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Does Financial Openness Tell Much about Fertility Transitions?

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ABSTRACT

This study examines the impact of financial openness on fertility transitions with global evidence of seven regions by using unbalanced panel data of 140 countries for 1967-2016 period. Other 'conventional' determinants included are real GDP per capita, consumer price index, female gross tertiary school enrolment, and urban population. The estimates of panel least squares equations show that financial openness has negative impact on fertility as a whole, as well as in Europe and Central Asia, and Sub-Saharan Africa regions, but a reverse position holds for Middle East and North Africa region. The estimated sign of the control variables is found to be varying among the regions, except for, urban population. This study reaffirms the impact of financial openness on fertility, and it is important for policy implication.

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INTRODUCTION

Fertility and 'finance' have seen remarkable transition over time. The global fertility rate was 5 children per woman in the period of 1950-1955, decreased by half to record 2.52 children in 2010-2015. This figure is projected to decline further to 2.24 children by 2045-2050 (United Nations, 2017). Contrary to fertility, financial development is a multifaceted phenomenon that spreads globally to allow credit and intertemporal trade for households and firms, but recently its negative impact on fertility ascertained in many studies (Basso and Cuberes, 2013; Filoso and Papagni, 2015; Zakaria et al., 2016; Idris et al., 2018) has become a major concern, especially in developed countries with fertility far below replacement level.

Indeed, financial openness and financial development are closely related (Rajan and Zingales, 2003, Baltagi et al., 2009). Financial openness, in general refers to the willingness of an economy to liberalize the restriction measures for cross-border financial transactions of the capital and financial accounts in the Balance of Payments (BoP) such as FDI inflows. However, there is no 'chicken and egg situation' as opening up a country's financial market is a *necessary* condition for advancing financial market development. There is well-established empirical evidence that financial openness led to domestic financial sector development (Kose et al., 2009). For example, Rajan and Zingales (2003) showed that continuous trade and capital (financial) accounts openness contributed towards successful financial development. In fact, financial openness is being considered as driver to spur economic development greatly via productivity growth, and the degree of financial openness is important in transforming a country from low to middle income (Bekaert et al., 2011).

A concern is that low fertility not only reduces future population growth but also increases the aged population, and subsequently leads to issues related to labor shortage and the capacity to cope with the rising number of older persons, such as pension and healthcare system and social security. Hence, this is a crucial phenomenon that needs further understanding, and provides motivation to investigate the potential determinants of fertility, by considering the impact of financial openness.

In the past decades, many empirical studies have widely examined the 'conventional' determinants of fertility[1], such as income and female education (Ren, 2008; Adhikari, 2010; Dey and Wasoff, 2010; Kamal and Pervaiz, 2011; Indongo and Pazvakawambwa, 2012; Shapiro, 2012; Brinker and Amonker, 2013; Al Awad and Chartouni, 2014; Gubhaju et al., 2014; Hwang and Lee, 2014; Lai and Tey, 2014; Kamaruddin and Khalili, 2015; Zakaria et al., 2016; Khraif et al., 2017; Nozaki, 2017; Sheikh et al., 2017), inflation rate (Teguh, 2009; Peng, 2010), and urbanization (Teguh, 2009; Aldieri and Vinci, 2012; Basso and Cuberes, 2013; Miljkovic and Glazyrina, 2015; Adhikari, 2010; Kamal and Pervaiz, 2011; Indongo and Pazvakawambwa, 2012; Gubhaju et al., 2014; Lai and Tey, 2014; Sheikh et al., 2017), but the important role of financial development, in particularly financial openness on fertility were eventually ignored. Hence, this study fills the gap of existing literature of fertility by adding a fresh evidence of the impact of financial openness on fertility rate with a global perspective. Majority of the existing literatures on fertility-finance study focus on the impact of financial development on fertility in country or regional specific (Basso and Cuberes, 2013; Filoso and Papagni, 2015; Zakaria et al., 2016; Idris et al., 2018).

This study explores a global evidence of a total of seven regions on the impact of financial openness on fertility rate with application of panel data testing methods. The annual observations are ranging between 1967 and 2016. The findings are expected to be relevant for policy makers on future policy implication to formulate appropriate policies to achieve 'equilibrium' between population and economic growth for sustainable development. This study adds to the existing literature that financial openness has negative implication on fertility in general, and in Europe and Central Asia, and Sub-Saharan Africa regions, but a positive effect for Middle East and North Africa regions. The estimated sign of the conventional variables such as real GDP per capita, consumer price index, and female gross tertiary school enrolment is found to be varying among the regions, except for, urban population which is in negative sign.

The rest of this study is outlined as follows. Data, Model, and Methods Section describes the data used, empirical equations, and the testing methods. The empirical results are reported in the following section. Final remark and discussion are in the last section.

[1] A summary review of the selected fertility studies for between 2008 and 2017, is available upon request from the corresponding author.

DATA, MODEL, AND METHODS

This study considers an unbalanced short panels because of data unavailability that the number of time periods is not the same for all individuals (i.e. countries) and there are a large number of individuals observed for a few time periods. The raw data are collected from the World Development Indicators, World Bank comprising 140 countries in seven geographical regions as listed in Appendix A. The data are annual observations ranging between 1967 and 2016.[2] Some countries have been eliminated due to substantial data unavailability, i.e. missing data for consecutive five years period.

