A NONPARAMETRIC MODEL OF FINANCIAL SYSTEM-ECONOMIC GROWTH NEXUS

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CORRESPONDING AUTHOR

Professor Paresh Kumar Narayan
School of Accounting, Economics and Finance
Faculty of Business and Law
Deakin University,
221 Burwood Highway,
Burwood, Victoria 3125
Australia.
Telephone: +61 3 924 46180
Fax: +61 3 924 46034
Email: paresh.narayan@deakin.edu.au
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ABSTRACT

In this paper we examine a familiar topic in financial economics: the financial system-economic growth nexus. However, we depart from the extant literature in the sense that we empirically show that proposed models and variables are nonparametric, implying that the use of estimation techniques that assume a linear data generating process are questionable. We, thus, use a nonparametric panel data model to estimate the financial-economic growth relationship. We find that the banking sector shows a greater case of a statistically significant positive effect on GDP: for example, domestic credit and private credit both have a statistically significant positive effect on GDP in six of the seven panels. On the other hand, the evidence from the stock market suggests relatively less cases of a statistically significant positive effect on GDP: for only four panels in the case of market capitalization and two panels in the case of stocks traded.
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 root of research on the financial system-economic growth nexus owes to Schumpeter (1911), whose inspirational work provided the theoretical motivation for applied research. His work singled out the role of financial intermediaries in fund mobilization, project selection and monitoring, risk management, and transaction facilitation. Early empirical work, such as those by Goldsmith (1969), found a positive relationship between the financial system and economic growth. This empirical literature can be categorized into two groups: one that has undertaken single countries studies of the role of the financial system in economic development and the other that has taken a cross-sectional or panel data approach to estimating this relationship.

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 and Rousseau, 2001; Luintel and Khan, 1999; Demetriades and
Hussein, 1996) 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 and Levine, 2004) has also found a positive role for the financial system in economic growth.

One feature of the literature so far is that they have used estimation models that assume a linear data generating process. While we consider the same research question, our approach to modeling this relationship is completely different from the extant literature, in that we use a panel based nonparametric model. Our motivation for this paper 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. Should this not be the case, it casts doubt on the perceived relationship between the financial system and economic growth. Hence, we first test whether the variables are linear and whether or not an OLS-based linear model is suitable for modeling 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, for the first time in this literature, 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 \textit{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. Another advantage of using a non-parametric 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 two variables.

Our second contribution is that we construct several panels of countries, namely high income, middle income, and low income; and, in addition, we consider a number of regional panels, such as the OECD, the European, and the East Asian panels. The 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 organized 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

The empirical model can be explained through considering the following data generating process (DGP):

\[ y_{it} = \alpha_i + m(x_{it}) + u_{it} \quad i = 1, \ldots, n, \quad t = 1, \ldots, T, \]  

(1)

where \( x_{it} \) is of dimensions \( p \times 1 \), \( m(\cdot) \) is an unknown smooth function, \( \alpha_i \)'s are fixed effects and \( u_{it} \)'s are random disturbances. To estimate this model, we provide a simplified model in the form of a Taylor series expansion given as:

\[ y_{it} = \alpha_i + m(x) + m'(x)(x_{it} - x) \bigg|_{x_{it}=x} + R + v_{it} \]  

(2)

where \( m'(x) \) is the first derivative of \( x_{it} \) around \( x \), \( R \) contains all higher order terms that can be ignored. For identification purpose we impose \( \sum_{i=1}^{n} \alpha_i = 0 \). We are interested in the consistent estimation of \( \hat{m}(x) \) and \( \hat{m}'(x) \). To achieve this, first we have to partial out the effect of \( \alpha_i \)'s. Let \( M_1 \) be an idempotent matrix, which is defined as follows:

\[ M_1 = I - \alpha_i (\alpha'_i \alpha_i)^{-1} \alpha_i \]

where \( \alpha_i \)'s are fixed effects and \( I \) is an identity matrix. To partial out the effect of \( \alpha_i \)'s, we can pre-multiply \( M_1 \) with Equation (2). So, the modified model is

\[ M_1 y_{it} = M_1 m(x) + M_1 m'(x)(x_{it} - x) + M_1 v_{it} \]  

\[ y^*_i = m^*(x) + m^*'(x)(x_{it} - x) + v^*_it. \]  

