. Both family size and labour force participation affect each other; and 4. The observed negative relationship is spurious and is caused by common antecedents of both variables.

More empirical analyses are therefore crucial to analyze the mechanisms setting up this relationship. This study is the first attempt to investigate the causality between fertility and female LFP in Turkey. Few studies provided useful insights on the relationship between fertility rate and female LFP in Turkey (Isvan, 1991, Stycos and Weller, 1967, and Farooq and Tuncer, 1974). However these studies did not have a chance of analyzing causality with advanced tools. No macro-level studies have yet been undertaken on Turkey to investigate the causal link between female LFP and fertility. This study fills this vacuum, covering the period 1968 to 2006 by investigating the existence of long run relationship as well as the causal links between total fertility rate and female LFP rate in Turkey using macro-level data over the period: 1968-2006.

Several macro-level studies have investigated this issue by applying the Granger causality tests and/or the error correction modelling to investigate the direction of causality as well as the existence of a long-run relationship between the two. Such empirical techniques are regarded as appropriate tools for dealing with time series that are not stationary in their levels, as being mostly the case. Most empirical studies to date have used a two-variable framework. Although small sample sizes may force a researcher to adopt a two-variable framework, the omission of a third important variable may lead to misspecification bias. This study uses the infant mortality rate (IMR), real per

capita gross domestic product (GDP) and adult female illiteracy rate (FIR) as alternative possible factors. These variables represent social and economic changes taking place in a country through time and, therefore, can be considered important factors determining both fertility behaviour and female LFP.

2. Data

Time period for our analysis is 1968-2006. The primary source of 'total fertility rate' (TFR) is Demographic and Health Surveys conducted by Hacettepe University Institute of Population Studies every five years since 1968 and the secondary source is TURKSTAT. Linear interpolation was used to estimate the missing values for TFR on the year variable. Linear interpolation was chosen to estimate missing values since the data points to be used for interpolation were close to each other, i.e. the intervals between the known data points were not very large. The fitted line from interpolation indicated a high goodness of fit (of 0.9544).

Data for female labour force participation rate (FLFP rate) as percentages comes from TURKSTAT from two sources: Censuses and Household Labour Surveys. Minor corrections were needed for the Census data to be able to set one variable from two sources.

For real GDP per capita, data from 1968 to 2006 on an annual basis (at 1987 prices) from TURKSTAT were used. Yearly infant mortality rates (IMR) used in this study, are estimates using the Best Line of the Direct and Indirect Estimations employed by Yuksel (2008). Data for female adult illiteracy rate come from UNESCO (UNESCO Institute for Statistics online database) and TURKSTAT, whose definitions of the indicator are identical.

3. Analysis and Results

Of the various causality and cointegration tests, the vector error correction modelling (VECM) suggested by Johansen and Juselius (1990), that is, the maximum likelihood in an error correction modelling (MLECM) satisfies well the desirable properties of a time-series modelling and, therefore, has gained wide acceptance in recent empirical applications. This paper, therefore, applies the Johansen-Juselius MLECM, in conjunction with the 'general to specific modelling', for examining the existence of long-run relationship as well as the causal link between female LFP and fertility.

The empirical results are based on the application of the dynamic time-series modelling of the vector error correction[1]. Initially combination of the five variables (Total fertility rate (TFR), female LFP (FLFP), infant mortality rate, real GDP per capita (GDP) and female illiteracy rate (FIR)), all of which included TFR and FLFP, suggested eight model specifications. Therefore there were eight preliminary models to be tested for a long-run relationship. Using the upper-case letters denotes natural logarithm of the variables and the models that are initially of our interest were as follows:

Model 1: $U_1(TFR_t, LFP_t)$

Model 2: $U_2(TFR_t, LFP_t, IMR_t)$

Model 3: $U_3(TFR_t, LFP_t, GDP_t)$

[1] For the analyses, softwares of Stata/MP 10.1 for Windows and JMulTi 4 are used.