Past studies on different sampled countries, and/or regions consistently delivered a negative impact of financial development (instead of, financial openness) on fertility by assuming other variables (income per capita, urbanization level, educational attainment, agricultural productivity) are constant (Basso and Cuberes, 2013; Filoso and Papagni, 2015; Zakaria et al., 2016; Idris et al., 2018). However, the impact of financial openness on fertility remains exploratory. Following the past studies, this study considers equation (1) that allows examination of the influence of financial openness (KAOPEN)[3], a *de jure* indicator of financial openness (Chinn and Ito, 2006) on fertility, along with other 'conventional' control variables, namely real GDP per capita (Y), and consumer price index (CPI) are transformed into natural logarithms, *ln* for interpretation convenience, i.e. elasticity. Other variables such as female gross tertiary school enrolment (EDU) and urban population (UP) are in percentages.

$$lnTFR_{i,t} = \beta_0 + \beta_1 \boldsymbol{KAOPEN_{i,t}} + \beta_2 lnY_{i,t} + \beta_3 lnCPI_{i,t} + \beta_4 EDU_{i,t} + \beta_5 UP_{i,t} + \varepsilon_{i,t} \quad (1)$$

where *i* is country sample, *t* is time dimension, and TFR is total fertility rate, dependent variable. Given past studies have found a significant association between financial openness and economic growth (Estrada et al., 2015, Bekaert et al., 2011), an interaction term of real GDP per capita and financial openness is being added into equation (1) as in equation (2).

$$lnTFR_{i,t} = \beta_0 + \beta_1 \boldsymbol{KAOPEN_{i,t}} + \beta_2 lnY_{i,t} + \beta_3 lnCPI_{i,t} + \beta_4 EDU_{i,t} + \beta_5 UP_{i,t} + \beta_6 (\boldsymbol{lnY} \times \boldsymbol{KAOPEN_{i,t}}) + \varepsilon_{i,t} \quad (2)$$

Descriptive Statistics

Table 1 provides some key descriptive statistics of the underlying variables for all countries panel as well as the seven regions. Sub-Saharan Africa has the highest average total fertility rate (*ln*TFR), and regions such as Latin America and Caribbean, Middle East and North Africa, and South Asia are having higher average *ln*TFR than the all countries average (1.199), with 1.203, 1.394 and 1.412 respectively. In contrast, North America has the lowest average *ln*TFR. The fertility rates in East Asia and Pacific, and Europe and Central Asia are below the all countries average, with 1.077 and 0.637 respectively.

For financial openness (KAOPEN), the all countries average is 0.015. North America region has the highest mean financial openness, with 2.389 while the lowest is South Asia, with -1.121. Other than North America, the average KAOPEN in East Asia and Pacific, Middle East and North Africa, and Europe and Central Asia are higher than the all countries average KAOPEN, with 0.331, 0.379 and 0.809 respectively. Latin America and Caribbean, and Sub-Saharan Africa are having low average KAOPEN, with negative values after South Asia. The standard deviation indicates the variation of all countries fertility rate is 0.559. Each of the seven regions is having lower variation in *ln*TFR than the all countries. The all countries KAOPEN variation is 1.533. Latin America and Caribbean, and Middle East and North Africa are having higher variation in KAOPEN than the all countries, with 1.556 and 1.702 respectively. The variations in KAOPEN are lower than the all countries variation for the remaining regions.

[2] The financial openness data is only available in annual observations between 1967 and 2014.

[3] KAOPEN refers to freely international inflow and outflow of money across countries. The scale for the openness is between the range of -2.5 and 2.5 where higher values represent higher degree of financial openness in that country. It is a *de jure* measure, which means that it is recognized by the law and government legally.

