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Fertility and Population Policy

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Abstract

There have been significant changes in both the fertility rates and fertility perception since 1970s. In this paper, we examine the relationship between government policies towards fertility and the fertility trends. Total fertility rate, defined as the number of children per woman, is used as the main fertility trend variable. We use panel data from the United Nations World Population Policies database, and the World Bank World Development Indicators for the period 1976 through 2013. We find significant negative association between a country's fertility rate and its anti-fertility policy. On the other hand, there is no significant and robust relationship between the fertility rate and a country's pro-fertility or family-planning policies. In addition we find evidence of spatial autocorrelation in the total fertility rate, and spatial spillovers from government's policy on fertility.

Keywords: fertility rate; population; government policies
JEL Classification: H10, H59, J11, J13, J18

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1. Introduction

Fertility rates have decreased substantially over the last few decades. While decreases are more profound in developed countries, developing countries have also experienced significant changes following, in some cases, specific government policies. While population control policies vary widely around the world, governments in developing countries tend to have a relatively negative view towards fertility, which often leads to the adoption of anti-fertility policies. It is not clear, however, whether there is indeed a significant or strong relationship between population policies and fertility rates.

In this paper, we examine the relationship between government policies towards fertility and the change in the total fertility rate using panel data on 133 countries over the 1976-2013 period. We use country-level data from the United Nations World Population Policies Database, and the World Bank's World Development Indicators.[1] In our analysis we consider different types of government policy. The first is to reduce fertility through education, health care, family planning, employment programs and availability of low-cost contraception. We can refer to this as anti-fertility policy. The second is to raise fertility through a variety of government subsidies for childcare and housing, tax incentives, maternal and paternal leave and media campaigns. We can refer to this as pro-fertility policy.[2] In addition, within the anti-fertility policy category, we examine family planning policy separately to see if that policy is particularly strongly related to change in

[1] The UN World Population Policies Database provides data for the years 1976, 1986, 1996, 2001, 2003, 2005, 2007, 2009, 2011, and 2013. Data for 2015 became available very recently but was excluded from our analysis due to lack of data for that year for other variables used in our regressions.
[2] The term "pro-natal policy" is also used in many studies.

fertility. We also control for country fixed effects and spatial autocorrelation in the data. We present results for different econometric specifications to understand the robustness of our results. Our main findings show a statistically significant, negative relationship between change in total fertility rate and anti-fertility policy. On the other hand, there is no significant and robust relationship between change in total fertility rate and pro-fertility policy. We also do not find significant and robust relationship with family planning policy. In addition we find evidence of spatial autocorrelation in the total fertility rate, and spatial spillovers from government's policy on fertility.

In the next section, we start with a brief discussion on the previous literature and then present trends in the total fertility rate and the government policies towards fertility. This is followed by a description of our empirical approach, models and variables used in our analysis. We present our results in section 4 and provide summary and concluding remarks in the last section.

2. Fertility Trends and Population Control Policies

Other studies that examined whether fertility responds to population policies have had mixed results. Pritchett (1994) argues and shows that the significant variation in fertility rates across countries is due to desired fertility of couples, and is not driven by the availability of contraceptives or family planning policy by governments. At the same time, Haub (2010) argues that population control policy in South Korea not only worked but it worked too well. South Korea now has one of the lowest fertility rates in the world. Singapore is another example where the population policy went from anti-natalist in

1960s and 1970s to pro-natalist after the mid-1980s (Yap, 2003). Yap (2003) notes that the total fertility rate in Singapore rose sharply from 1.6 to about 2 children per woman in 1988, soon after the introduction of the new pro-natalist policy in 1987. Feyrer, Sacerdote and Stern (2008) argue that there may be an increase in the fertility rates in high-income countries due to increased participation of males in the household, which is not necessarily driven by a specific government policy. A recent book by Takayama and Werding (2011) provides an overview of policy responses to low fertility with a particular focus on China, France, Japan, South Korea and Sweden. While there is no consensus on whether there are policies that have clearly worked to raise fertility rates, public involvement may be justified or required in some cases. Studies in the volume also point to difficulties with available data and complexity in studying the fertility behavior. For example, Bradshaw and Attar-Schwartz (2011) examine the relationship between fertility and social policy using the European Social Survey data on sixteen European countries. They point to problems particularly with measurement of social policy variables and do not find strong evidence of a relationship between social policy and fertility.

There have been significant decreases in fertility rates in recent decades. Figures 1 and 2 show the variation in total fertility rates in1976 and 2013, respectively. Figure 1 shows very high fertility rates (over 5 children per woman) in 90 countries in 1976. Africa and the Middle East had the highest concentration of countries with very high fertility rates. Only 23 countries in Europe and North America had below replacement fertility. Figure 2 shows drastic changes in fertility. In 2013, the number of countries with very high

fertility decreased to 15, and the number of countries with below replacement fertility increased to 73. While the highest concentration of countries with very high fertility is still in Africa, none of the Middle Eastern countries had very high fertility. Many African countries experienced significant decreases in fertility. Unlike what we observed in the map for 1976, all other European countries (particularly Eastern European countries), and some emerging market economies such as Brazil, China and Turkey also moved to below replacement fertility in 2013.

<Insert Figure 1 here>

<Insert Figure 2 here>

We now turn to government policies towards fertility. United Nations World Population Policy database provides a comprehensive and rich dataset on government attitudes towards fertility and other important demographic variables.[3] United Nations (2013) notes that the database uses four major sources of information. The first is the official response from the country governments to the inquiries directly sent by the United Nations. The second is government documents, publications, laws, regulations and proclamations. The third is the official materials provided by international and intergovernmental organizations, including other United Nations agencies. The final source is the materials provided by non-governmental organizations such as the media outlets, academic and other research institutions.[4]

[3] See United Nations (2013) and https://esa.un.org/poppolicy/img/Definitions_Policy_Variables.pdf for a detailed description of the variables in the database.

[4] See United Nations (2013) for more on these data sources. Box I.1 on page 43 in that publication has a chart that shows both the inputs to the database and major outputs or publications from the database.

The key variable of interest in this database is the "policy on fertility level." United Nations (2013) describes this variable as "Government's stated policy to influence the level of fertility in the country." Response categories for the variable are "raise," "maintain," "lower," and "no intervention." The map in Figure 3 shows how government policies towards fertility differ for countries in our dataset. In 1976, only 55 countries had an anti-fertility policy in 1976. We see that a number of governments in Africa did not have an anti-fertility policy. It is also noteworthy that only 18 countries had a pro-fertility policy in 1976.

<Insert Figure 3 here>

While we see a similar pattern in 2013 in Figure 4, significantly more governments have anti-fertility policy. At the same time, more governments have adopted pro-fertility policies from 1976 to 2013. This could be seen as an indication of concerns regarding the impact of population aging on economies.[5] Figure 4 shows that the number of governments with an anti-fertility policy rose to 76, which is significantly greater than the number of governments with such policy in 1976. In addition, most African countries now have policies to reduce fertility. The number of governments with pro-fertility policy also increased substantially to 51. In Figure 5, we also summarize the time trend in the percent share of countries with policies to reduce and raise fertility. We see a significant increase in the share of countries with policies to reduce fertility between 1986 and 2001 and then a sharp increase in the share of countries with policies to raise fertility after 2001.

<Insert Figure 4 here>

[5] Note that there are more countries added to the UN World Population Policies Database after 2000.

