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MODELLING THE EFFECT OF SOCIAL AFFINITY BETWEEN NATIONS ON THEIR DEVELOPMENT

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Abstract: Nations have developed at different rates and this differential development is manifested on the wellbeing of their populations. The reasons for different rates of development can not fully be explained by different initial economic states, political regime nor by geography. In this paper social cohesion, social homogeneity and social contact with other societies are explored to determine if this offers and additional explanation. UNDP data is modelled using a panel data approach to explain the rate of development as reflected by declines in total fertility rates in terms of variables such as GDP per capita, life expectancy, literacy rates and infant mortality rates. A created measure of social similarity between nations is added to the model network analysis are applied to examine the cohesion within clusters and the degree of connectedness between nations using additional information on the similarity between nations. The inspection of sociograms and multivariate statistical models suggest that social affinity does indeed offer some explanation to differences in rates of development.

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1. Introduction

Many have drawn attention that as nations develop there is a tendency to converge to similar demographic, economic and cultural profiles. This is illustrated in the debates over onset and cessation of the demographic transition which describes the idea that nations change from a regime of high fertility typified by six or more children per mother to a regime of low fertility in which fertility falls to or often below replacement levels of 2.1 children per mother. Nations which have achieved this are very often part of the developed group of nations in which their profiles are characterised by high levels of GDP per capita, high levels of life expectancy, literacy and female autonomy and low levels of infant mortality. Broadly it is observed that as a nation develops as say measured by the UNDPs human development index then fertility falls and the observed relationship is linear. For further discussion see [9], [11] and [2]. However, others are critical of this Kennelly [8] for example is doubtful of the importance of social capital stating that growth and convergence is mainly a product of growth in GDP. Bongaarts and Watkins [3] showed that countries which are socially and economically similar often jointly undergo or delay the transition. They comment on the importance of social interaction in explaining the fertility of nations and in general those in the field of social network analysis draw attention to the concept of homophily in explaining individual, group or national behaviour in that conformance to the norm as set by ones peers is a powerful force. The purpose of this paper is to investigate the effect of social affinity on the convergence of nations. Taking forward the idea that nations are converging to a low fertility regime there is some evidence that nations cluster together as can be observed from Figure 1. From 1975 to 2005 convergence to low fertility is apparent and it is also observed that Muslim countries (indicated by the solid circles) tend to cluster off trend.

To investigate convergence further, firstly a panel data approach is used to derive a model of how human development index which is a composite measure of female life expectancy, GDP per capita and female literacy rates to explain fertility. Then a measure of the social affinity between nations is formed and finally this created variable is added to the model. If the explanatory power of the model significantly increases then it is argued the there is evidence to support the importance of social affinity at the national level in explaining convergence between nations. Panel models are derived by simultaneously combining both cross sectional and time series data, i.e.