Table 1 Descriptive statistics

Panel	Variables	Mean	Median	Max.	Min.	Std. Dev.
All countries	*ln*TFR	1.199	1.186	2.183	-0.104	0.559
	KAOPEN	0.015	-0.313	2.389	-1.895	1.533
	*ln*Y	24.123	23.873	30.440	18.743	2.249
	*ln*CPI	3.003	4.003	5.855	-30.234	3.171
	EDU	0.262	0.172	1.137	0.000	0.272
	UP	0.500	0.503	1.000	0.025	0.247
East Asia and Pacific	*ln*TFR	1.077	1.080	2.027	-0.104	0.504
	KAOPEN	0.331	-0.126	2.389	-1.895	1.496
	*ln*Y	24.914	25.137	29.818	20.641	2.202
	*ln*CPI	3.618	4.093	5.102	-1.575	1.298
	EDU	0.285	0.209	1.063	0.001	0.263
	UP	0.490	0.425	1.000	0.045	0.295
Europe and Central Asia	*ln*TFR	0.637	0.610	1.757	0.082	0.295
	KAOPEN	0.809	1.091	2.389	-1.895	1.508
	*ln*Y	25.638	25.954	28.939	21.615	1.826
	*ln*CPI	3.502	4.232	5.327	-9.308	2.078
	EDU	0.434	0.380	1.137	0.011	0.273
	UP	0.644	0.658	0.979	0.293	0.141
Latin America and Caribbean	*ln*TFR	1.203	1.172	2.004	0.547	0.375
	KAOPEN	-0.032	-0.126	2.389	-1.895	1.556
	*ln*Y	23.494	23.408	28.515	18.743	2.020
	*ln*CPI	1.963	3.687	5.377	-21.753	4.077
	EDU	0.228	0.185	1.043	0.006	0.200
	UP	0.521	0.509	0.953	0.084	0.198
Middle East and North Africa	*ln*TFR	1.394	1.426	2.183	0.300	0.472
	KAOPEN	0.379	0.029	2.389	-1.895	1.702
	*ln*Y	24.409	24.533	27.234	20.435	1.476
	*ln*CPI	3.462	4.131	5.735	-6.582	1.874
	EDU	0.212	0.166	0.773	0.000	0.183
	UP	0.687	0.712	0.992	0.119	0.210
North America	*ln*TFR	0.613	0.604	0.939	0.399	0.127
	KAOPEN	2.389	2.389	2.389	2.389	0.000
	*ln*Y	28.734	28.652	30.440	26.852	1.178
	*ln*CPI	3.985	4.201	4.703	2.728	0.613
	EDU	0.788	0.811	1.130	0.386	0.216
	UP	0.772	0.766	0.818	0.726	0.027
South Asia	*ln*TFR	1.412	1.462	1.938	0.685	0.383
	KAOPEN	-1.121	-1.189	1.091	-1.895	0.506
	*ln*Y	24.076	24.169	28.462	18.922	2.096
	l*n*CPI	3.302	3.536	5.111	0.500	1.203
	EDU	0.052	0.033	0.253	0.002	0.055
	UP	0.207	0.196	0.388	0.038	0.089
Sub-Saharan Africa	*ln*TFR	1.752	1.827	2.134	0.307	0.275
	KAOPEN	-0.857	-1.189	2.389	-1.895	0.862
	*ln*Y	22.468	22.361	26.859	18.966	1.472
	*ln*CPI	2.577	3.818	5.855	-30.234	4.366
	EDU	0.031	0.009	0.442	0.000	0.057
	UP	0.288	0.268	0.872	0.025	0.157

Notes: Max is maximum; Min is minimum; Std. Dev. is standard deviation.

Augmented Dickey-Fuller (ADF) Fisher Panel Unit Root Test

The stationary property of the underlying variables of the respective panels are examined using ADF Fisher Chi-Square panel unit root test (Maddala and Wu, 1999). This test is appropriate for unbalanced panel data. The computed *p*-value from individual unit root tests is joined into Fisher ADF panel unit root test where the π_i determined as the *p*-value from any individual unit root test for cross-section *i*. Under the null hypothesis of presence of unit root for all N cross-sections, the asymptotic outcome is as $-2\sum_{i=2}^{N}\log(\pi_i) \rightarrow \chi^2_{2N}$. Then, Choi (2001) showed, $Z = \frac{1}{\sqrt{N}}\sum_{i=1}^{N}\Phi^{-1}(\pi_i) \rightarrow N(0,1)$, where Φ^{-1} is the inverse of the standard normal cumulative distribution function. Given that Fisher test depends on ADF statistics, the number of lags chosen is based on the Schwartz Information Criterion (SIC). The hypotheses of ADF Fisher test is H_0= p_i= 1 (non-stationary) against H_1= p_i< 1 (stationary).

Table 2 reports the results of ADF Fisher tests. Given [at least] 10 percent level of significance, the fertility rate (*ln*TFR) is found to be stationary in level, *I*(0) for all panels. For financial openness (KAOPEN), it is stationary, *I*(0) for all panel regions as well as all countries panel, but it is not the case for Europe and Central Asia, and Latin America and Caribbean (*I*(1)). For North America, the unit root test statistics of KAOPEN is infeasible because this region consists of two countries only, with a constant value of 2.389

throughout the period 1967-2014. For real GDP per capita (*ln*Y), all regions except for the all countries, Europe and Central Asia, and Middle East and North Africa are stationary at first differenced, *I*(1). For the consumer price index (*ln*CPI), all countries, East Asia and Pacific, Europe and Central Asia, and Middle East and North Africa regions are stationary at *I*(0) but the remaining regions are at *I*(1). For North America, *ln*CPI remains non-stationary at *I*(1) based on the ADF Fisher Chi-Square, but the Levin et al. (2002) test reports t-statistic of *ln*CPI with -1.249 and *p*-value of 0.1, suggesting nearly *I*(1). For female tertiary educational attainment level (EDU), all countries panel, and all regions are stationary at *I*(1), except for North America (*I*(0)). Lastly, all countries panel and all regions panel are stationary at *I*(0) for the variables of urbanization level (UP), except for East Asia and Pacific (*I*(1)).

Overall, the dependent variable, fertility rate (*ln*TFR) is found to be stationary, *I*(0) for all countries panel, as well as for all regions, hence cointegration analysis is infeasible in this natural (i.e. no cointegration can be concluded). In fact, some of the independent variables are inconclusive on their degree of integration, i.e. between *I*(0) and *I*(1). For convenience and simplicity, it is assumed that the equations (1) and (2) are estimated by panel least squares estimator with the data at levels.[4]

