THE CONTRIBUTIONS OF FINANCIAL DEVELOPMENT TO INCOME LEVELS IN SUB-SAHARAN AFRICA

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ABSTRACT

This paper investigates the contribution of financial development to income levels in a sample of Sub-Saharan African countries over a selected period. After controlling for physical capital stock and human capital, we found that there is substantial evidence of financial development which is positively and significantly related to income per capita. We further found that the impact of financial development on income levels is first, higher for countries that have adopted the British Common Law as opposed to French Civil Law. Secondly, this impact is lower when quality of institutions is weaker.

Keywords: Finance, Development, Africa, Institutions, Law.

JEL Classifications: G2, K4, N2, N3, O.

1. INTRODUCTION

This paper investigates the effect of financial development on income levels in Sub-Saharan Africa. Financial development, measured by bank credit to the private sector as a ratio to GDP, is quite low in the region. Over the period 1965-2000, the overall sample mean of financial development is 0.16 for the countries in the study, which is small compared to the figure of 0.60 for the United States.¹

Panel regressions on annual data spanning the period 1965 through to 2000 show that financial development has a positive impact on real income. Specifically, we apply a hierarchical linear model which allows for the slopes of financial development to differ across countries according to persistent characteristics such as quality of institutions and legal origin. We find evidence of a positive and significant effect of financial development on GDP per capita if the legal origin of the country is British as opposed to French. On the other hand, poor quality institutions dilute the effect of financial development. Since GDP is responsive to financial development in Sub-Saharan Africa, financial development can be used as an effective tool for policy aimed at increasing income per capita in the region.

¹ In this study, we look at the period before the year 2000, for the sake of data reliability.
Section II summarizes the theory behind the relationship between financial intermediation and economic growth. The discussion condenses the arguments on how financial systems arise in order to mitigate transaction and information costs, and how they act as a conduit in channeling savings to the most productive investments. This section also reviews the main findings in the literature that are particularly relevant to this study. Section III presents the data and Section IV presents the methodology. Section V presents the results and Section VI concludes the paper.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Pioneering work by Levine and Zervos (1998) has spawned a growing literature on the positive influence of the financial system on growth. The idea, however, can be traced as far back as Bagehot (1873, in Levine et al. (2000)) who stated that technological innovations, an important factor for growth, rely on external funds to come to fruition. Schumpeter (1912) believed that the ability of good banks to single out potentially successful entrepreneurs and then fund them could spur technological innovation.

Levine (1997) makes a point that the financial system can promote specialization due to the increasing number of transactions, thus reducing costs. He uses the argument that in the nineteenth century, the financial system facilitated technological innovation because financial transactions were a marked improvement over barter.

As noted earlier, there is some skepticism in the theoretical literature on the role of finance in economic growth. Bencivenga and Smith (1991) note that higher returns from a more efficient allocation of funds could depress the savings rate and hence hamper growth. Lucas (1988) holds the opinion that economists have badly over-stressed the contribution of the financial system. Robinson (1952) has also expressed doubts over its influence on the economy, hypothesizing that banks merely respond passively to economic growth.

Within the empirical domain, the evidence is however still mixed. Patrick (1966) and Goldsmith (1969) are the earliest to evince a positive correlation between financial development and growth. However, they do not address the question of causality explicitly. McKinnon (1973) and Shaw (1973) have gained popularity among policy makers as they specifically recommend governments to liberalize their financial sector in order to spur growth. Xu (2000) finds a negative relationship between bank-based financial development and growth in 14 middle and low income countries (mostly African), but finds significant positive long run effects of financial development on growth in 27 other countries.

Recent studies by Beck and Levine (2005) and Levine, Beck and Demirgüç-Kunt (2001, 2003) stress the importance of legal factors and institutional preconditions in influencing financial development. These studies find that countries that inherited the British legal tradition tend to have better performing financial systems. Hayek (1960) hints at the effectiveness of the British legal tradition by arguing that checks and balances in Anglo-American courts play an important role in judicial independence. Indeed, the British government adopted the Common Law to limit Crown intervention in the seventeenth century as a response to conflict between Parliament (mainly composed of landowners) and the English Monarchy. Thus, under British Common Law, there is more protection for the individual through private property rights and economic freedom.