$$y_{it} = \alpha + X_{it}\beta + u_{it} \ ;$$

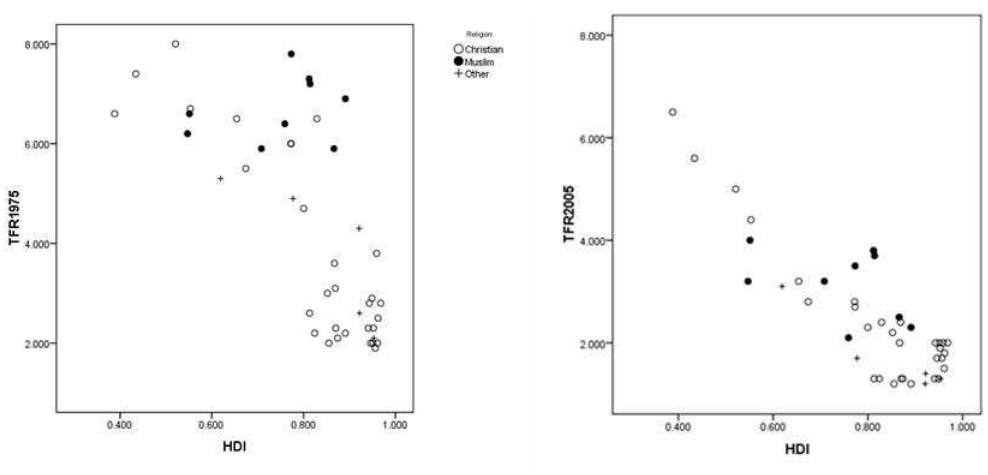

Figure 1: Fertility change and development

where $i = 1 \cdots N$; $t = 1 \cdots T$ and $u_{it} = u_i + \nu_{it}$. This is the unobservable individual specific effect and ν is the remainder disturbance. This can be generalised into a two way error component:

$$u_{it} = u_i + \lambda_t + \nu_{it}\,.$$

Balgati [1] outlines the advantages of panel data stating that they control for individual case heterogeneity, allows more information to be used from the data giving more variability and less colinearity among the variables and this allows the construction of complex behavioural models. Such models are more able to identify and measure effects that would be hidden or lost by using traditional cross sectional or time series models. There are two main categories of panel models; fixed effects in which inference is restricted to a specific finite set of entities e.g. countries in the world. But over parameterisation might result which restrict the number of degrees of freedom and causes estimation issues. The other category is that of random effects which is appropriate if N individuals are drawn from a large population. The data used in this investigation has been compiled from the United Nations Development Programme [12] taking reports from 1975 to 2008. Hence fixed effects panel models will be developed using the software *STATA*. 43 countries where chosen based on ease of data availability, this gave 11 developed nations, 6 former Eastern block nations, 11 medium developed nations, 7 Middle Eastern nations and 8 developing nations.

2. Initial Panel Model

A model was developed to model fertility using the logarithm of GDP, which is the main component the human development index and was easily available rather than the other components (literacy and life expectancy) for the countries over the years 1975 to 2005 in five yearly steps. The model is displayed in Table 1.

	Coefficient	Standard Error	p-value
$\ln gdp$	-0.837	0.0617	< 0.001
constant	10.157	0.4840	< 0.001

Table 1: The initial panel model to explain fertility

This model explained 37.5 % of the variation in fertility, the variation associated with effects not included in the model = 1.380 and the variation associated with individuals over time is 0.805. Clearly fertility depends on more than GDP and now the affinity between nations will be investigated and added to the model.

3. The Affinity Between Nations

To obtain a measure of similarity or closeness between nations is difficult. There are many possibilities such as transactions of one form or another for example migration flows or volume of trade [5] and [6]. However, in this analysis a multivariate measure will be constructed in which attributes of the nations will be used in cluster analysis applying Wards method and standardising the variables using z scores to construct a proximity matrix for each nation based on the Euclidian distance between the nations. The attributes used were infant mortality rates, percentage adult literacy, education index, female secondary school enrolment, female life expectancy, percentage of population who live in urban areas, number of physicians per 100,000, mobile phones per 1,000, internet subscribers per 1,000, murder rate per 100,000, high technology exports as a percentage of GDP, percentage employed in services, military expenditure as a percentage of GDP, armed force size in 1,000s and percentage members of parliament who are women. These variables are explained in [12]. This follows from the ideas presented by Hofstede [7]) to measure the cultural distance between nations. When the distances between two countries were less than 20 (an arbitrary chosen value) were coded 1 to indicate similarity and zero

otherwise. This binary proximity matrix was then input into the social network package UCINET [4].

Social network analysis is an emerging method based on graph theory to reveal the interconnectedness between entities and is well described in [10]. The relationships between entities can be displayed in a graphic known as a sociogram and illustrated in Figure 2 is the relationship between the sample nations. In the social network approach the degree of connectedness is reflected by the derived measure called Freedmans centrality which measures the number of arcs into or leaving a node the higher the value the more connected the entity is. This centrality measure is added to the data set as a measure of affinity between nations and is now entered to the panel model.