Table 2 Results of ADF – Fisher panel unit root tests

Region Variable	All Countries	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub-Saharan Africa
$lnTFR_{i,t}$	648.329*** (0.000)	398.335*** (0.000)	124.084*** (0.001)	103.375*** (0.000)	92.953*** (0.000)	8.782* (0.067)	50.409*** (0.000)	200.202*** (0.000)
I(d)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)
$KAOPEN_{i,t}$	419.459*** (0.000)	51.314*** (0.009)	72.013 (0.286)	48.145 (0.238)	58.061*** (0.001)	#1	43.687*** (0.000)	146.239*** (0.000)
$\Delta KAOPEN_{i,t}$			741.630*** (0.000)	525.494*** (0.000)				
I(d)	*I*(0)	*I*(0)	*I*(1)	*I*(1)	*I*(0)		*I*(0)	*I*(0)
$lnY_{i,t}$	313.361* (0.083)	33.507 (0.492)	109.462** (0.011)	43.365 (0.499)	62.221*** (0.002)	2.566 (0.633)	5.604 (0.935)	56.637 (0.933)
$\Delta lnY_{i,t}$		241.454*** (0.000)		299.007*** (0.000)		34.745*** (0.000)	110.983*** (0.000)	737.894*** (0.000)
I(d)	*I*(0)	*I*(1)	*I*(0)	*I*(1)	*I*(0)	*I*(1)	*I*(1)	*I*(1)
$lnCPI_{i,t}$	1167.310*** (0.000)	59.072*** (0.005)	942.151*** (0.000)	26.055 (0.986)	80.137*** (0.000)	0.822 (0.936)	10.826 (0.544)	48.251 (0.991)
$\Delta lnCPI_{i,t}$				139.696*** (0.000)		4.283 (0.369)	89.852*** (0.000)	376.193*** (0.000)
I(d)	*I*(0)	*I*(0)	*I*(0)	*I*(1)	*I*(0)	*I*(1)$^{\#2}$	*I*(1)	*I*(1)
$EDU_{i,t}$	193.744 (0.999)	9.937 (0.999)	69.536 (0.742)	46.568 (0.161)	19.150 (0.981)	8.138* (0.087)	1.675 (0.999)	38.740 (0.999)
$\Delta EDU_{i,t}$	964.459*** (0.000)	141.672*** (0.000)	247.226*** (0.000)	118.765*** (0.000)	151.214*** (0.000)		25.972** (0.011)	263.076*** (0.000)
I(d)	*I*(1)	*I*(1)	*I*(1)	*I*(1)	*I*(1)	*I*(0)	*I*(1)	*I*(1)
$UP_{i,t}$	699.243*** (0.000)	39.328 (0.175)	398.781*** (0.000)	68.449** (0.011)	53.957** (0.016)	13.713*** (0.008)	21.995** (0.038)	103.019** (0.015)
$\Delta UP_{i,t}$		48.107** (0.034)						
I(d)	*I*(0)	*I*(1)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)	*I*(0)

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent respectively. #1 Only two countries, i.e. Canada and the United States are involved with constant value of KAOPEN, 2.389 for the sample period 1967-2014. #2 Levin et al. (2002), t-test, -1.249 with *p*-value of 0.10 suggesting nearly *I*(1).

Panel Ordinary Least Squares Regression with Fixed Effect

This study employs panel ordinary least squares (OLS) estimator with fixed effect assumption imposed. This assumption gets rid of the impacts of the possible time-invariant characteristics, therefore the net effect of the

[4] It is acknowledged that many intervening factors are ignored in equation (1) which can be considered for multi-equation model. A set of control variables that are commonly employed in this topic are included i.e. real GDP per capita, consumer price index, female gross tertiary school enrolment, and urban population. However, due to limited observations for the unbalanced panel data used with at least 5 observations, adding other 'intervening factors' may cause substantial reduction in the degree of freedom, and making estimation exercise incomputable. Multi-equation model is a system of equations consisting of many equations (i.e. all markets equations), which describe a given economic system. A reservation is that this study does not (or in fact, impossible) look at an economic system i.e. one [individual] country for all 140 countries as their data in nature, but regional-wise specific will do. Indeed, study on fertility is extremely regional/geographical in nature of the literature, and rarely (nothing) to say about an economic system. This concern has been added as one of the limitations of this study as in the end of last section - Discussion and Policy Implications

predictors on the outcome variable can be assessed. Besides, it considers those time-invariant features are unique to the individual, and should not be related with the features of other individual. Given the differences among each entity, the entity's error term and the constant cannot be correlated to others. The empirical equation can be generally expressed as $Y_{i,t} = \beta_1 X_{i,t} + \alpha_i + \varepsilon_{i,t}$, where α_i $(i = 1 \ldots . N)$ is the unknown intercept for each entity, $Y_{i,t}$ is the dependent variable, i is entity, t is time, $X_{i,t}$ is independent variable, β_1 is the coefficient, and $\varepsilon_{i,t}$ is the error term.

EMPIRICAL RESULTS

The estimates of the panel least squares regression equations are reported in Table 3.[5] For the all countries panel, financial openness poses a negative effect on fertility. Higher standard of living (real GDP per capita), cost of living, and urban population result a lower world fertility rate. However, women with tertiary education have more willingness to produce children. The interaction term in this panel is statistically significant. The impact of financial openness on fertility does not change in sign and remains significant, with an estimated coefficient of -0.225[6]. It can be observed that the financial openness after considering the interaction term has greater impact on fertility instead of the individual effect. Other variables remain unaffected when the interaction term is included in the estimation.

