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## An Investigation of Hemophilia, Consanguineous Marriages and Economic Growth: Panel MLP and Panel SVR Approach

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### Abstract

The study has two aims. The first is to investigate the interrelations of haemophilia, consanguineous marriages and their impacts on economic development. The second aim of the paper is to augment the panel regression techniques by incorporating them with Multi-Layer Perceptron neural networks models and Support Vector Machine methods. The extension is proposed to overcome the commonly criticized aspect of panel regressions, the inability to obtain homogeneity in panels. The study utilizes a panel data set that consists of 46 countries covering the 1980-2009 period and models are evaluated in terms of their ability to model the interrelations between the variables analysed. According to the empirical results, the proposed Panel Neural Network Multi-Layer Perceptron and Panel Support Vector Machine models provide success with this purpose. The empirical findings suggest that haemophilia and consanguineous marriages have significant effects on economic development.

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### 1. Introduction

One point that cannot be overlooked is the fact that, though the impacts of consanguineous marriages and haemophilia have been investigated in detail by many medical and genetics papers, there is an important link among these factors and economic development. Accordingly, the paper aims at focusing on genetics in light of

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consanguineous marriages and its relation to haemophilia by following an economic development perspective. Nevertheless, such diseases have strong links with social structures such as consanguineous marriages that also affect societies through its impacts on health. Further, consanguineous marriages have strong impact through human capital that also affects the economic performance of the household. Accordingly, the paper will focus on investigating consanguineous marriages, haemophilia, economic development and the relationships among them.

In clinical genetics, a consanguineous marriage means union between couples being relatives especially as the first cousins, second cousins or with a comparatively more distant relationship (Tadmouri et.al. 2009: 17-26; Grant and Bittles, 1997: 61-143). As a preferred marriage practice in some societies, this type of marriage has been a cultural practice in the Middle Eastern countries, with cousin marriages being particularly frequent among Muslim Arabs (Tamim et.al., 2003). The highest consanguineous marriage rates (from 20% to over 50% in various regions) are reported in North Africa (Bittles et al. 2001, 2002; Kanaan et al., 2008; Sathyanarayana et al., 2009).

Consanguineous marriages that had been practiced for hundreds of years in many parts of the world cause a great risk of being homozygous to a harmful gene and consequently, people practicing such marriages are subject to autosomal recessive genetic disorders, which constitute great concerns especially focusing on the children of first-degree cousins (Melki et. al., 2003). In addition, consanguineous marriages has been associated with congenital heart disease and blood diseases (haemophilia,  $\alpha$ -thalassemia), deafness, cystic fibrosis, chronic renal failure, neonatal diabetes mellitus, prenatal and infant mortality, congenital birth defects, malformations and mental retardation, chronic renal failure, breast cancer, many genetically complex late onset diseases some autosomal recessive disorders.

Nonetheless, there is an important relationship between consanguineous marriages and haemophilia in perspectives of medical and genetics. Peyvandi et.al.(2002) discussed the occurrence of bleeding disorders – such haemophilia B – and its interrelations between consanguineous marriage frequency in countries with high rates of consanguineous marriage practices such as certain middle eastern countries and southern India. Borhani et al. (2010) determined the link between frequency of bleeding disorders as a result of consanguineous marriages in family trees of African tribes. Tadmouri et.al. (2009) showed that in addition to the association of consanguineous marriages to reproductive health parameters, the main impact of consanguineous marriages is on the rate of homozygotes of recessive genetic disorders. Further, Almeida,et.al. (2002), Mansouritorgabeh et.al. (2004) and Mehdizadeh and Zamani (2008) are among the studies that evaluated the relationship between consanguineous marriages and haemophilia.

In this study, we will analyse the relationship among economic growth, consanguineous marriages and haemophilia. Since haemophilia and diseases caused by the effect of consanguineous marriage have significant implications on human capital as effectiveness and lower productivity of household, haemophilia and consanguineous marriages cause to decrease of economic growth.

The first aim of the paper is to investigate the newly proposed methods of the study; namely, the Panel Multi Layer Perceptron (MLP) and Panel Support Vector machine (SVM) analyses. The second aim of the paper is to evaluate the relationships between haemophilia, consanguineous marriages and economic development by using the proposed methods vis-à-vis the panel regressions. The Panel MLP and Panel SVM models will be discussed in Part 2. The consanguineous marriages and haemophilia is given in Part 3. Empirical analyses are given in Part 4. Part 5 concludes.

## **2. Panel multi-layer perceptron and panel support vector regression models**

We developed two modelling techniques in this section, the Panel data Multi-Layer Perceptron (MLP) and Panel data Support Vector Machine (SVM) analyses, which are augmented nonlinear methods by deriving certain conditions from neural network learning algorithms and architectures. SVM models also possess interesting features in terms of their universal approximation properties, similar to neural networks, and the models analysed are their panel data augmentations to provide improved modelling techniques vis-à-vis the panel regression models.

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