(4)

Equation (4) can be estimated in a kernel setting. Unlike the linear regression case, where we estimate a fixed coefficient, here we estimate a smooth function \( \hat{m}^*(\cdot) \) and \( \hat{m}'^*(\cdot) \) for the stationary variables \( x_{it} \). However, due to the curse of dimensionality, sometimes it is useful to
estimate the model in an additive framework following a spline setting. In the additive framework, the model can be written as follows:

\[ y_{it}^* = m_1^*(x_1) + m_2^*(x_2)(x_{1it} - x_1) + m_2^*(x_2)(x_{2it} - x_2) + \cdots + m_p^*(x_p)(x_{p_{it} - x_p}) + v_{it}^* \]  

(5)

where \( m_1^*, \ldots, m_p^* \) are smooth functions. Unlike the representation in Equation (4) where we estimate one smooth function, here we estimate \( p \) smooth functions. Holding other things constant, we are interested in the effect of individual \( x \) on \( y \) so it is more appropriate to model the variables in an additive framework rather than estimating a single smooth function. These smooth functions can be estimated by choosing a basis function, defining the space of function of which \( m_1^*, \ldots, m_p^* \) are elements. These basis functions can be estimated using parametric or non-parametric means. Under parametric means, these functions may use a scatter plot smoother, running mean or a factor model. Whereas under the non-parametric fit these functions can be estimated using a polynomial basis or a spline basis. The estimation of such statistical models is proposed by Hastie and Tibshirani (1990) and are referred as Generalised Additive Model (GAM). By allowing a non-parametric fit, GAM provides better fits to the data with relaxed assumptions.

Spline models capture the non-linearity in the data generating process adequately. There are different types of splines, such as P-splines, B-splines, thin plate splines, cubic splines. Spline basis performs well when we are interested in \( m_1^*, \ldots, m_p^* \) over its whole domain. It is because they can be shown to have good approximation theoretic properties (See Li and Racine, 2007). Also splines interpolants suggest that splines should provide a good basis for representing smooth terms in statistical models. Whatever the true underlying smooth function is, a spline
should be able to approximate it closely and if we want to construct models from smooth functions of covariates then representing those functions from smoothest approximations is intuitively appealing. Suppose we have only $x_1^s$ in our model. So estimation of $m_1^s(.)$ requires minimisation of

$$
\sum_{i=1}^{n} \sum_{t=1}^{r} \left\{ y_{it}^s - m_1^s(x_{1i}) - m_1'(x_{1i})(x_{1it} - x_{1i}) \right\}^2 + \lambda \int m_1''(x_{1})(x_{1it} - x_{1i})^2dx_{1it}
$$

(6)

where $\lambda$ is the smoothing parameter. When $\lambda \to \infty$ leads to a straight line and when $\lambda \to 0$ results a regression spline estimate. In the given model, the basis for representing smooth functions is not chosen in advance but emerge from the function minimisation. For details regarding the estimation procedure and intuition, see Hastie and Tibshirani (1990).

To fit a spline model, it is important to determine the knots. A spline is a curve constructed from sections of polynomial joined together so that the curve is continuous up to the second order derivative. The points at which the polynomial sections are joined, including the end points, are known as knots.

In this study, we consider four financial system variables to investigate the relationship between economic growth and the financial system. The four variables are market capitalization (MC), volume of stocks traded (ST), domestic credit provided by banking sector (DC), and domestic credit provided to private sector (PC). In addition to these variables, we consider four macroeconomic variables, namely the gross domestic product (GDP), the consumer price index (CPI), the gross fixed capital formation (GFCF), and the volume of trade (VT). So, the models we estimate are:
All data are extracted from the *World Development Indicators* database. The data is annual and for the period 1985 to 2007. All variables are converted into the natural logarithmic form before analysis. In total, we consider seven panels. These are the all country panel (45 countries), the high income panel (19 countries), the middle income panel (19 countries), the developing country panel (23 countries), the OECD panel (22 countries), the East Asia panel (13 countries), and the Europe panel (15 countries). Preliminary panel unit root tests for each of these seven panels are conducted and all variables are found to be panel stationary; detailed results are available from the authors upon request.