For East Asia and Pacific, financial openness does not has any effect on fertility, as well as the overall price level before interaction term is considered. The remaining variables are statistically significant with the similar signs as the all countries panel. When the interaction term is included, the impact of financial openness on fertility become significant, with an estimated coefficient of -0.278, while the other variables remain statistically significant, except for cost of living.

The Europe and Central Asia region shows similar findings as the all countries panel for all variables in the estimation before entering the interaction term. However, the effect of interaction term is insignificant, while the significance and signs of the 'conventional' variables remain unchanged when the interaction term is included.

Fertility in Latin America and Caribbean can be explained only by female tertiary educational attainment and urban population before interaction term is included. The interaction term is statistically significant, and the impact of financial openness on fertility suggests negative implication with an estimated coefficient of -0.262. The overall price level shows negative impact on fertility only after interaction term is included in the estimation, but real GDP per capita remains unexplainable to the fertility. Female tertiary educational attainment and urban population remain unaffected after interaction term is considered in the estimation.

For the Middle East and North Africa region, all variables pose an impact towards the fertility rate excluding the overall price level. Compare to other regions, financial openness shows a contrast finding of positive impact on fertility, with an estimated coefficient of 0.023. Real GDP per capita also forms positive relationship with fertility rate, as well as female tertiary educational attainment. Similar to other regions, urban population negatively influences fertility. However, the interaction term is not significant as well as the overall price level. The remaining variables are unaffected when interaction term is added.

The estimates of the panel of North America countries show that financial openness and real GDP per capita cannot be estimated due to the constant values of KAOPEN (2.389) and inclusion of only two countries in this region. At the same time, the remaining variables are insignificant including the interaction term.

Turning to the South Asia, the empirical results show that financial openness and urban population cannot explain the fertility rate, but real GDP per capita and overall price level positively affect fertility rate. Tertiary educated women in South Asia are different from other region where bearing and rearing children

[5] This study also re-estimated equations (1) and (2) by using data in first-differenced due to non-stationary of some variables for cross checking purpose, see Appendix B. Surprisingly, the change in financial openness (KAOPEN) has statistically insignificant (at 10 percent level) on the change in fertility rate over all of the regions including all countries panel. Comparing to the estimates of the data at levels, more conventional determinants are statistically insignificant at 10 percent level. Nevertheless, the estimation of data in levels are used since fertility study is about its rate rather than of its growth rate. On the other hand, it can be explained by the information loss due to the first differencing transformation.

[6] The effect of financial openness on fertility rate with this interaction term, is sum of the estimated coefficients of KAOPEN and this interaction term (i.e. -0.234 +0.009 = -0.225).

bring higher opportunity cost to them, and hence fertility rate decreases when more women with tertiary education. However, the interaction term and urban population are not significant. Real GDP per capita, overall price level, and female tertiary educational attainment remain unaffected when the estimation includes interaction term.

In Sub-Saharan Africa, all variables are statistically significant. Fertility is lowered by higher financial openness, better standard of living, widespread of female tertiary education, and highly urbanized population, while cost of living suggests a positive relationship with fertility. The interaction term is statistically significant, and the impact of financial openness on fertility becomes positive after considering the interaction term. All 'conventional' variables remain unchanged when interaction term is added.

Before concluding this study, an additional question is worth to answer here that is "*Does financial openness cause fertility rate?*". The reason is that, according to Granger (1969), "*…the cause occurs before the effect".* It complements the earlier results of panel least squares[7]. The answer from this study is *Yes, it does!* The findings are presented in Appendix C. The panel pairwise Granger non-causality test reveals that financial openness causes fertility rate in the world (all countries) and all regions in a bidirectional linkage, except for Middle East and North Africa, and North America regions. It is worth to note that financial openness also indirectly influences fertility rate through its transmission channels, but it is not the case in North America that real GDP per capita is important cause to the fertility rate in this region. The most common indirect transmission channel that almost all regions are having is, financial openness indirectly causes fertility rate through real GDP per capita. However, in Middle East and North Africa regions, financial openness affects fertility through urban population.

Table 3 Unbalanced panel least squares – fixed effect (dependent variable, $lnTFR_{i,t}$)

Region	All Countries		East Asia & Pacific		Europe & Central Asia		Latin America & Caribbean	
Variable								
$KAOPEN_{i,t}$	-0.011***	-0.234***	0.011	-0.290***	-0.028***	-0.005	0.001	-0.274***
	(0.000)	(0.000)	(0.153)	(0.003)	(0.000)	(0.929)	(0.818)	(0.000)
$lnY_{i,t}$	-0.160***	-0.144***	-0.245***	-0.225***	-0.156***	-0.159***	0.027	0.021
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.393)	(0.508)
$lnCPI_{i,t}$	-0.008***	-0.007***	0.006	0.015	-0.038***	-0.039***	-0.002	-0.005**
	(0.000)	(0.000)	(0.603)	(0.184)	(0.000)	(0.000)	(0.318)	(0.044)
$EDU_{i,t}$	0.258***	0.209***	0.506***	0.478***	0.130***	0.130***	0.626***	0.601***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)
$UP_{i,t}$	-0.849***	-0.808***	-0.293**	-0.271**	-0.418***	-0.420***	-0.486***	-0.595***
	(0.000)	(0.000)	(0.036)	(0.049)	(0.007)	(0.006)	(0.000)	(0.000)
$KAOPEN_{i,t} \times lnY_{i,t}$		0.009***		0.012***		-0.001		0.012***
		(0.000)		(0.002)		(0.709)		(0.000)
$Constant$	5.391***	4.957***	7.087***	6.521***	4.944***	5.016***	0.579	0.805
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.435)	(0.267)
Adj. R^2	0.954	0.954	0.957	0.958	0.812	0.812	0.960	0.962
F-statistics	334.897	338.276	130.329	132.065	54.573	53.900	126.694	132.331
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cross-section	140	140	17	17	39	39	22	22

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent respectively.