<Insert Figure 5 here>

We also see in figures 3 and 4 that the spatial distribution of the government policies and the total fertility rates are not random. There seems to be a significant degree of spatial clustering among countries. The Local Indicators of Spatial Association (LISA) map in Figure 6 shows that the spatial correlation in total fertility rates in 1976 is particularly strong between countries with high fertility rates, and particularly strong for Africa and the Middle East. The LISA map in Figure 7 shows that this significant spatial association persisted for countries in Africa. These two maps point to presence of spatial autocorrelation in total fertility rates, which we examine further in the next section.

<Insert Figure 6 here>

<Insert Figure 7 here>

3. Empirical Approach and Methodology

We examine empirically how fertility responds to government policies towards fertility. We use *Change in the total fertility rate* as the dependent variable. Data on total fertility rate comes from the United Nations Population Division. The three key explanatory variables are *Anti-fertility policy, Pro-fertility policy*, and *family planning policy*, which are all constructed from the variables in the United Nations World Population Policies database. *Anti-fertility policy* is a dummy variable that takes the value 1 if the government has an anti-fertility policy, and 0 otherwise. As we explained in section 2, we used the variable "policy on fertility level" from the United Nations database and recoded the response category "lower" as 1 and other responses ("raise," "maintain," and "no intervention") as 0.

Pro-fertility policy is a dummy variable that takes the value 1 if the government has a pro-fertility policy, and 0 otherwise. For this variable, we used "policy on fertility level" from the United Nations database again, and this time recoded "raise," and "maintain" as 1 and other responses ("lower" and "no intervention") as 0.[6]

Family planning policy is also a dummy variable that takes the value 1 if the government has a policy that supports family planning directly or indirectly, and 0 otherwise. While family planning is mentioned as part of the definition of "policy on fertility level" in the United Nations database, the same database has a separate variable called "government support for family planning." For the variable *Family planning policy*, we used "government support for family planning" from the United Nations database, and recoded "direct support" and "indirect support" as 1 and other responses ("no support" and "not permitted") as 0. Our three explanatory variables are related to each other. *Anti-fertility policy* is strongly and negatively correlated with *Pro-fertility policy*. *Family planning policy* is positively correlated with *Anti-fertility policy* but the correlation is not very high (about 0.24). *Family planning policy* is also negatively correlated with *Pro-fertility policy*. We are using these variables in separate regressions, which gives us a way to compare results across different regressions.

[6] We coded "maintain fertility" response as 1 since a policy to maintain fertility or to prevent fertility from declining would still involve some pro-fertility intervention from the government. We have checked the robustness of our results by coding it as zero and found that our results did not change significantly and qualitatively.

We also use a number of other control variables that include *GDP per capita, Health spending per capita*, *Trade to GDP, Share of urban population*, and country fixed effects. *GDP per capita* is gross domestic product divided by midyear population and measured in constant (2005) US dollars. The relationship between GDP and the fertility rate can be rather complex. While economic development in a country that is measured by GDP per capita can act like a contraceptive, countries at high level of development may engage in promotion of higher fertility.[7] Hence we do not have a specific expectation regarding the relationship between the fertility rate and the GDP per capita. *Health spending per capita,* defined as the ratio of the sum of public and private health expenditures to total population, is an important variable that controls for a potential impact of the level (and quality) of the health care provided to citizens on their fertility behavior. We might expect a negative relationship to total fertility rate since couples may likely decide to have less children if they know that they will receive good healthcare for themselves and their kids. *Trade to GDP*, defined as the ratio of the sum of exports and imports of goods and services to GDP, captures vulnerability of economies to external shocks. Kim and Prskawetz (2006) argue and show evidence that households use children (or fertility) as a consumption smoothing strategy in response to external shocks. Hence we would expect a positive relationship between *Trade to GDP* and the total fertility rate. We use *Share of urban population* as a control for the level of urbanization.

We apply the spatial econometric methods to estimate the relationship between the government policies towards fertility and change in the total fertility rate. Fertility

[7] See also Becker (1960) and Razin and Sadka (1995) for theoretical arguments on the relationship between income and fertility.

behavior in one country could correlate with the fertility rates in adjacent countries. A lot of countries in our dataset have relatively open borders with good degree of mobility between countries. For example, people in many African countries have ethnic, religious or tribal links with others across the border. That could lead to spatial correlation in the fertility behavior. Similarly, government policies on fertility could also have spillover effects on adjacent countries. Central and regional governments interact with those that are in close proximity, which could lead to spatial dependence in fertility policies. There may also be concern for spatial dependence if the policy of aid organizations in one country is driven by their experience in a neighboring country or region. Other studies have pointed to similar spatial or neighborhood effects in developing countries. For example, Parent and Zouche (2012) show evidence that spatial dependence matters for growth outcomes in Africa and the Middle East. Easterly and Levine (1998) also show evidence of neighborhood effects in growth performance and growth-related policies in African countries.

Statistically, we refer to the standard Moran's I test statistic to understand the spatial correlation in the data. Figure 8 shows the Moran's I scatter plot of all countries.[8] The Moran's I test statistic is equal to 0.295 and is statistically significant at 0.05 level, which means the spatial autocorrelation is significant and can not be neglected in our data. The x-axis is the value of the total fertility rate of each country, and the y-axis is the corresponding Moran's I values for the country with adjacent countries. The scatter plot shows that generally with the increase of the fertility rate, Moran's I tends to be positive,

[8] We included a different version of this graph (Appendix Figure 1) with country codes and a list of countries used in the graph in the appendix section.

and vice versa. Most positive Moran's I values are for African countries, while most negative Moran's I values are for countries in Europe.[9]

<Insert Figure 8 here>

We examine spatial dependence by running spatial lag and spatial error regressions. Models of spatial dependence account for influences from places that are geographically close to each other. Failing to consider spatial dependence may lead to biased, inefficient, or inconsistent coefficient estimates (Cliff and Ord 1981, Anselin 1988). A spatial error model contains an autoregressive process in the error term, whereas a spatial lag model assumes a spatially lagged dependent variable. The linear spatial lag or spatial autoregressive model (SAR) can be expressed as:

$$Change\ in\ fertility\ rate_{it} = \alpha_0 + \boldsymbol{\rho} \boldsymbol{W} Fertilityrate_{it} + \beta \boldsymbol{X}_{it} + \gamma_i + \tau_t + \varepsilon_{it,} \quad (1)$$

where $\boldsymbol{W}$ denotes the spatial weighting matrix that provides the spatial neighborhood information. There are different ways to generate the spatial matrices. Here we use the inverse distance matrix[10] . $\boldsymbol{\rho}$ denotes the spatial parameter. $\boldsymbol{X}$ includes the main explanatory and other control variables that are described at the beginning of this section. Finally, each year in the panel data set is controlled for by time fixed effects (τ), and γ represents the country fixed effects in the model. The spatial error model (SEM) can be

[9] We also conducted more detailed spatial diagnostic tests where we find that spatial autocorrelation is a concern in our data.

