Ouedraogo, Abdoulaye; Tosun, Mehmet S.; Yang, Jingjing

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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

* Corresponding Author.
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


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-Schwart (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 in 1976 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.

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. 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.

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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.

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. 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.

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

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. 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,

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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.\(^9\)

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:

\[
\text{Change in fertility rate}_{it} = \alpha_0 + \rho WFertilityrate_{it} + \beta X_{it} + \gamma_i + \tau_t + \varepsilon_{it} \tag{1}
\]

where \(W\) 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\(^{10}\). \(\rho\) denotes the spatial parameter. \(X\) 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 (\(\tau\)), and \(\gamma\)
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:

\[ \text{Change in fertility rate}_{it} = \alpha_0 + \beta X_{it} + \gamma_i + \tau_t + \varepsilon_{it}, \]  
where \( \varepsilon_{it} = \beta W \varepsilon_{it} + \nu_{it}, \tag{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 \( \text{Change in fertility rate}_{it} = \alpha_0 + \beta X_{it} + \gamma_i + \tau_t + \varepsilon_{it}. \)

\(^{12}\) 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 \textit{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 \textit{Pro-fertility policy} or \textit{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.

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.\textsuperscript{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.

\begin{table}[h]
\centering
\caption{Table 4}
\end{table}

\begin{table}[h]
\centering
\caption{Table 5}
\end{table}

\begin{table}[h]
\centering
\caption{Table 6}
\end{table}

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.

\textsuperscript{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

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


Government Policy on Fertility in 1976:
Figure 4. Government Policy on Fertility in 2013

Government Policy on Fertility in 2013:
Figure 5. Percent Share of Countries with Anti-fertility and Pro-fertility Policies

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>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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<th>(5)</th>
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<tr>
<td>Change in Total Fertility Rate</td>
<td>SAR</td>
<td>SAR</td>
<td>SAR</td>
<td>SEM</td>
<td>OLS</td>
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<td>Variables:</td>
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<td>Indirect</td>
<td>Total</td>
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<td>Anti-fertility policy</td>
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<td>($ thousand)</td>
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<td>(0.01)</td>
<td>(0.002)</td>
<td>(0.002)</td>
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<tr>
<td>Health spending</td>
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<td>-0.0733*</td>
<td>-0.0861**</td>
<td>-0.0120***</td>
<td>-0.00817**</td>
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<td>per capita ($ thousand)</td>
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<td>(0.04)</td>
<td>(0.042)</td>
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<td>Trade to GDP</td>
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<td>0.00146</td>
<td>0.00172</td>
<td>0.000265**</td>
<td>0.000255**</td>
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<td>(SAR)</td>
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<td>(0.0010)</td>
<td>(0.0011)</td>
<td>(0.0001)</td>
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<td>0.0176**</td>
<td>0.0209***</td>
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<td>(rho)</td>
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</table>

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

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
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</thead>
<tbody>
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<td>Change in Total Fertility Rate</td>
<td>SAR</td>
<td>SAR</td>
<td>SAR</td>
<td>SEM</td>
<td>OLS</td>
</tr>
<tr>
<td>Variables: Direct</td>
<td>Indirect</td>
<td>Total</td>
<td>SEM</td>
<td>OLS</td>
<td></td>
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<tr>
<td>Pro-fertility policy</td>
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<td>-0.00598</td>
<td>-0.00675</td>
<td>-0.00384</td>
<td>0.00917</td>
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<td>(0.0060)</td>
<td>(0.0383)</td>
<td>(0.0438)</td>
<td>(0.0057)</td>
<td>(0.0072)</td>
<td></td>
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<tr>
<td>GDP per capita ($ thousand)</td>
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<td>0.0234**</td>
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