[7] The tests statistics and diagrams are not reported here, but available from the corresponding author upon request.

Table 3 Continued

Region / Variable	Middle East & North Africa		North America	South Asia		Sub-Saharan Africa	
$KAOPEN_{i,t}$	0.023***	0.049		-0.028	-0.789	-0.008*	0.176*
	(0.001)	(0.626)		(0.241)	(0.276)	(0.099)	(0.087)
$lnY_{i,t}$	0.145***	0.147***		0.346***	0.384***	-0.102***	-0.107***
	(0.001)	(0.001)		(0.000)	(0.000)	(0.000)	(0.000)
$lnCPI_{i,t}$	0.002	0.002	-0.606	0.351***	0.326***	0.003*	0.003*
	(0.768)	(0.715)	(0.567)	(0.000)	(0.000)	(0.088)	(0.093)
$EDU_{i,t}$	0.506***	0.502***	0.217	-1.261***	-1.370***	-0.489***	-0.481***
	(0.000)	(0.000)	(0.437)	(0.005)	(0.003)	(0.000)	(0.000)
$UP_{i,t}$	-1.657***	-1.662***	-1.763	-0.730	-0.895	-0.494***	-0.487***
	(0.000)	(0.000)	(0.936)	(0.249)	(0.170)	(0.000)	(0.000)
$KAOPEN_{i,t} \times lnY_{i,t}$		-0.001	0.919		0.032		-0.008*
		(0.795)	(0.429)		(0.293)		(0.073)
$Constant$	-1.297	-1.331	-60.246	-8.240***	-9.011***	4.123***	4.237***
	(0.244)	(0.236)	(0.376)	(0.000)	(0.000)	(0.000)	(0.000)
Adj. R^2	0.946	0.946	0.868	0.975	0.975	0.959	0.959
F-statistics	105.129	103.209	8.427	93.744	92.152	190.168	188.671
	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)
Cross-section	17	17	2	6	6	37	37

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent respectively.

DICUSSION AND POLICY IMPLICATIONS

This study ascertains that financial openness poses a negative impact on fertility (in all countries panel), including the Europe and Central Asia, and Sub-Saharan Africa regions. It reveals that the more open the financial market, the lower the fertility rate in these regions. Middle East and North Africa region shows contrast finding where financial openness positively affects fertility rate. Financial openness has no implication for East Asia and Pacific, Latin America and Caribbean, and South Asia regions. The interaction term of financial openness and real GDP per capita is feasible in all countries panel, East Asia and Pacific, Latin America and Caribbean, and Sub-Saharan Africa regions. Since none of the reviewed studies investigate the role of financial openness in explaining fertility decline, it is therefore vital for the policy makers not to lose sight and, must monitor it closely. Given that financial openness fosters financial and/or economic development (Rajan and Zingales, 2003; Baltagi et al., 2009; Kose et al., 2009; Bekaert et al., 2011), and financial development exerts negative impact on fertility (Basso and Cuberes, 2013; Filoso and Papagni, 2015; Zakaria et al., 2016; Idris et al., 2018), countries whose fertility remained high should promote wider degree of financial openness to achieve a desired fertility level, especially those countries in the Sub-Saharan Africa region. In Middle East and North Africa, financial openness should be discreetly implemented in a way of promoting financial development as it can produce higher fertility rate which, in fact is unfavorable to this region.

Does the estimated sign of the conventional determinants of fertility transitions consistent with the past studies? The estimated sign of the conventional variables such as real GDP per capita, consumer price index, and female gross tertiary school enrolment are found to be inconsistent among the regions, except for, urban population which is in negative sign.

For discussion, many studies have found negative relationship between income and fertility (Basso and Cuberes, 2013; Dey and Wasoff, 2010; Filoso and Papagni, 2015; Shapiro, 2012; Zakaria et al., 2016). However, Aldieri and Vinci (2012) and Becker (1960) proved that children are consumer durable goods, in which parents demanded more children as their income level increases because children provide the highest satisfaction level. Both arguments were corroborated in this study, in which a negative relationship between real GDP per capita (proxy for income) and fertility were established in all countries panel, East Asia and Pacific, Europe and Central Asia, and Sub-Saharan Africa regions, but a positive correlation was found in Middle East and North Africa, and South Asia regions. Thus, the influence of income on fertility can be positive or negative, depending whether the parents dominate substitution or income effect. Apart from providing affordable workplace childcare services, promotion of shorter working hours can indirectly bring about lesser income, and this is a key step to encourage larger family size, especially in the developed

countries. At the same time, a positive relationship between real GDP per capita and fertility implies that income effect tends to dominate, where higher real income increases the fertility rate due to higher purchasing power on the consumer goods (children). Thus, the policy makers should increase the minimum wages, at the same time reducing the mandatory taxes paid by the citizens to encourage childbearing.