[10] The inverse distance matrix is generated using the latitude and longitude information for countries: https://developers.google.com/public-data/docs/canonical/countries_csv. Note that we also ran regressions with a contiguity matrix. Results are largely similar but inverse distance weighting allows more observations particularly from island nations, which would clearly be dropped from the regression analysis that uses contiguity weighting.

expressed as:

$$\textit{Change in fertility rate}_{it}=\alpha_0 + \beta X_{it} +\gamma_i + \tau_t + \varepsilon_{it,} \text{ where } \varepsilon_{it} =\beta W\varepsilon_{it}+ v_{it}\,, \qquad (2)$$

where the error process can be written as a spatially autoregressive process. We will be showing results from both the SAR model and SEM, in addition to the ordinary least squares (OLS) regression that does not include any spatial correction in the next section.[11]

4. Empirical Results

In the first set of regressions we are using panel data to examine the relationship between government's policy on fertility and change in the total fertility rate.[12] In Table 1 we are seeing a statistically significant negative association between change in the total fertility rate and government's anti-fertility policy. The results for *Anti-fertility policy* show that an anti-fertility policy has both a negative direct and a negative indirect (or spatial spillover) association with the change in total fertility rate, which together lead to a strong negative total effect as indicated in column (3). The coefficient estimate for the SAR direct effect in column (1) shows that when there is an anti-fertility policy, change in total fertility rate is reduced by about 0.021 points. With an average total fertility growth rate of about -0.058 (or -5.8%) for the 1976-2013 period, this translates into about 35% of the fertility growth rate on average. We see a similar but smaller coefficient estimates in the SEM and OLS regressions in columns (4) and (5). While we get a

[11] The OLS regression specification is very similar to the one shown in equation 2, with the exception that the error term is not subject to the spatially autoregressive process. That specification can be written as $\textit{Change in fertility rate}_{it}=\alpha_0 + \beta X_{it} +\gamma_i + \tau_t + \varepsilon_{it.}$

[12] Please see the list of countries used in different regression specifications and the countries left out in Appendix Tables 1-3.

consistently negative and significant coefficient for *Anti-fertility policy* in all three regression specifications, it is important to note that the magnitude of the association with change in total fertility rate is substantially greater when direct and indirect (spillover) results are combined together in the SAR model results. We also see that both spatial parameters (rho and lambda) are positive and statistically significant.

<Insert Table 1 here>

In tables 2 and 3, we do not see any significant relationship between the change in total fertility rate and *Pro-fertility policy* or *Family planning policy*. The latter result (in Table 3) is consistent with the evidence from Pritchett (1994) where evidence suggested desired fertility of families matter more than family planning policies.

Results for the remaining control variables are quite consistent across all three regressions. While the coefficients for GDP per capita, trade-to-GDP ratio and share of urban population are positive and mostly statistically significant, the coefficient for health spending per capita is negative and statistically significant. While we find negative and significant relationship between health spending per capita and the change in total fertility rate, it is hard to say whether this is driven by the decision of the couples to have fewer children due to better healthcare for their kids and themselves. It is also not possible to know with the data we have whether the quality of healthcare has gotten better over time in those countries that experienced lower fertility rates. There is also some evidence of a positive and significant relationship between urbanization and change in fertility. While we expect urbanization to have a negative association with change in

fertility, it is possible that happens after a certain threshold of urbanization is reached. Until that point we may still see an increase in fertility as less developed and less urbanized countries go through significant urbanization. Note that all regressions also control for time-invariant country fixed effects, which would include institutional differences between countries. It is also noteworthy that, in all three regressions, spatial dependence parameters (rho for the SAR and lambda for the SEM) are positive and significant. We have also examined spatial autocorrelation in total fertility rate and found a positive and significant Moran's I parameter, which we already discussed before in section 3. Hence, we indeed think spatial autocorrelation is a concern, which we control for in SAR and SEM regressions.

<Insert Table 2 here>

<Insert Table 3 here>

While the results in Table 1 may make one think that anti-fertility policy has been effective in reducing total fertility rate, these results are not necessarily indicating causal links. It is possible that government policies are also driven by the total fertility rate. As another robustness check, in the next set of regressions, we are moving away from the panel data structure and regressing the change in the fertility rate between 1976 and 2013 on the 1976 value of the policy and other control variables. Results for the policy variables in tables 4-6 are quite similar to the ones in tables 1-3.[13] We are still seeing a negative and statistically significant association between change in fertility rate and anti-fertility policy in all three regression specifications, and there is generally no significant

[13] Note that we had to drop health spending per capita due to lack of data for that variable in 1976.

association for other policy variables.[14] Among the control variables, the only robust and significant relationship is for GDP per capita where the coefficient is positive. Also, the only robust and significant spatial parameter is for rho in the spatial lag (SAR) model, where the parameter is positive.

<Insert Table 4 here>

<Insert Table 5 here>

<Insert Table 6 here>

5. Summary and Concluding Remarks

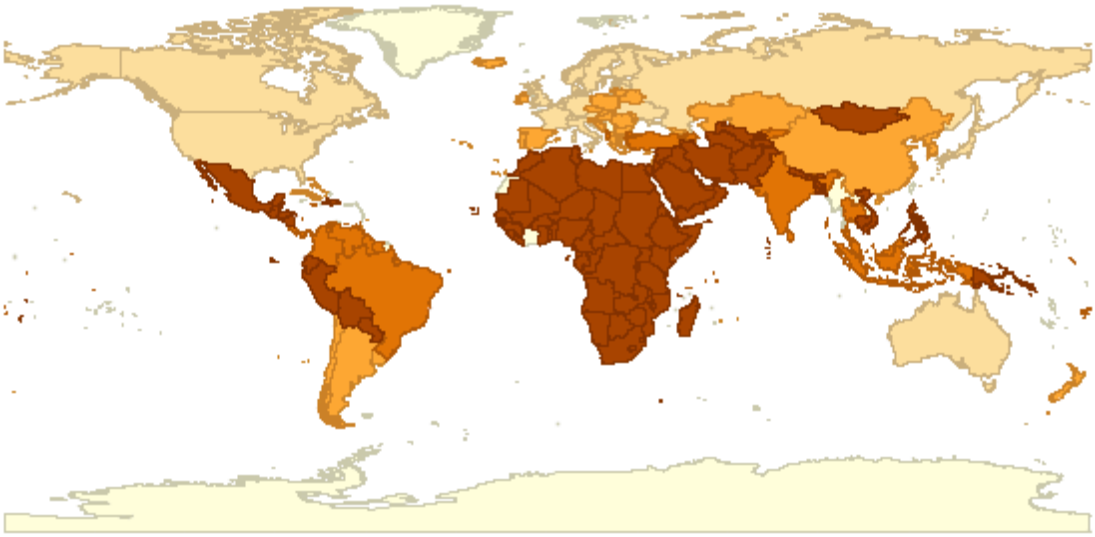
In this paper, we find significant negative association between change in the total fertility rate and anti-fertility policy. On the other hand, there is no significant relationship for the pro-fertility policy or family planning policy, which makes it hard to conclude that government policy towards fertility works. It is possible that pro-fertility policy may not have been as strong (or long-lasting) as the anti-fertility policy. It is true that pro-fertility policies have become popular more recently. We may not be seeing the full impact of those policies on fertility rates empirically yet. We expect more countries to adopt such pro-fertility policies in the near future. We also need to consider the possibility of a change in culture towards a life with fewer children particularly in more developed countries, which is hard to change with a pro-fertility policy. Additionally, as many scholars noted before, fertility behavior is quite complex which makes it hard to establish causal links between fertility and government policy. We also find evidence of spatial autocorrelation in the total fertility rate, and spatial spillovers from government's policy

[14] Note that it was not possible to break down the SAR results into direct and indirect components as these regressions are run as spatial cross-sectional regressions.

on fertility. It is noteworthy that there is significant spatial autocorrelation with fertility, which may explain the persistence of relatively high fertility in contiguous regions of Africa.