3. **Conceptual framework: financial system and economic growth link**

It is now well accepted that when stock markets function robustly, at least theoretically, they should stimulate economic growth and development by virtue of raising the savings rate and increasing the quantity and quality of investments (Singh, 1997). Essentially, when the stock market operates efficiently, it enables savings to be allocated to investment projects with higher returns. Higher returns further boost savings, increasing the probability of additional savings flowing to the corporate sector. Patrick (1966) demonstrated the relationship between financial development and economic growth eloquently. In this exposition, the expansion of the financial system was seen as inducing demand for its services. The central idea was that through

\[
GD_P = m_1(CPI_i) + m_2(GFCF_i) + m_3(VT_i) + m_4(DC_i) + v_i. 
\]

\[
GD_P = m_1(CPI_i) + m_2(GFCF_i) + m_3(VT_i) + m_4(MC_i) + v_i. 
\]

\[
GD_P = m_1(CPI_i) + m_2(GFCF_i) + m_3(VT_i) + m_4(PC_i) + v_i. 
\]

\[
GD_P = m_1(CPI_i) + m_2(GFCF_i) + m_3(VT_i) + m_4(ST_i) + v_i. 
\]
channeling scarce resources from savers to investors according to the relative rate of return, the financial system contributes to economic growth. Moreover, several studies using the endogenous growth framework show that financial development contributes to economic growth. For example, improved efficiency of capital allocation increases returns and improved management of liquidity risks enhances profit maximization (see Bencivenga and Smith, 1991) and the choice of more productive investments allows for portfolio diversification (Levine, 1991).

Furthermore, Berthelemy and Varoudakis (1996) develop a theoretical model that demonstrates multiple steady state equilibria, which is due to a reciprocal externality between the banking sector and the real sector. They show that growth in the real sector increases banking competition and efficiency by virtue of stimulating the financial market. It follows, in their model, that the growth of the banking sector improves net yield on savings and contributes to capital accumulation and economic growth.

Greenwood and Jovanovic (1990) developed a theoretical model which demonstrates that in the early stage of the development process, economic growth is slow. However, as incomes rise, it gives stimulus to the financial system, and as a result the speed of economic growth increases. This speedier growth gives rise to income inequality according to their model. Finally, when the economy reaches full maturity, the development of the financial structure is complete—which results in reduced income inequality, and the economy thus enjoys a relatively (relative to its infancy) higher rate of economic growth.
The opponents to the financial system-led growth contend that stock market liquidity, achieved through financial liberalization, exposes an economy to greater risk. This risk becomes a source of an interest rate rise (Federer, 1993), which, by virtue of impeding investment, slows down economic growth. In related work, Devereux and Smith (1994) demonstrate how risk sharing in stock trading hurts savings and, in turn, economic growth, while De Long et al. (1989) provide a convincing argument linking “noise” emanating from the stock market and misallocation of resources.

Moreover, investor myopia emanates from a very liquid stock market, which is a source of corporate governance inefficiency. This point is well made by Bhide (1993), who contends that a highly liquid stock market may be an impediment for investors in terms of having a long-term commitment with firms with whom they already have commercial interests. Significantly, based on Singh’s (1997) observation that financial markets are underdeveloped, particularly in developing countries, Fry (1997) contends that this is one of the main reasons for the lack of facilitation of financial intermediation between households and firms in developing countries.

4. Results

4.1. Main findings

There is every reason to believe that the pooling of countries to form cross-sections and panel datasets may exert nonlinearities in the data. It is now common knowledge that if data displaces a nonlinear pattern and it is subjected to estimation techniques which assume a linear data
generating process, then the estimated results are most likely to be biased. To confirm that this possibility exists in our dataset, we did a nonparametric test of models and variables.

