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A nonparametric model of financial system and economic growth

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ABSTRACT

In this paper, we show that in the proposed models for economic growth, the financial system variables are generally nonparametric. We, thus, use a nonparametric panel data model to estimate the financial system–economic growth relationship. Our results suggest that as long as a country's domestic credit and private credit are above their cross-sectional mean they have a positive effect on GDP growth. We also discover that market capitalisation positively and significantly impacts GDP growth, while stocks traded (with the exception of OECD countries) has a statistically insignificant effect on GDP growth.

1. Introduction

The relationship between the financial sector development, commonly referred to as the financial system, and economic growth has received growing attention, particularly in the last decade or so. This interest has, in large part, being sparked by the growth of financial markets and the growing role of the banking sector in economic development. The importance of the financial system and economic growth has also resulted from the greater synchronization of the financial system with key macroeconomic indicators, such as the exchange rate and the interest rate, which are key parameters in several economic models, such as, inter alia, the exchange rate models and the current account models, which all have implications for economic growth.

The empirical findings from recent studies, both time series and cross-section, support the earlier findings that the financial system fosters economic growth. For example, the time series based studies (see, for instance, Bell & Rousseau, 2001; Campos, Karanasos, & Tan, 2012; Luintel & Khan, 1999; Demetriades & Hussein, 1996; Kendall, 2012; Bordo & Rousseau, 2012; Odhiambo, 2014; Hasanov & Huseynov, 2013) find causality running from the financial system to economic growth. However, a feature of this strand of research is that results generally tend to vary across countries. The second group of studies on cross-sectional/panel data models (see, for instance, Beck & Levine, 2004; Hassan, Wachtel, & Zhou, 2009; Cole, Moshirian, & Wu, 2008; Chang, Jia, & Wang, 2010; Zhang, Wang, & Wang, 2012) has also found a positive role for the financial system in economic growth. In a panel data framework Narayan and Narayan (2013), Cecchetti and Kharroubi (2012) and Arcand, Berkes, and Panizza (2012) showed positive relation between financial system and economic growth.

One feature of the literature so far is that they have used estimation models that assume a linear data generating process. However, there are studies that introduce nonlinearity in the model by adding quadratic terms of the financial sector variables (see Cecchetti & Kharroubi, 2012; Beck, Georgiadis, & Straub, 2014). While we consider the same research question, our approach to modelling this relationship is completely different from the extant literature, in that we use a nonparametric panel data model. Our motivation for

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this approach is as follows. The bulk of the empirical research provides support for a positive relationship between the financial system and economic growth. However, while there is no tension and conflict in this literature in terms of the role that the financial system plays in generating economic growth, this literature has made a strong assumption in the estimation framework: that the variables and models are linear Whether or not this is the case is an empirical issue, and this literature has ignored empirically ascertaining the linearity of variables and models, particularly in the case of panel data models. Should the linearity assumption be rejected, it will cast doubt on the perceived relationship between the financial system and economic growth. However, there are two studies (Cecchetti & Kharroubi, 2012; Beck et al., 2014) that introduce nonlinearity in the model by introducing a quadratic term of the financial sector variable in the model and find it to be statistically significant. This suggests that the financial system and economic growth relationship might be non-linear. Hence, we first test whether the variables are linear and whether or not an OLS-based linear model is suitable for modelling the relationship between the financial system and economic growth. Conditional on this outcome, we decide on the appropriate model type. It follows that there are two specific contributions of this paper to the literature on the financial system-economic growth nexus. Our first contribution is that we identify that our proposed regression models and variables are nonlinear; hence, we use nonparametric models to estimate the impact of the financial system on economic growth.

The basic idea behind the use of this non-parametric method is that it allows the data to proffer the underlying relationship between the variables without imposing any structure a priori (linear model). Since a non-parametric model estimates a smooth function instead of a fixed coefficient, we will be able to infer how a change in the level of a variable leads to changes in the dependent variable. The interesting feature of this model is that, if the underlying relationship between any two variables, say *x* and *y*, is linear then the estimation gives back the linear relationship, whereas this is obviously not the case if we use a linear model. The implication is that a non-parametric model represents a rich framework for understanding the statistical relationship between any set of variables.

Our second contribution is that we construct several panels of countries, namely all countries, high income, middle income and developing countries; and, in addition, we consider a number of regional panels, such as the OECD, the European countries, and the East Asian panels. The motivation for this is based on a recent study by Narayan, Mishra, and Narayan (2011) where they grouped 120 countries into different regional panels and found that the speed of convergence in stocks traded and market capitalisation was heterogeneous in that they were region-specific. Based on these findings, because we use the same financial system variables, such as stocks traded and market capitalisation as Narayan et al. (2011), there is a need to account for any region-specific heterogeneity. Therefore, our objective here is twofold: (a) to achieve as homogenous a panel as possible; and (b) to compare the role of the financial system on economic growth in the various categories of countries.

The rest of the paper is organised as follows. In Section 2, we provide the model and estimation strategy. In Section 3, we discuss the conceptual framework that motivates the relationship between the financial system and economic growth. In Section 4, we discuss our main findings, while in the final section we provide some concluding remarks.

2. The model and estimation strategy

Let's consider a simple linear panel data model with one variable.

$$y_{it=\alpha_i+\beta_1 x_{it}+u_{it}} \qquad i=1,\ldots,n, \qquad t=1,\ldots,T. \tag{1}$$

To estimate $\hat{\beta}_1$, we need to remove α_i from the Eq. (1). This can be done either using least square dummy variable estimator or fixed effect estimator. If we apply the fixed effect estimation then the transformed model is

$$\tilde{y}_{it}=\beta_1\tilde{x}_{it}+\tilde{u}_{it.} \tag{2}$$

Now we can apply OLS to the transformed model to get estimate of $\hat{\beta}_1$, which is a fixed number. The interpretation then would be if we change *x* by one unit y will change by $\hat{\beta}_1$ unit. This is kind of a restriction on the data. It is not the case that for different values of (intervals) *x* the effect on y will be the same. If we have to take a flexible modelling approach to account for the fact that as the value of *x* changes, it's effect on *y* changes then instead of estimating $\hat{\beta}_1$ we will be estimating a smooth function ($S(x)$). The idea is to fit linear models for small intervals of *x* and then join them together to get a smooth function. This way the true nature of the relationship between *x* and *y* is uncovered. It is also possible to extract the $\hat{\beta}_1$ for the small interval of *x* (let's call it local $\hat{\beta}_1$) associated with the ($S(x)$) to demonstrate that the relation between *x* and *y* is not linear.

In the context of the present paper we can write the model as

$$GDPGR_{it}=\alpha_{i+S_1}(INF_{it-1})+S_1(GFCF_{it-1})+S_3(VT_{it-1})+S_4(FS_{it-1})+u_{it.} \tag{3}$$

Where *GDPGR* is the GDP growth of the country, computed as a percent change from one period to another (based on constant local currency), *INF* is the inflation, *GFCF* is the gross fixed capital formation, *VT* is volume of trade, *FS* is a financial system variable. The *FS* is either MC (market capitalisation) or DC (domestic credit provided by banking sector) or PC (domestic credit provided by private sector) or ST (stocks traded). We have used natural log of *GFCF*. Other variables are measured as a percentage of GDP except inflation. Country specific fixed effects are denoted by α_i. As Eq. (3) suggests, we do not put any linear restriction on the model. Rather we allow the data to tell us what the underlying relations between these variables are. Instead of estimating fixed coefficients, we are estimating smooth functions of the variables.