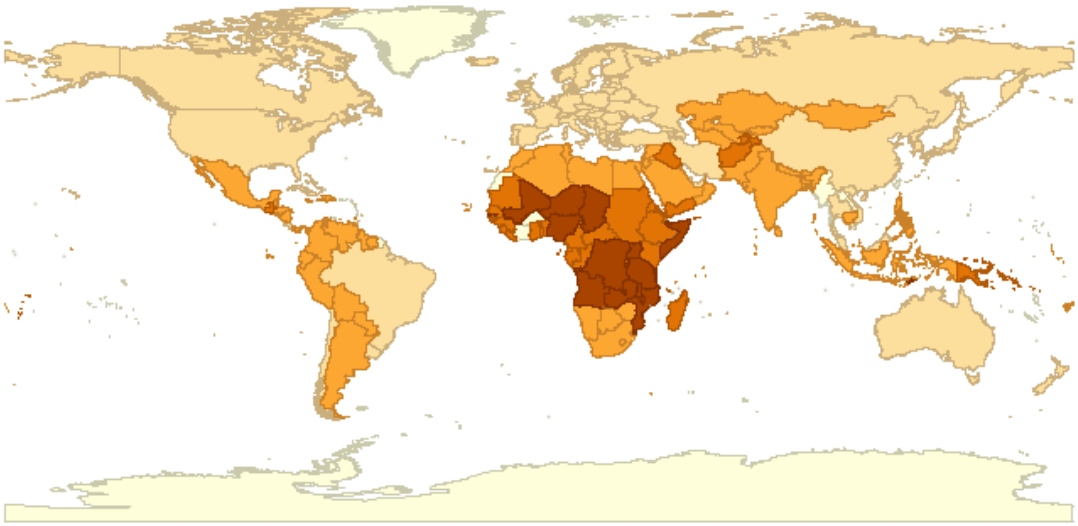
This study can be extended in a number of ways. Particularly, we find the data from the United Nations World Population Policies database to be quite rich. The dataset would allow one to examine government policies on other demographic variables such as population growth, population mobility and population aging, among others. At the same time, we should also caution that the database does not provide information specifically on the magnitude of government policies and data are not available annually. With this database, it is not possible to distinguish between countries that pursue anti-fertility or pro-fertility policy more strongly than others. Having a policy may not be enough to impact fertility behavior, especially when the policy is seen as a relatively minor intervention by the government. One should also keep in mind that we had to drop a number of countries from our analysis due to lack of data in some regression specifications. We include a list of those countries in the appendix. This study can be followed by a micro study on a country or a group of countries, which may have more detailed information on individual or household characteristics.

Figure 1. Total Fertility Rate in 1976



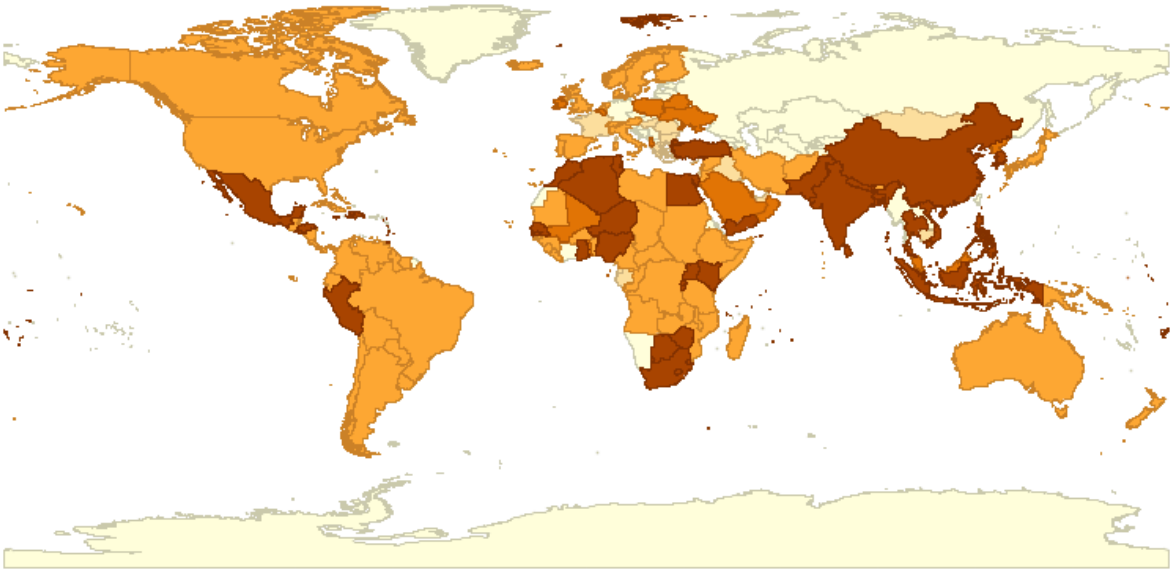
Source: United Nations Population Policies Database, 1976.
Total Fertility Rate in 1976

Figure 2. Total Fertility Rate in 2013 (United Nations Population Policies Database)