In Teguh's (2009) and Peng's (2010) studies, the consumer price index that reflects the living costs showed that higher consumer price index reduced the real value of income and subsequently lowered the intentions to have more children. Similarly, this study shows that cost of living poses negative impact on fertility in all countries, and Europe and Central Asia regions. However, positive effect was found in South Asia and Sub-Saharan Africa. Policy makers should stabilize inflation rate as it poses negative impact on fertility rate for all countries as a whole. Contractionary monetary policy should be employed to solve the high inflation problem. This macroeconomic strategy forces the bank and central bank to increase interest rate and discount rate respectively, that results in money supply contraction, which will stabilize the commodities prices. When the commodities in market are not overpriced, it reduces burden to the parents, which is beneficial for higher fertility rate. This contractionary monetary policy is pertinent to the developed countries that are reaching the ultra-low fertility level, such as Portugal (1.31)[8], Greece (1.33), Spain (1.33), Cyprus (1.34), and Italy (1.35) (World Bank, 2018).

Female education affects fertility inversely due to the increasing knowledge on contraceptive use and demand for quality children (Ren, 2008; Dey and Wasoff, 2010; Kamal and Pervaiz, 2011; Aldieri and Vinci, 2012; Indongo and Pazvakawambwa, 2012; Shapiro, 2012; Basso and Cuberes, 2013; Brinker and Amonker, 2013; Hwang and Lee, 2014; Al Awad and Chartouni, 2014; Gubhaju et al., 2014; Lai and Tey, 2014; Zakaria et al., 2016; Khraif et al., 2017; Nozaki, 2017; Sheikh et al., 2017). This study shows that this argument only holds for South Asia and Sub-Saharan Africa. Highly educated women usually have higher employment opportunities, higher earning power, and married to partners with similar background. Hence, the income effect tends to dominate when building larger family size becomes affordable, and easily accomplish.

Urbanization was found to be an important determinant of fertility in many empirical studies (Adhikari, 2010,;Kamal and Pervaiz, 2011; Aldieri and Vinci, 2012; Indongo and Pazvakawambwa, 2012; Shapiro, 2012; Basso and Cuberes, 2013; Gubhaju et al., 2014; Lai and Tey, 2014; Kamaruddin and Khalili, 2015; Miljkovic and Glazyrina, 2015; Zakaria et al., 2016; Sheikh et al., 2017). Similar outcome was reported in this paper, in which urban population has consistent negative impact on fertility, except for North America and South Asia regions. Urban area is usually associated with higher living costs, and hence policy makers should monitor and control the prices to avoid over-inflated in commodities prices, which in turn increase the burden of young couples that may discourage their fertility intentions. Subsidies through infrastructure in urban area, for example public transportation and medical facilities may be effective in reducing the burden of the urban population.

One of the major *drawbacks* of this study is that the empirical findings are mainly based on a *de jure* indicator of financial openness, KAOPEN which may not fully reflect the actual cross-border financial transactions. For example, China – the country with tightened capital controls, but Chinese companies have become increasingly bold in searching for growth in overseas markets with outbound direct investment (ODI) hit a record high of $183 billion in 2016 which is nearly 50 percent more than FDI.[9] For further study, *de facto* financial openness indicators such as capital inflows and capital stocks, and the composition of capital inflows – the most commonly used is the sum of foreign assets and liabilities over GDP, can be considered. Besides, other 'intervening factors' such as age of marriage and contraceptive use are ignored in this study that requires multi-equation model which describes an economic system. However, it is incomputable (infeasible) due to short panels with limited observations of at least 5, and the KAOPEN variable is either uniform or binomial for some countries such as the United States. Indeed, study on fertility is extremely regional (geographical) in nature of the literature, and rarely (nothing) to say about an economic system. Further study can consider this concern for a single country if data are sufficient to do so.

[8] Figures in parentheses show the total fertility rate in 2016.
[9] See, https://www.ft.com/content/adbd4e0e-9163-11e7-bdfa-eda243196c2c

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APPENDICES

Appendix A Sample countries by regions (140 countries)

East Asia & Pacific (17 countries)	Australia, Cambodia, China, Fiji, Hong Kong SAR, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, New Zealand, Papua New Guinea, Philippines, Singapore, Thailand, and Vietnam.
Europe & Central Asia (39 countries)	Albania, Armenia, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Macedonia, FYR, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and United Kingdom.
Latin America & Caribbean (22 countries)	Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, St. Lucia, Suriname, Trinidad and Tobago, and Uruguay.
Middle East & North Africa (17 countries)	Algeria, Bahrain, Djibouti, Egypt, Arab Rep., Iran, Islamic Rep., Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Qatar, Saudi Arabia, Tunisia, and Yemen, Rep.
North America (2 countries)	Canada, and the United States.
South Asia (6 countries)	Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka.
Sub-Saharan Africa (37 countries)	Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo, Rep., Cote d'Ivoire, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Swaziland, Tanzania, Togo, and Uganda.