Model 4: $U_4(TFR_t, LFP_t, FIR_t)$

Model 5: $U_5(TFR_t, LFP_t, IMR_t, GDP_t)$

Model 6: $U_6(TFR_t, LFP_t, IMR_t, FIR_t)$

Model 7: $U_7(TFR_t, LFP_t, GDP_t, FIR_t)$

Model 8: $U_8(TFR_t, LFP_t, IMR_t, GDP_t, FIR_t)$

where

TFR_t = total fertility rate

LFP_t = female labour force participation rate

IMR_t = infant mortality rate

GDP_t = real GDP per capita

FIR_t = female illiteracy rate

All the variables were found to be integrated of order 1 since the null of a unit root could not be rejected according to Phillips Perron tests. Also breaks for the series of female LFP rate and female illiteracy rate were tested for and rejected (Table 1).

Figure 1. The plots of TFR, LFP, IMR, GDP and FIR (in logarithmic scale) for Turkey, 1968-2006

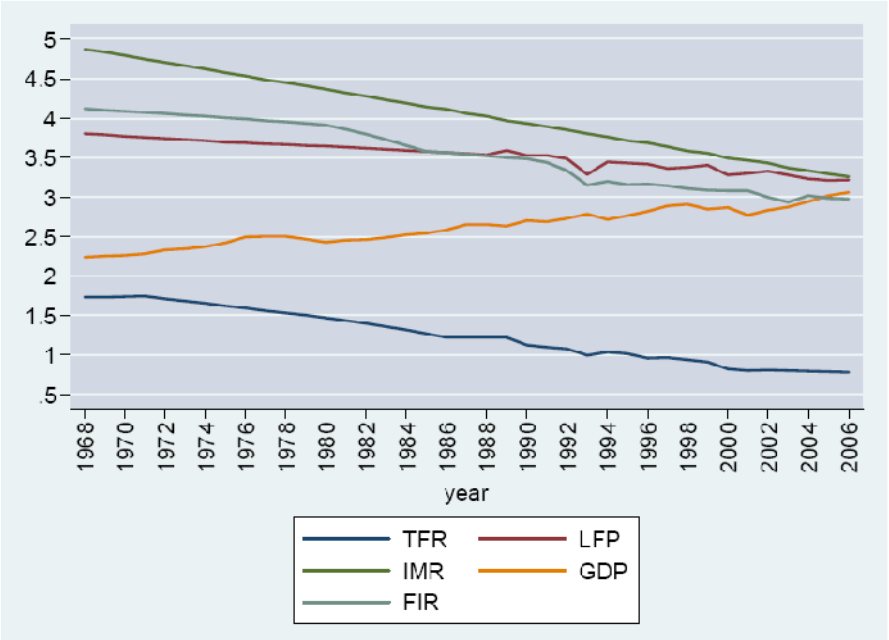

Table 1. Phillips Perron (PP) unit root tests

Variables	PP statistic [LL]	CV	Result
TFR	-0.378 [3]	-2.964	Unit root
ΔTFR	-6.233 [3]	-2.966	No unit root
LFP	-0.066 [3]	-2.964	Unit root
ΔLFP	-11.568 [3]	-2.966	No unit root
IMR	-0.445 [3]	-2.964	Unit root
ΔIMR	-16.638 [3]	-2.966	No unit root
GDP	-0.084 [3]	-2.964	Unit root
ΔGDP	-5.995 [3]	-2.966	No unit root
FIR	-0.324 [3]	-2.964	Unit root
ΔFIR	-5.565 [3]	-2.966	No unit root

Notes: LL is Newey West Lag Lengths. CV is Critical values at the 5% level, based on MacKinnon.

The Johansen-Juselius trace and maximum eigenvalue tests of cointegration were analyzed for all the eight models. The lag lengths to be used in this test were chosen according to the minimum information criteria, such as AIC, SBIC and FPE. The test results indicated that only one trivariate and one multivariate model had cointegration (Model 2 and Model 6) (See Table 2).