From Figure 2 it is apparent that nations in different stages of development or are in similar culture political systems cluster together and three nations appear outside of these relations, the USA, China and South Africa. Over the years nations are forming into more cohesive groups as illustrated by a 36 % decline in the mean centrality score from 22 in 1990 to 14 in 2005. This suggests movement to a more polarised world.

4. Final Panel Model

The final model including the centrality score is displayed in Table 2.

	Coefficient	Standard Error	p-value
$\ln gdp$	-0.346	0.0945	< 0.001
centrality	4.350	0.8580	< 0.001
constant	10.157	0.4840	< 0.001

Table 2: The final panel model to explain fertility

The R^2 of this model is now 50.7 % an improvement in explanatory power of 35 %. The variation associated with individuals over time has been reduced by 37.5 % to 0.503.

5. Conclusion

Fertility does seem to fall with development, but the rate of fall depends on the economic and cultural region. In this the affinity between nations has been

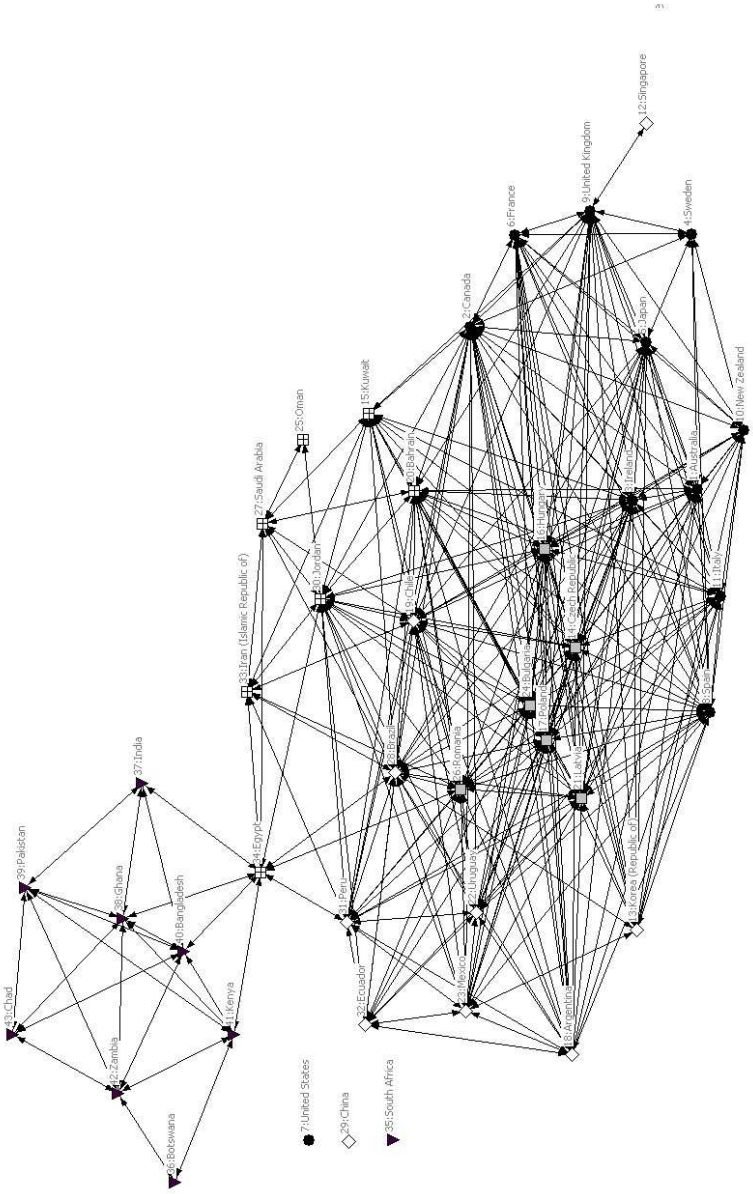

Figure 2: Sociogram of affinity between nations (inverted solid triangles are developing nations, open squares are middle eastern nations, unfilled diamonds as middle developed nations, grey squares are former Eastern block nations and solid circles are developed nations.

shown to be an important influence. However, more research is required on how best to derive measures of this affinity.

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