Appendix B Panel least squares (fixed effect) estimates in first-differenced data

Regions Variables	Dependent Variable: $\Delta lnTFR_{i,t}$							
	All Countries		East Asia & Pacific		Europe & Central Asia		Latin America & Caribbean	
$\Delta KAOPEN_{i,t}$	0	-0.002	0.004	-0.006	-0.002	-0.002	0.001	-0.001
	-0.868	-0.303	-0.487	-0.644	-0.482	-0.56	-0.528	-0.722
$\Delta lnY_{i,t}$	0.025*	0.024*	0.068	0.067	0.078**	0.078**	0.025*	0.026*
	(0.076)	(0.091)	(0.427)	(0.440)	(0.028)	(0.028)	(0.058)	(0.050)
$\Delta lnCPI_{i,t}$	-0.033***	-0.033***	-0.006	-0.006	-0.043***	-0.043***	0.006	0.004
	(0.000)	(0.000)	(0.839)	(0.848)	(0.000)	(0.000)	(0.453)	(0.633)
$\Delta EDU_{i,t}$	0.045**	0.045**	-0.027	-0.026	0.044	0.044	0.01	0.008
	(0.043)	(0.042)	(0.716)	(0.730)	(0.201)	(0.201)	(0.618)	(0.682)
$\Delta UP_{i,t}$	0.626***	0.622***	0.698	0.658	1.142**	1.143**	-0.773***	-0.745***
	(0.007)	(0.008)	(0.36)	(0.389)	(0.013)	(0.013)	(0.007)	(0.009)
$\Delta KAOPEN_{i,t}$		0.056		0.187		0.004		0.041
$\times\ \Delta lnY_{i,t}$		(0.136)		(0.375)		(0.965)		(0.210)
$Constant$	0.012***	-0.012***	-0.018***	-0.018***	-0.008***	-0.008***	-0.018***	-0.018***
	(0.000)	(0.000)	(0.005)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)
Adj. R^2	0.203	0.203	0.272	0.272	0.325	0.325	0.568	0.569
F-statistics	4.503	4.494	2.847	2.813	6.632	6.548	6.187	6.138
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cross-section	140	140	17	17	39	39	22	22

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent respectively. North America region is excluded because it involves only two countries, i.e. Canada and the United States and the KAOPEN is constant values of 2.389 for the sample period 1967-2014, changes in KAOPEN is zero.

Appendix B Continue

Region Variables	Dependent Variable:$\Delta lnTFR_{i,t}$					
	Middle East & North Africa		South Asia		Sub-Saharan Africa	
$\Delta KAOPEN_{i,t}$	-0.005	-0.01	-0.009	-0.022	-0.002	-0.001
	(0.383)	(0.132)	(0.169)	(0.474)	(0.308)	(0.454)
$\Delta lnY_{i,t}$	0.055	0.064*	0.072	0.075	0.006	0.007
	(0.150)	(0.098)	(0.157)	(0.150)	(0.556)	(0.511)
$\Delta lnCPI_{i,t}$	-0.029*	-0.030*	0.025	0.019	-0.006	-0.006
	(0.056)	(0.052)	(0.563)	(0.684)	(0.449)	(0.463)
$\Delta EDU_{i,t}$	0.096	0.095	-0.093	-0.099	0.015	0.015
	(0.238)	(0.239)	(0.471)	(0.448)	(0.813)	(0.819)
$\Delta UP_{i,t}$	0.137	0.196	1.785	1.925	0.146	0.156
	(0.833)	(0.763)	(0.475)	(0.449)	(0.493)	(0.466)
$\Delta KAOPEN_{i,t}$		0.183		0.302		-0.012
$\times\ \Delta lnY_{i,t}$		(0.177)		(0.662)		(0.663)
$Constant$	-0.018***	-0.019***	-0.034***	-0.035***	-0.012***	-0.012***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Adj. R^2	0.22	0.222	0.617	0.61	0.33	0.329
F-statistics	2.483	2.481	4.152	3.997	4.051	3.997
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cross-section	17	17	6	6	37	37

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent respectively. North America region is excluded because it involves only two countries, i.e. Canada and the United States and the KAOPEN is constant values of 2.389 for the sample period 1967-2014, changes in KAOPEN is zero.

Appendix C Transmission channels of fertility rate

Full panel (World)

- KAOPEN →*ln*Y →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI→*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → EDU →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → UP →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → EDU → UP →*ln*TFR

East Asia and Pacific

- KAOPEN →*ln*Y →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI→*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → UP → EDU →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → UP → KAOPEN →*ln*TFR

Europe and Central Asia

- KAOPEN →*ln*Y →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI→*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → EDU →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → UP →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI → EDU → UP →*ln*TFR

Latin America and Caribbean

- KAOPEN →*ln*Y →*ln*TFR
- KAOPEN →*ln*Y → EDU →*ln*TFR
- KAOPEN →*ln*Y →*ln*CPI →UP → EDU →*ln*TFR

Middle East and North Africa

- KAOPEN → UP →*ln*TFR

North America

- *ln*Y →*ln*CPI →*ln*TFR
- *ln*Y →*ln*CPI → EDU → UP →*ln*Y →*ln*TFR

South Asia

- KAOPEN →*ln*Y →*ln*TFR
- KAOPEN →*ln*Y → EDU →*ln*TFR
- KAOPEN →*ln*Y → UP →*ln*TFR
- KAOPEN →*ln*Y → EDU → UP →*ln*TFR
- KAOPEN →*ln*CPI → EDU → UP →*ln*TFR

Sub-Saharan Africa

- KAOPEN →*ln*Y →*ln*CPI→*ln*TFR
- KAOPEN →*ln*Y → UP →*ln*TFR
- KAOPEN →*ln*Y → UP → EDU →*ln*TFR