The results are as follows. First, we conduct the model specification test proposed by Hsiao et al. (2007) and report results in Table 1. The null hypothesis tested is that the proposed model is linear. The test is run on seven different models. These are: the all country panel, the high income panel, the middle income panel, the developing panel, the OECD panel, the East Asia panel, and the European panel. These panels are listed in column 1 of table 1 and the test statistic is reported in column 2, with its associated p-value in column 3. In the final column, the test decision is reported. We find that the null of a linear model is rejected in the case of all seven panels. It follows that from this specification test, it is inappropriate to apply linear models in estimating the relationship between the financial system and economic growth for any of the seven panels. This, then, justifies our approach of a nonparametric panel data model.

**INSERT TABLE 1**

Our second test relates to the variables to be used in each of the seven proposed models. These variables are CPI, capital formation, trade, and one of the four financial sector variables (market capitalization, stocks traded, domestic credit provided by banking sector and domestic provided to private sector). Essentially, we test whether or not each of these variables for each of the seven panels can be classified as nonparametric. If so, then this renders the use of linear models inappropriate. The results are reported in Table 2. The first column consists of the four variables to be used while the subsequent columns consist of panels of countries, as described earlier. The results reveal that the seven panels, for which we reject the linear model specification test, have
all variables that can be classified as nonparametric. This provides a strong justification for using a nonparametric model to estimate the relationship between the financial system and economic growth.

**INSERT TABLE 2**

We now estimate nonparametric panel data models for each of the seven panels identified for this exercise. We estimate four models for each of the panels. As explained earlier, the core variables, namely CPI, capital stock, and trade are included in all four models; the difference is that in each of these models, we use a different proxy for the financial system. For example, in model 1 (See Figure 1), we use domestic credit; in model 2, we use market capitalization (see Figure 2); in model 3, we use private credit (see Figure 3); and in model 4, we use stocks traded (Figure 4). In these figures, essentially we have plotted the smooth functions, \( \tilde{m}_1, \ldots, \tilde{m}_4 \), from Equations (7) to (10). The rug plot (dark lines) in the x-axis of the figures shows the clustering of the values of the data points of the covariates.

In Table 3, we provide a summary of the key result—that relating to the relationship between the financial system and GDP. The results here are organized as follows. In column 1, the seven panels are listed. In columns 2-5, each of the four proxies for the financial system is listed. Each of columns 2-5 are subdivided into two sub-columns, the first of which represents the sign of the impact of the financial system and its significance (or otherwise), while the second sub-column notes the magnitude (in logs) of the financial system variable over which the impact on GDP is statistically significant.

**INSERT TABLE 3**
Based on plots obtained, when we include domestic credit in the model (Equation 7), the following results emerge. For six of the seven panels, domestic credit has a statistically significant positive effect on GDP; see Table 3 for a summary of results. Only for the All Country panel, the relationship is statistically insignificant. For the Middle Income and OECD panels, the range of domestic credit (in logs) over which it exerts a positive effect on GDP is 0-1.0. The range is smallest for Europe and Developing panels at 0-0.5 and the High Income panel at 0.3-0.8, but slightly higher at 0.2-0.8 for East Asia. This means that there are more cases of countries with different levels of domestic credit having a positive effect on GDP in the OECD and Middle Income panels.

The log of CPI has a negative and statistically significant effect for the bulk of the countries in three of the seven panels, namely the Developing Country panel, the OECD panel, and the European panel. Capital formation has a positive and statistically significant effect on GDP for most countries in all the seven panels, while trade has a positive and statistically significant effect in six of the seven panels (the exception here is East Asia).