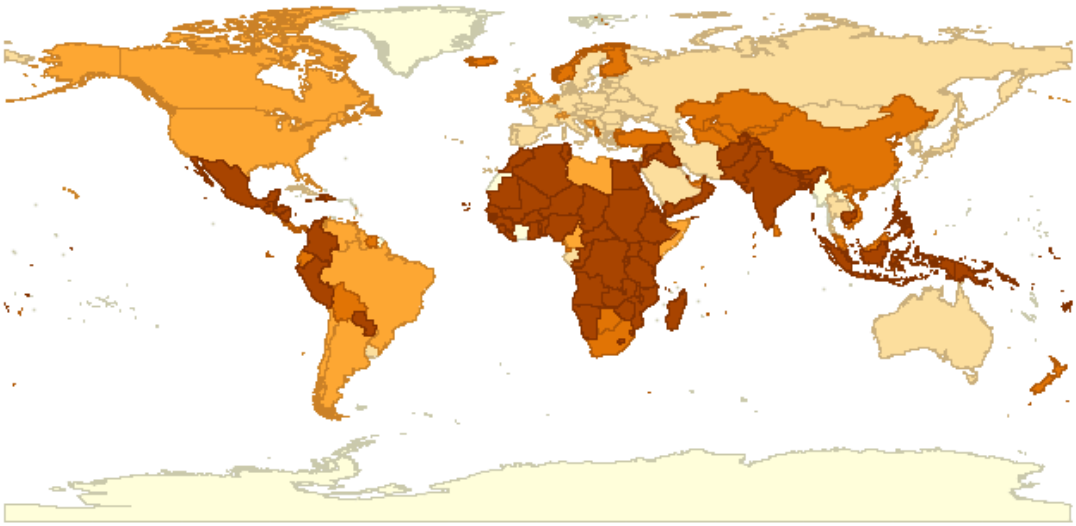
Total Fertility Rate in 2013

Figure 3. Government Policy on Fertility in 1976



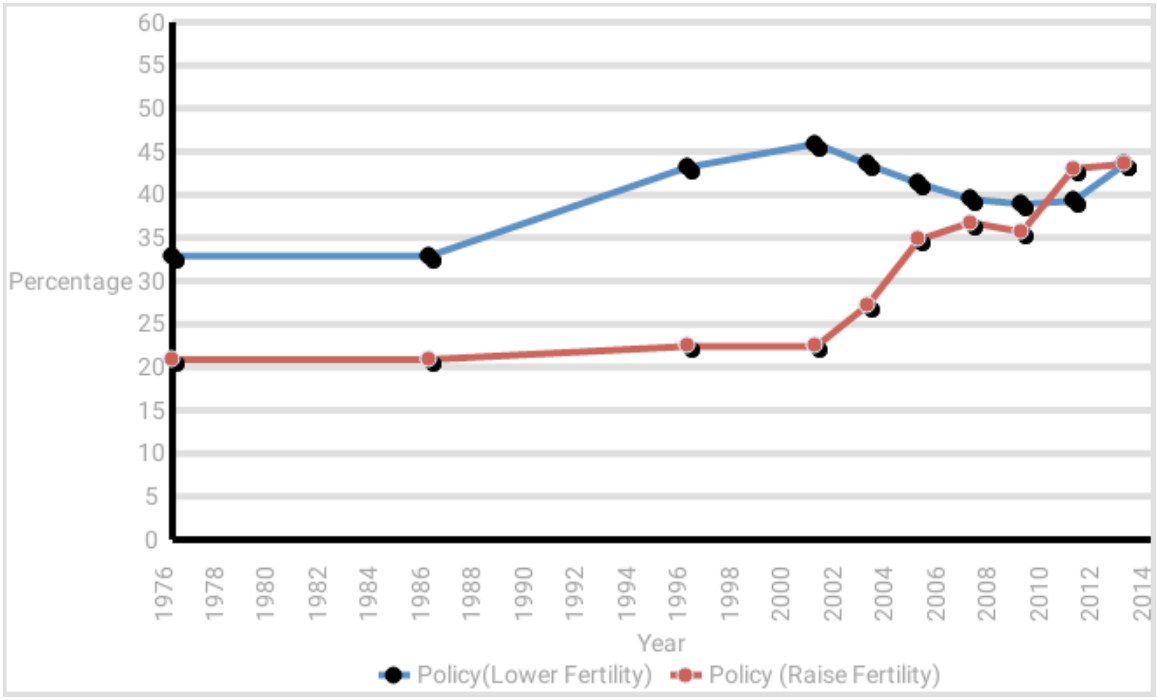
Source: United Nations Population Policies Database, 1976.
Government Policy on Fertility in 1976:

Figure 4. Government Policy on Fertility in 2013



Source: United Nations Population Policies Database, 2013.
Government Policy on Fertility in 2013:

Figure 5. Percent Share of Countries with Anti-fertility and Pro-fertility Policies



Source: United Nations Population Policies Database, 1976-2013.

Figure 6. Local Indicators of Spatial Association (LISA Map), Total Fertility Rate in 1976

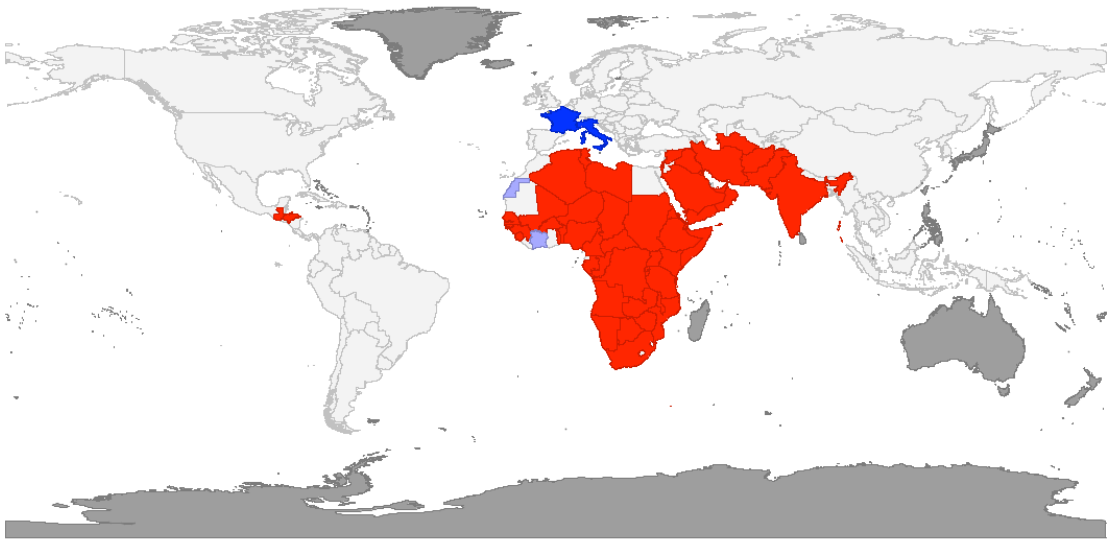


Figure 7. Local Indicators of Spatial Association (LISA Map), Total Fertility Rate in 2013