Table 2. Johansen Cointegration Test, 1968-2006

	H_0	H_A	λ_{max} test	λ_{max} (0.95)	H_A	λ_{tr} test	λ_{tr} (0.95)	Lag Length Chosen	Number of Cointegrating Vectors
Model 1	r = 0	r = 1	14.6242*	14.07	r ≥ 1	15.0400	15.41	**1**	**0**
	r ≤ 1	r = 2	1.8749	3.76	r ≥ 2	1.8749	3.76		
Model 2	r = 0	r = 1	31.7264*	20.97	r ≥ 1	34.8305*	29.68		
	r ≤ 1	r = 2	2.8865	14.07	r ≥ 2	3.1041	15.41	**1**	**1**
	r ≤ 2	r = 3	0.2176	3.76	r ≥ 3	0.2176	3.76		
Model 3	r = 0	r = 1	17.5202	20.97	r ≥ 1	21.4396	29.68		
	r ≤ 1	r = 2	3.7838	14.07	r ≥ 2	3.9194	15.41	**1**	**0**
	r ≤ 2	r = 3	0.1356	3.76	r ≥ 3	0.1356	3.76		
Model 4	r = 0	r = 1	17.8034	20.97	r ≥ 1	26.5070	29.68		
	r ≤ 1	r = 2	8.2872	14.07	r ≥ 2	8.7036	15.41	**1**	**0**
	r ≤ 2	r = 3	0.4163	3.76	r ≥ 3	0.4163	3.76		
Model 5	r = 0	r = 1	35.4055*	27.07	r ≥ 1	46.2985	47.21		
	r ≤ 1	r = 2	7.8320	20.97	r ≥ 2	10.8930	29.68		
	r ≤ 2	r = 3	2.9002	14.07	r ≥ 3	3.0610	15.41	**1**	**0**
	r ≤ 3	r = 4	0.1607	3.76	r ≥ 4	0.1607	3.76		
Model 6	r = 0	r = 1	32.9793*	27.07	r ≥ 1	49.6215*	47.21		
	r ≤ 1	r = 2	13.7973	20.97	r ≥ 2	16.6422	29.68		
	r ≤ 2	r = 3	2.5998	14.07	r ≥ 3	2.8449	15.41	**1**	**1**
	r ≤ 3	r = 4	0.2450	3.76	r ≥ 4	0.2450	3.76		
Model 7	r = 0	r = 1	18.8093	27.07	r ≥ 1	35.2754	47.21		
	r ≤ 1	r = 2	10.9057	20.97	r ≥ 2	16.4661	29.68		
	r ≤ 2	r = 3	5.3785	14.07	r ≥ 3	5.5604	15.41	**1**	**0**
	r ≤ 3	r = 4	0.1819	3.76	r ≥ 4	0.1819	3.76		
Model 8	r = 0	r = 1	39.2871*	33.46	r ≥ 1	64.9829	68.52		
	r ≤ 1	r = 2	15.6335	27.07	r ≥ 2	25.6959	47.21		
	r ≤ 2	r = 3	7.2337	20.97	r ≥ 3	10.0624	29.68	**1**	**0**
	r ≤ 3	r = 4	2.6186	14.07	r ≥ 4	2.8287	15.41		
	r ≤ 4	r = 5	0.2101	3.76	r ≥ 5	0.2101	3.76		

*Notes: * indicates statistical significance at the 0.05% level. r stands for the number of cointegrating vectors. When maximum and trace tests give contradictory results, the result of the trace test is used to determine the number of cointegrating vectors (Models 1, 5 and 8).*

Since the trivariate model appeared to have non-normally distributed residuals only the multivariate model was analyzed further. It should be noted that the implication of multivariate models vis-à-vis the bivariate framework should be considered more reliable in terms of bias and consistency of the parameter estimates as the former overcome the misspecification bias. Following is the error correction term for Model 6 derived from the estimated long-run equation:

$$Model\ 6 \qquad EC_t = TFR_t + 0.40 + 0.49LFP_t - 0.63IMR_t - 0.27FIR_t$$

The specified multivariate model, which is composed of total fertility rate, female LFP rate, infant mortality rate, and female illiteracy rate, is indicative of the existence of an inverse long-run

relationship between fertility and female LFP in Turkey. All the long-run estimates have the theoretically anticipated signs. LFP, for instance, is negatively related to fertility. The elasticity of the fertility rate is around -0.5, which suggests that a 1% increase in FLFP rate reduced fertility by 0.5%. This result is consistent with the facts that, as females devote more time working, the tendencies or opportunities for having children declines. This finding supports the "role incompatibility theory" although previous studies in Turkey (Isvan 1991, Stycos and Weller, 1967) found no evidence for this theory. However to the best of knowledge, no study has modelled a multivariate time analysis for Turkey.

The infant mortality and female illiteracy long-run elasticities of 0.6 and 0.3 of fertility, respectively, are also consistent with the theories. The coefficient of female illiteracy supports the view that higher levels of female education reduce fertility levels. Female illiteracy was shown to be a good proxy for the education levels according to this result.