**INSERT FIGURE 1**

In Figure 2, plots are based on the model where we use market capitalization as a proxy for the financial system (Equation 8). The main results are as follows. Market capitalization is positive and statistically significant in four of the seven panels, namely the All Country panel, the Middle Income panel, the Developing Country panel, and the East Asia panel. It is, however, negative and statistically significant for High Income and European panels, while it is statistically insignificant in the case of the OECD panel. We notice that the level of market capitalization
which exerts a positive effect on GDP varies panel by panel; for some panels, the range is large (such as for the Developing and East Asian panel, where the range is 0-2.0) while for some it is relatively short (such as in the case of the All Country panel (1.0-2.0)). The bigger the range the more heterogeneity exists in that more countries with different levels of market capitalization experience a positive relationship with GDP.

Trade and capital formation are positive and statistically significant for most countries in all the seven panels, while the log of CPI is statistically insignificant in the case of the All Country, Middle Income, and Developing Country panels, and statistically significant and negative for OECD and European panels.

**INSERT FIGURE 2**

Figure 3 contains results for the model where private credit is used as a proxy for the financial system. Private credit is found to have a statistically significant positive effect on GDP in six of the seven panels. The exception is the High Income panel, where the relationship is statistically insignificant. We notice that the range of private credit (in log form) over which it exerts a positive effect on GDP for the bulk of the countries is largest for the All Country panel (0-1.0), followed by the Middle Income panel (0.2-1.0) and Europe (0-0.8). The range is least for the Developing Country and OECD panels at 0.5-1.0, over which for most of the countries private credit has a statistically significant positive effect on GDP.
Meanwhile, capital stock has a positive and statistically significant effect for High Income, Middle Income, Developing Country, East Asia, and European panels, and trade has a positive and statistically significant effect for most countries in all seven panels. The evidence regarding the effect of log of CPI on GDP is mixed: for All Country, OECD, and European panels, it is negative and statistically significant; for High Income and East Asia, it is positive and statistically significant; and for rest of the panels, it is statistically insignificant.

**INSERT FIGURE 3**

Finally, in Figure 4 results relating to the model where stocks traded are used as a proxy for financial system are presented. We find that in the case of the High Income, OECD, and European panels, stocks traded have a statistically significant negative effect on GDP, while for the Middle Income and Developing Country panels, the impact of stocks traded is positive and statistically significant. For the All Country panel, however, the relationship is statistically insignificant. For Middle Income and Developing country panels, the only cases of statistically significant positive effect on GDP, we notice that the range of stocks traded (in logs) over which this relationship exists is 0-2.0. This implies that disparity is greater, meaning that even countries with a relatively small level of stocks traded in these two panels experience a statistically significant relationship with GDP.

On the relationship between the other variables and economic growth, we notice the following. The log of CPI is statistically insignificant in the case of All Country, Middle Income, and East Asian panels, while it is negative and statistically significant for most countries in Developing, OECD, and European panels. Capital formation, on the other hand, has a positive and
statistically significant effect in most countries for six of the seven panels (the exception is the High Income panel). Trade, meanwhile, has a statistically significant and positive effect on GDP for most countries in all seven panels.

INSERT FIGURE 4
4.2. **A discussion of the results; impact of financial system on economic growth**

Essentially, there are four main findings. First, domestic credit has a statistically significant effect on GDP in six of the seven panels. This is not a surprising outcome, because, as demonstrated in the work of Patrick (1966), financial development is able to induce real innovation-type investment, leading to economic growth. This, according to Patrick (1966), is supply-leading development.

Second, market capitalization has a statistically significant positive effect in four of the seven panels, namely in the All Country, Middle Income, Developing Country, and East Asian panels. The positive effect emanates due to the crucial role of stock markets in easing liquidity constraints—providing borrowers a long term supply of capital and lenders immediate access to funds. Stock markets also allow investors to diversify their risk, in that they can purchases shares in multiple firms. As explained by Obstfeld (1994), this diversification provides the investor with the option of investing in relatively more risky productive technology, which he considers to be a source of economic growth.

Third, private credit has a statistically significant positive effect in most countries of the six out of seven panels, while it has a statistically insignificant effect on GDP for the High Income panel. This positive association between GDP and banking sector has been well established by the literature. First, in the absence of banks, investment projects have to be self-financed. Thus, banks provide liquidity. In their absence, there are likely to be delays in project completion and hence in returns from projects; for a lucid discussion on this, see Bencivenga and Smith (1991),
who also argue that without financial intermediaries, agents must self ensure against random liquidity needs, resulting in excessive investment in unproductive liquidity assets.