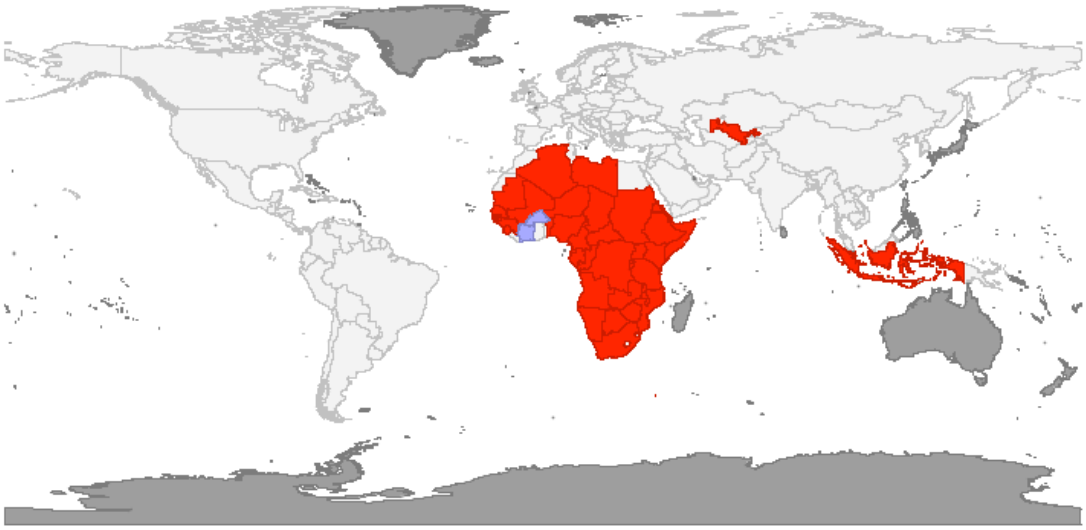


Figure 8. Moran Scatterplot for Total Fertility Rate

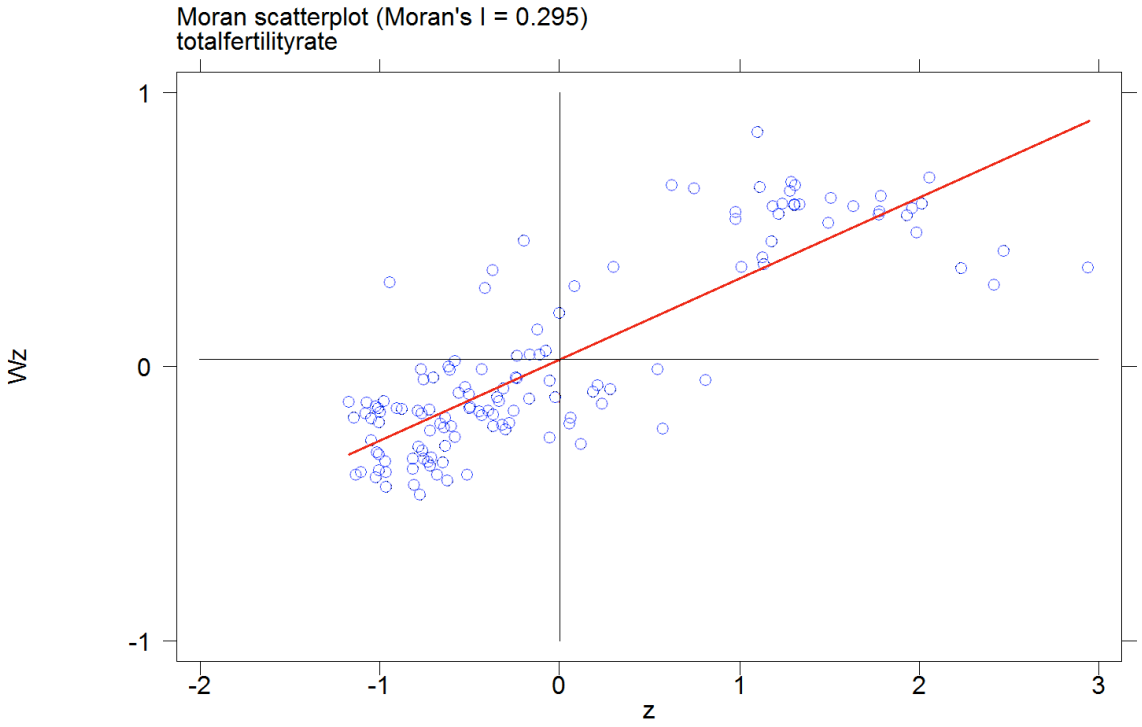


Table 1. Change in Total Fertility Rate and Government's Anti-fertility Policy

Dependent Variable: Change in Total Fertility Rate	(1) SAR	(2) SAR	(3) SAR	(4)	(5)
Variables:	Direct	Indirect	Total	SEM	OLS
Anti-fertility policy	-0.0205***	-0.116*	-0.136*	-0.0183***	-0.0317***
	(0.0067)	(0.0670)	(0.0709)	(0.0066)	(0.0081)
GDP per capita	0.00352***	0.0195**	0.0230**	0.00355**	0.00803***
($ thousand)	(0.001)	(0.01)	(0.01)	(0.002)	(0.002)
Health spending	-0.0128***	-0.0733*	-0.0861**	-0.0120***	-0.00817**
per capita ($ thousand)	(0.004)	(0.04)	(0.042)	(0.004)	(0.004)
Trade to GDP	0.000259**	0.00146	0.00172	0.000265**	0.000255**
	(0.0001)	(0.0010)	(0.0011)	(0.0001)	(0.0001)
Share of urban	0.00323***	0.0176**	0.0209***	0.00324***	0.00725***
population	(0.0009)	(0.0076)	(0.0080)	(0.0010)	(0.0009)
Spatial parameter	25.00***				
(rho)	(1.1740)				
Spatial parameter				25.78***	
(lambda)					
Constant					-0.514***
					(0.0529)
Observations	798	798	798	798	798
Number of countries	133	133	133	133	133
Econometric model	SAR	SAR	SAR	SEM	FE
Country and time fixed effects	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2. Change in Total Fertility Rate and Government's Pro-fertility Policy

Dependent Variable:	(1)	(2)	(3)	(4)	(5)
Change in Total Fertility Rate	SAR	SAR	SAR	SEM	OLS
Variables:	Direct	Indirect	Total		
Pro-fertility policy	-0.00077	-0.00598	-0.00675	-0.00384	0.00917
	(0.0060)	(0.0383)	(0.0438)	(0.0057)	(0.0072)
GDP per capita	0.00383***	0.0234**	0.0272**	0.00366**	0.00825***
($ thousand)	(0.001)	(0.012)	(0.013)	(0.002)	(0.002)
Health spending	-0.0130***	-0.0825*	-0.0955*	-0.0119***	-0.00918**
per capita ($ thousand)	(0.004)	(0.048)	(0.05)	(0.004)	(0.004)
Trade to GDP	0.000249**	0.00154	0.00179	0.000251**	0.000242*
	(0.0001)	(0.0011)	(0.0012)	(0.0001)	(0.0001)
Share of urban	0.00329***	0.0199**	0.0231**	0.00329***	0.00732***
population	(0.0009)	(0.0097)	(0.0101)	(0.0010)	(0.0010)
Spatial parameter	25.30***				
(rho)	(1.1290)				
Spatial parameter				25.92***	
(lambda)				(0.9920)	
Constant					-0.535***
					(0.0532)
Observations	798	798	798	798	798
Number of countries	133	133	133	133	133
Econometric model	SAR	SAR	SAR	SEM	FE
Country and time fixed effects	YES	YES	YES	YES	YES

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Change in Total Fertility Rate and Government's Family Planning Policy

Dependent Variable: Change in Total Fertility Rate	(1) SAR	(2) SAR	(3) SAR	(4)	(5)
Variables:	Direct	Indirect	Total	SEM	OLS
Family planning policy	0.00583	0.0437	0.0496	0.00523	0.00903
	(0.0255)	(0.1960)	(0.2180)	(0.0241)	(0.0266)
GDP per capita	0.00369*	0.0236	0.0273	0.00359	0.00849***
($ thousand)	(0.002)	(0.019)	(0.021)	(0.003)	(0.003)
Health spending	-0.0127**	-0.0822	-0.0949	-0.0123**	-0.00830
per capita ($ thousand)	(0.006)	(0.063)	(0.066)	(0.006)	(0.005)
Trade to GDP	0.000254*	0.00179	0.00204	0.000258**	0.000246*
	(0.0001)	(0.0021)	(0.0022)	(0.0001)	(0.0001)
Share of urban	0.00321**	0.0215	0.0247	0.00324*	0.00735***
population	(0.0015)	(0.0237)	(0.0245)	(0.0017)	(0.0014)
Spatial parameter	25.28***				
(rho)	(1.3270)				
Spatial parameter				25.88***	
(lambda)				(1.2090)	
Constant					-0.546***
					(0.0808)
Observations	798	798	798	798	798
Number of countries	133	133	133	133	133
Econometric model	SAR	SAR	SAR	SEM	FE
Country and time fixed effects	YES	YES	YES	YES	YES

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Change in Total Fertility Rate and Government's Anti-fertility Policy

VARIABLES	(1) SEM	(2) SAR	(3) OLS
Anti-fertility policy	-0.208***	-0.144**	-0.210***
	(0.0666)	(0.0603)	(0.0609)
GDP per capita	0.0180***	0.0149***	0.0179**
($ thousand)	(0.00439)	(0.00431)	(0.00697)
Trade to GDP	0.0000679	-0.00049	0.0000846
	(0.000661)	(0.000612)	(0.000536)
Share of urban	-0.00300*	-0.000645	-0.00303*
population	(0.00163)	(0.0016)	(0.00181)
Constant	-0.406***	-0.625***	-0.394***
	(0.146)	(0.12)	(0.0805)
Spatial parameter	-0.0404		
(lambda)	(0.394)		
Spatial parameter		1.314***	
(rho)		(0.129)	
Observations	102	102	102
Wald chi2(4)	40.0463	31.5678	
Prob > chi2	0	0	
Econometric Model	SEM	SAR	OLS

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Change in Total Fertility Rate and Government's Pro-fertility Policy