We analyzed the reverse and/or bidirectional causality between TFR and LFP by estimating the error correction equation for first difference of LFP:

Table 3. Parsimonious Error Correction Equations for ΔTFR_t and ΔLFP_t for Multivariate Model 6

Dependent Variable: ΔTFR_t			**Dependent Variable:** ΔLFP_t		
Regressor	Coefficient	t-Value	**Regressor**	Coefficient	t-Value
$constant$	0.690	10.406*	$constant$	0.372	2.439*
ΔTFR_{t-1}	1.136	8.433*	ΔTFR_{t-3}	1.495	4.503*
ΔTFR_{t-2}	0.387	3.594*	ΔLFP_{t-2}	-0.431	-3.547*
ΔTFR_{t-3}	0.643	3.890*	ΔLFP_{t-3}	-0.822	-4.444*
ΔTFR_{t-4}	0.287	2.660*	ΔIMR_{t-1}	-1.441	-1.997*
ΔLFP_{t-3}	-0.261	-2.322*	ΔIMR_{t-2}	2.849	2.502*
ΔLFP_{t-4}	-0.176	-2.115*	ΔIMR_{t-3}	5.530	4.412*
ΔIMR_{t-1}	-0.357	-1.246	ΔIMR_{t-4}	2.651	3.030*
ΔIMR_{t-3}	0.477	1.679**	ΔFIR_{t-2}	0.475	3.392*
ΔFIR_{t-3}	0.232	2.619*	ΔFIR_{t-4}	-0.446	-3.638*
ΔFIR_{t-4}	-0.204	-2.232*	EC_{t-1}	-1.465	-8.588*
EC_{t-1}	-1.354	-10.588*			
Log Likelihood	417.8153				
PORTMANTEAU	229.3016	[0.2252]	**JB** u_1	0.9748	[0.6142]
LM	109.4869	[0.0003]	**JB** u_2	3.1569	[0.2063]
Doornik and Hansen	18.0919	[0.0205]			
Lütkepohl	24.1348	[0.0022]			

*Notes: *significant at 5% level or less; ** significant at 10% level or less. Figures in parentheses denote the p values.*

Diagnostic Tests:

Portmanteau: Test for residual serial correlation (H_0: No autocorrelation)

LM: Lagrange multiplier test for residual serial correlation (H_0: No autocorrelation)

Doornik and Hansen: Test for normality of residuals (H_0: Normally distributed residuals)

Lütkepohl: Test for normality of residuals (H_0: Normally distributed residuals)

JB: Jarques Bera test for normality of residuals (H_0: Normally distributed residuals)

The short run result indicates a negative relationship between LFP and fertility (with third and fourth lag of first differences of LFP and fertility). This may be due to the fact that a change in female LFP rates showing its effect on the incentives for having children with a time lag (of about 3-4 years) – this seems to be a valid scenario in the short run where socio-economic changes precede the transition of childbearing behaviours of women.

We found the direction of causality to be two-way for fertility and female LFP, i.e. there is a feedback relationship between total fertility rate and FLFP rate according to the multivariate model. Moreover instantaneous joint causality tests indicate that there also exist contemporaneous effects among the variables, jointly.

4. Preliminary Conclusion

This study found that no long-run relationship between fertility and FLFP rate exists in a bivariate setting, instead when the multivariate model is employed; the joint causality tests suggest that there exists a feedback relationship between TFR and FLFP rate.

The empirical results also indicate that infant mortality rate and female illiteracy rate Granger-cause both fertility and female LFP. The error correction equations of TFR and LFP show that there is also short-run causality from TFR and LFP, and LFP to TFR when controlled for other variables since the short-run coefficients were significant.

Impulse response functions (IRF) in the VEC model indicate the response of fertility to a shift in LFP is a sharp decline, which is in line with the negative short-run and long-run coefficients of the VEC model.

On the whole, the findings of this study are consistent with similar macro-level studies of other countries and provided evidence for the role incompatibility hypothesis. The cointegrated models further suggest that the long-run relationship between fertility and female LFP exist in a multivariate setting. The causality may not exist overall, or, provided that infant mortality and female illiteracy are also included in the model, may it exist. The latter seems to be more valid when the cointegration equations are analyzed further (in terms of white noise error terms). The result that there exists a causality relationship between TFR and LFP running from both ways gives support the Weller's third classification, which is "both family size and LFP affect each other".

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