Fourth, stocks traded have a statistically significant negative effect on countries making up three of the seven panels, namely High Income, OECD, and European panels. Aghion et al. (2004) develop a theoretical model—a dynamic open economy model where a tradable good is produced using capital and a country-specific factor. They show an important result, which is somewhat consistent with our finding of a negative relationship between stocks traded and GDP. They argue that full financial liberalization maybe a source of macroeconomic instability, including a slowdown in economic growth. Financial liberalization becomes a source of capital inflow, which leads to an investment boom. Capital inflow, on the other hand, has its own side-effects: for example, inflows contribute to growing imbalances causing real current appreciation (see Calvo et al., 1996) and/or an increase in non-performing loans (World Bank, 1997). In contrast, for Middle Income and Developing Country panels we find a statistically significant positive effect of stocks traded on GDP. This relationship is consistent with the bulk of the empirical literature in this field.

4. **Concluding remarks**

The literature on financial system and economic growth is large and growing. To the best of our knowledge, this literature has used estimation techniques that assume a linear data generating process. While generally results are mixed, the bulk of the empirical findings provide support for a positive relationship between the financial system and economic growth. Our contribution to
this literature is that we empirically show that models of financial system and economic growth are nonparametric. Equally importantly, we show that all variables entering the model are also nonparametric. In light of this finding, we depart from the extant literature in that we estimate the relationship between the financial system and economic growth using a nonparametric model.

Our results can be categorized into: (a) the role of the banking sector—domestic credit and private credit—on GDP, and (b) the role of the stock market—market capitalization and stocks traded—on GDP. Based on these two classifications, we find that the banking sector shows a greater case of a statistically significant positive effect on GDP: for example, domestic credit and private credit both have a statistically significant positive effect on GDP in six of the seven panels. On the other hand, the evidence from the stock market suggests relatively less cases of a statistically significant positive effect on GDP: for only four panels in the case of market capitalization and two panels in the case of stocks traded.
References


Table 1: Specification test

Panel A: Market capitalisation

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Panel B: Stocks traded

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Panel C: Domestic credit

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Panel D: Private credit

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<td>0.00**</td>
<td>0.000***</td>
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<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td>Reject linear model</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table 2: A nonparametric test of variables

Nonparametric test, if a variable is nonparametric (Market Capitalisation)

<table>
<thead>
<tr>
<th>Variables</th>
<th>All Test Statistic</th>
<th>High Income Test Statistic</th>
<th>Middle Income Test Statistic</th>
<th>Developing OECD Test Statistic</th>
<th>East Asia Test Statistic</th>
<th>Europe Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>8.87</td>
<td>8.07</td>
<td>8.83</td>
<td>8.81</td>
<td>8.93</td>
<td>5.84</td>
</tr>
<tr>
<td>Cap. formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>7.61</td>
<td>6.12</td>
<td>5.08</td>
<td>5.9</td>
<td>5.27</td>
<td>6.96</td>
</tr>
<tr>
<td>Market Cap</td>
<td>1.95</td>
<td>4.21</td>
<td>2.32</td>
<td>1.52</td>
<td>6.46</td>
<td>2.13</td>
</tr>
</tbody>
</table>

Nonparametric test, if a variable is nonparametric (Stocks Traded)

<table>
<thead>
<tr>
<th>Variables</th>
<th>All Test Statistic</th>
<th>High Income Test Statistic</th>
<th>Middle Income Test Statistic</th>
<th>Developing OECD Test Statistic</th>
<th>East Asia Test Statistic</th>
<th>Europe Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>8.86</td>
<td>8.26</td>
<td>8.83</td>
<td>8.83</td>
<td>8.88</td>
<td>5.12</td>
</tr>
<tr>
<td>Cap. formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>7.72</td>
<td>5.57</td>
<td>6.52</td>
<td>5.87</td>
<td>5.12</td>
<td>7.18</td>
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<tr>
<td>Stocks Traded</td>
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<td>6.4</td>
<td>1</td>
<td>6.38</td>
<td>1</td>
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</tbody>
</table>