VARIABLES	(1) SEM	(2) SAR	(3) OLS
Pro-fertility policy	0.0176	-0.0338	0.0288
	(0.0877)	(0.0777)	(0.0936)
GDP per capita	0.0201***	0.0166***	0.0193***
($ thousand)	(0.005)	(0.004)	(0.007)
Trade to GDP	0.000128	-0.000449	0.00022
	(0.0007)	(0.0006)	(0.0006)
Share of urban	-0.00135	0.000492	-0.00144
population	(0.0016)	(0.0016)	(0.0019)
Constant	-0.630***	-0.779***	-0.563***
	(0.1350)	(0.1070)	(0.0708)
Spatial parameter	-0.245		
(lambda)	(0.4170)		
Spatial parameter		1.335***	
(rho)		(0.1090)	
Observations	102	102	102
Wald chi2(4)	27.6384	24.6198	
Prob > chi2	0	0.0001	
Econometric Model	SEM	SAR	OLS

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Change in Total Fertility Rate and Government's Family Planning Policy

VARIABLES	(1) SEM	(2) SAR	(3) OLS
Family planning policy	0.118	0.139*	0.116
	(0.0927)	(0.0798)	(0.1240)
GDP per capita	0.0207***	0.0161***	0.020***
($ thousand)	(0.005)	(0.005)	(0.006)
Trade to GDP	0.000247	-0.0000804	0.000366
	(0.0007)	(0.0006)	(0.0005)
Share of urban	-0.00136	0.000492	-0.00146
population	(0.0016)	(0.0016)	(0.0019)
Constant	-0.754***	-0.696***	-0.676***
	(0.1610)	(0.1120)	(0.1500)
Spatial parameter	-0.277		
(lambda)	(0.4050)		
Spatial parameter		2.453***	
(rho)		(0.3360)	
Observations	102	102	102
Wald chi2(4)	29.6418	19.8782	
Prob > chi2	0	0.0005	
Econometric Model	SEM	SAR	OLS

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

References

Anselin, L. 1988. *Spatial Econometrics: Methods and Models.* Dordrecht: Kluwer Academic.

Becker, Gary S. 1960. "An Economic Analysis of Fertility." In Richard Easterlin ed. *Demographic and Economic Change in Developing Countries*. Princeton: Princeton University Press.

Bradshaw, Jonathan, and Shalhevet Attar-Schwartz. 2011. "Fertility and Social Policy." In Noriyuki Takayama and Martin Werding eds. *Fertility and Public Policy: How to Reverse the Trend of Declining Birth Rates*. Cambridge, MA: The MIT Press.

Cliff, A., and J. Ord. 1981. *Spatial Processes: Models and Applications.* London: Taylor & Francis.

Easterly, William and Ross Levine. 1998. "Troubles with the Neighbours: Africa's Problem, Africa's Opportunity," *Journal of African Economies*, 7 (1), pp. 120-142.

Feyrer, J., Sacerdote, B. and Stern, A.D. 2008. "Will the stork return to Europe and Japan? Understanding fertility within developed nations," *Journal of Economic Perspectives*, 22 (3), pp. 3-22.

Haub, Carl. 2010. "Did South Korea's Population Policy Work Too Well?" Washington, D.C.: Population Reference Bureau.

Kim, Jungho and Alexia Prskawetz. 2006. "External Shocks, Household Consumption and Fertility in Indonesia." Vienna Institute of Demography Working Papers No. 4.

Parent, Olivier and Abdallah Zouache. 2012. "Geography versus Institutions: New Perspectives on the Growth of Africa and the Middle East," *Journal of Institutional and Theoretical Economics* 168, pp. 488-518.

Pritchett, Lant H. 1994. "Desired Fertility and the Impact of Population Policies," *Population and Development Review*, 20 (1), pp. 1-55.

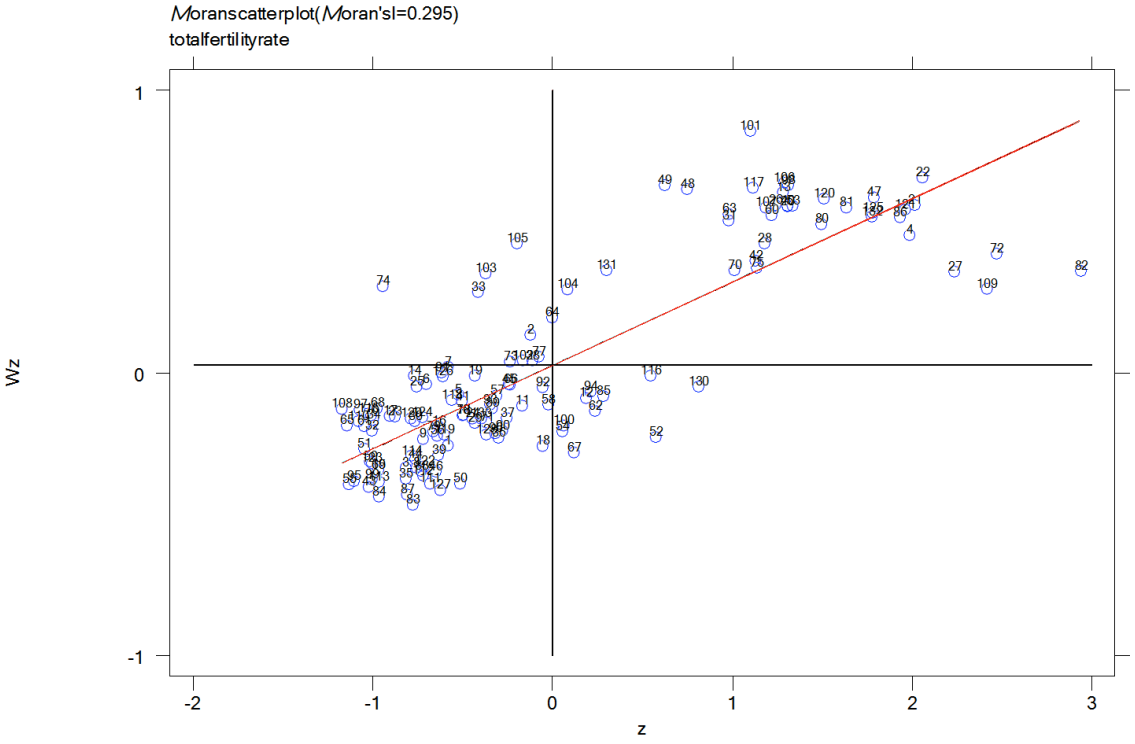
Razin, Assaf and Efraim Sadka. 1995. *Population Economics*. Cambridge, MA: The MIT Press.

Takayama, Noriyuki and Martin Werding. 2011. *Fertility and Public Policy: How to Reverse the Trend of Declining Birth Rates*. Cambridge, MA: The MIT Press.

United Nations. 2013. *World Population Policies 2013*. United Nations, Department of Economic and Social Affairs, Population Division. New York.

Yap, Mui Teng. 2003. “Fertility and Population Policy: the Singapore Experience,” *Journal of Population and Social Security (Population)*. Supplement to Volume 1, pp. 643-658.