Nonparametric test, if a variable is nonparametric (Bank Credit)

<table>
<thead>
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<th>Variables</th>
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<th>High Income Test Statistic</th>
<th>Middle Income Test Statistic</th>
<th>Developing OECD Test Statistic</th>
<th>East Asia Test Statistic</th>
<th>Europe Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>All Test Statistic p-value</td>
<td>High Income Test Statistic p-value</td>
<td>Middle Income Test Statistic p-value</td>
<td>Developing Income Test Statistic p-value</td>
<td>OECD Test Statistic p-value</td>
<td>East Asia Test Statistic p-value</td>
</tr>
<tr>
<td>-------------------</td>
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<td>-----------------------------------</td>
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<td>------------------------------------------</td>
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<tr>
<td>CPI</td>
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<td>8.28</td>
<td>8.71</td>
<td>8.85</td>
<td>8.86</td>
<td>2.74</td>
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<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td>Cap. formation</td>
<td>8.86</td>
<td>3.05</td>
<td>6.46</td>
<td>8.8</td>
<td>4.87</td>
<td>8.78</td>
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<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td>Trade</td>
<td>7.72</td>
<td>6.11</td>
<td>6.1</td>
<td>6.56</td>
<td>5.31</td>
<td>7.36</td>
</tr>
<tr>
<td></td>
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<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td>Private Credit</td>
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<td>6.17</td>
<td>6.73</td>
<td>5.36</td>
<td>6.69</td>
<td>7.49</td>
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<td>0.000***</td>
<td>0.000***</td>
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</tr>
</tbody>
</table>
Table 3: A summary of the findings on financial system-GDP relationship

<table>
<thead>
<tr>
<th>Panels</th>
<th>Domestic Credit</th>
<th>Market Capitalisation</th>
<th>Private Credit</th>
<th>Stocks Traded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+/- Magnitude</td>
<td>+/- Magnitude</td>
<td>+/- Magnitude</td>
<td>+/- Magnitude</td>
</tr>
<tr>
<td>All Country</td>
<td>Insig</td>
<td>----</td>
<td>+</td>
<td>1.0-2.0</td>
</tr>
<tr>
<td>High Income</td>
<td>+</td>
<td>0.3-0.8</td>
<td>-</td>
<td>0.0-1.0</td>
</tr>
<tr>
<td>Middle Income</td>
<td>+</td>
<td>0.0-1.0</td>
<td>+</td>
<td>0.5-2.0</td>
</tr>
<tr>
<td>Developing</td>
<td>+</td>
<td>0.0-0.5</td>
<td>+</td>
<td>0.5-2.0</td>
</tr>
<tr>
<td>OECD</td>
<td>+</td>
<td>0.0-1.0</td>
<td>Insig</td>
<td>----</td>
</tr>
<tr>
<td>East Asia</td>
<td>+</td>
<td>0.2-0.8</td>
<td>+</td>
<td>0.0-2.0</td>
</tr>
<tr>
<td>Europe</td>
<td>+</td>
<td>0.0-0.5</td>
<td>-</td>
<td>0.0-1.0</td>
</tr>
</tbody>
</table>

Notes: the signs reflect statistical significance. The magnitude represents the range (in natural logs) of the financial system variable over which it exerts a positive or negative effect on GDP. And, “Insig” represents statistically insignificant relationship.
Figure 1: When domestic credit is used as a proxy for the financial system

All Countries

High Income

Middle Income
Europe
Figure 2: When market capitalization is used as a proxy for the financial system

All Countries

High Income

Middle Income
Developing

OECD
East Asia

Europe
Figure 3: When private credit is used as a proxy for the financial system

All Countries

High Income

Middle Income
Europe
Figure 4: When stocks traded is used as a proxy for the financial system

All Countries

High Income

Middle Income
Developing

OECD

East Asia