Appendix Figure 1. Moran Scatterplot



List of countries and codes in the Moran's *I* graph							
Africa	Code	Africa	Code	Oceania	Code	Northern America	Code
Algeria	2	Mauritania	75	Australia	6	Canada	17
Angola	4	Mauritius	74	Fiji	45	United States	124
Benin	13	Morocco	73	Kiribati	64		
Botswana	105	Mozambique	80	New Zealand	91		
Burkina Faso	125	Niger	82	Samoa	130		
Burundi	22	Nigeria	86	Tonga	116		
Cabo Verde	33	Rwanda	101	Vanuatu	85		
Cameroon	26	Senegal	106				
Central African Republic	31	Sierra Leone	107				
Chad	27	Somalia	109				
Comoros	28	South Africa	103				
Congo, Dem. Rep.	21	Swaziland	131				
Congo, Rep.	20	Tanzania	120				
Cote d'Ivoire	60	Togo	117				
Egypt, Arab Rep.	38	Tunisia	118				
Equatorial Guinea	40	Uganda	121				
Ethiopia	42	Zambia	132				
Gabon	48						
Gambia, The	47						
Ghana	49						
Guinea	53						
Guinea-Bissau	98						
Kenya	63						
Lesotho	104						
Madagascar	70						
Malawi	81						
Mali	72						

List of countries and codes in the Moran's I graph (Continued)					
Europe	Code	Asia	Code	Latin Amer. & Caribbean	
Albania	3	Bahrain	7	Antigua and Barbuda	1
Austria	43	Bangladesh	10	Argentina	5
Belarus	69	Bhutan	24	Bahamas, The	9
Belgium	83	Brunei Darussalam	16	Barbados	8
Bulgaria	15	Cambodia	18	Belize	11
Denmark	35	China	23	Bolivia	12
Finland	44	Cyprus	34	Brazil	14
France	46	India	57	Chile	25
Greece	51	Indonesia	133	Colombia	29
Hungary	55	Israel	58	Costa Rica	30
Iceland	56	Japan	61	Cuba	32
Ireland	39	Jordan	62	Dominican Republic	36
Italy	59	Korea, Rep.	65	Ecuador	37
Luxembourg	84	Kuwait	66	El Salvador	41
Malta	76	Lao PDR	67	Grenada	50
Netherlands	87	Lebanon	68	Guatemala	52
Norway	88	Malaysia	79	Honduras	54
Poland	95	Mongolia	71	Mexico	78
Portugal	97	Nepal	89	Nicaragua	90
Romania	99	Oman	77	Panama	96
Spain	110	Pakistan	94	Paraguay	92
Sweden	112	Philippines	100	Peru	93
Switzerland	113	Saudi Arabia	102	St. Lucia	111
Ukraine	123	Singapore	108	St. Vincent and the Grenadines	127
United Kingdom	122	Sri Lanka	19	Trinidad and Tobago	114
		Thailand	115	Uruguay	126
		Turkey	119	Venezuela, RB	128
		Vietnam	129		

Appendix Table 1. Regions and Names of Countries Included in Table 1-3 Regressions

Africa1	Africa2	Europe	Asia	Latin Amer. & Caribbean	Oceania
Algeria	Mauritius	Albania	Bahrain	Argentina	Fiji
Angola	Morocco	Austria	Bangladesh	Bahamas	Kiribati
Benin	Mozambique	Belarus	Bhutan	Barbados	New Zealand
Botswana	Niger	Belgium	Brunei Darussalam	Belize	Samoa
Burkina Faso	Nigeria	Bulgaria	Cambodia	Bolivia	Tonga
Burundi	Rwanda	Denmark	China	Brazil	Vanuatu
Cameroon	Senegal	Finland	Cyprus	Chile	Antigua and Barbuda
Cape Verde	Sierra Leone	France	India	Colombia	
Central African Republic	Somalia	Greece	Indonesia	Costa Rica	
Chad	South Africa	Hungary	Israel	Cuba	
Comoros	Swaziland	Iceland	Japan	Dominican Republic	
Congo	Togo	Ireland	Jordan	Ecuador	
Cote d'Ivoire	Tunisia	Italy	Korea, Republic of	El Salvador	
Democratic Republic of the Congo	Uganda	Luxembourg	Kuwait	Grenada	
Egypt	Tanzania	Malta	Lao	Guatemala	
Equatorial Guinea	Zambia	Netherlands	Lebanon	Honduras	
Ethiopia		Norway	Malaysia	Mexico	
Gabon		Poland	Mongolia	Nicaragua	
Gambia		Portugal	Nepal	Panama	
Ghana		Romania	Oman	Paraguay	
Guinea		Spain	Pakistan	Peru	
Guinea-Bissau		Sweden	Philippines	Saint Lucia	
Kenya		Switzerland	Saudi Arabia	Saint Vincent and the Grenadines	
Lesotho		Ukraine	Singapore	Trinidad and Tobago	
Madagascar		United Kingdom	Sri Lanka	Uruguay	
Malawi			Thailand	Venezuela	
Mali			Turkey		
Mauritania			Viet Nam		

Appendix Table 2. Regions and Names of Countries Included in Table 4-6 Regressions

Africa1	Africa2	Europe	Asia	Latin Amer. & Caribbean	Oceania	Northern America
Algeria	Mali	Austria	Bangladesh	Argentina	Australia	Canada
Benin	Mauritania	Belgium	Brunei Darussalam	Barbados	Fiji	United States
Botswana	Mauritius	Denmark	China	Bolivia	Kiribati	
Burkina Faso	Morocco	Finland	Cyprus	Brazil	Papua New Guinea	
Burundi	Niger	France	India	Chile		
Cameroon	Nigeria	Greece	Indonesia	Colombia		
Central African Republic	Rwanda	Iceland	Iran, Islamic Rep.	Costa Rica		
Chad	Seychelles	Ireland	Israel	Cuba		
Congo, Rep.	Sierra Leone	Italy	Japan	Dominican Republic		
Cote d'Ivoire	Somalia	Luxembourg	Jordan	Ecuador		
Congo, Dem. Rep.	South Africa	Malta	Korea, Rep.	El Salvador		
Egypt, Arab Rep.	Swaziland	Netherlands	Malaysia	Guatemala		
Gabon	Togo	Norway	Nepal	Guyana		
Gambia, The	Tunisia	Portugal	Oman	Honduras		
Ghana	Zambia	Spain	Pakistan	Mexico		
Guinea-Bissau	Zimbabwe	Sweden	Philippines	Nicaragua		
Kenya		United Kingdom	Saudi Arabia	Peru		
Lesotho			Sri Lanka	Suriname		
Liberia			Syrian Arab Republic	Trinidad and Tobago		
Madagascar			Thailand	Uruguay		
Malawi			Turkey	Venezuela, RB		

Appendix Table 3.

Missing Countries from the Table 4-6 Regressions

Africa	Europe	Asia	Latin Amer. & Caribbean	Oceania
Comoros	Belarus	Kuwait	Belize	Samoa
Cabo Verde	Hungary	Singapore	Antigua and Barbuda	Vanuatu
Senegal	Switzerland	Bahrain	St. Lucia	Tonga
Equatorial Guinea	Ukraine	Lao PDR	Panama	New Zealand
Uganda	Albania	Bhutan	Grenada	
Ethiopia	Romania	Lebanon	St. Vincent and the Grenadines	
Guinea	Poland	Mongolia	Bahamas, The	
Angola	Bulgaria	Cambodia	Paraguay	
Tanzania		Vietnam		
Mozambique				

Missing Countries from the Table 1-3 Regressions

Africa	Europe	Asia	Latin Amer. & Caribbean	Oceania
Seychelles		Iran, Islamic Rep.	Guyana	Papua New Guinea
Liberia		Syrian Arab Republic	Suriname	
Zimbabwe				