On the other hand, the French under Napoléon reinforced government intervention, though the Civil Code (also known as the Code Napoléon) in 1802. Civil Law is also characterized by a high degree of procedural formalism and is thus less able to evolve with changing conditions. La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997, 1998) (henceforth LLSV) attribute higher economic performance under Common Law due to protection of property rights and economic freedom. They use dummy variables to distinguish countries by their legal tradition and find that legal origin can explain the wide
variation in cross-country financial development. Lower economic performance is attributed to Civil Law because it stifles individual economic freedom through state intervention, high taxation, rigidity and lower efficiency. Further evidence on the relationship between a country’s legal origin and its financial development is found in Bordo and Rousseau (2006) and Simplice and Asongu (2011).

Existing institutions also seem to have a lasting, persistent effect on how the financial system functions. Beyond protecting property rights, institutions administer justice, improve transparency, enforce corporate responsibilities and foster political competition which all favor development of free and competitive financial markets.²

Acemoglu, Johnson and Robinson (2001) (henceforth AJR) use settler mortality rates from previously colonized countries to proxy for the quality of institutions. AJR argue and in fact find evidence that the rate of mortality in the colonies affected the development path they took. Beck, Demirgüç-Kunt and Levine (2003) use the AJR settler mortality rate and show that the type of settlement established by colonizers has a lasting impact on financial development even today.

The approach in this model is similar to Jamison, Lau and Wang (2004) who adapt a multi-level modeling technique to an aggregate production function. The model is an improvement on previous panel data approach because it relaxes the assumption of homogeneity in the slope of policy parameters across countries. We allow for heterogeneity in the slope of financial development as the rate at which finance affects GDP may be different for each country based upon the preconditions established before the modern period. Therefore, this study is also consistent with previous heterogeneity in panel data detected by Boskin and Lau (2000), Lee, Pesaran and Smith (1997) and Dougherty and Jorgensen (1996).

3. MATERIALS AND METHODS

3.1 Materials

The data cover the period 1963 to 2000 on Sub-Saharan Africa (SSA). While there are about 50 continental and island states that qualify to represent the region, the paucity of data reduces estimation of the model to only 20 countries. Data on PPP-adjusted income and physical capital per capita come from the Penn World Table (Version 6.2). Measures of educational attainment of the total population aged 15 and over come from the Barro-Lee (2000) dataset. This variable measures the average years of schooling and is given for 5-year intervals. This educational data set actually restricts the time period of our study up to the year 2000.

Consistent with the current literature, we use the ratio of banks’ credit to the private sector to GDP from the Beck, Demirgüç-Kunt and Levine (2005) dataset. Earlier studies have also used the ratio of M2 to GDP as a proxy for financial development. However, this ratio is a better measure of the extent to which the economy is monetized, rather than a measure of banking activity. Banks’ credit to the private sector is the preferred measure of financial development because banks allocating credit to private firms are more engaged in researching firms, exerting corporate control, providing risk management services, mobilizing savings and facilitating transactions (as opposed to, for example, banks that channel credit to the state, or to state owned enterprises). Table 2 in Appendix 3 shows a wide variation in the average values of the bank credit ratio for the countries in the sample.

² See Acemoglu, Robinson and Johnson (2001) on the endowment theory, and Rajan and Zingales (2003). Corroborating studies by North and Thomas (1973), North (1981), Hall and Jones (1999), Rodrik (1999) and Johnson, McMillan and Woodruff (1999) all find that apart from secure property rights strong institutions such as good governance matter for economic development.
Republic of South Africa has the highest ratio at nearly 0.49, while Uganda, a country that had a severely repressed financial sector up until the late 1980’s, has the lowest ratio at 0.03. Legal origin data come from LLSV. In this sample, all countries have either a British legal tradition or a French legal tradition. The data on settler mortality rates come from AJR. They construct the data from archival records on mortality rates among soldiers, sailors and bishops during the seventeenth, eighteenth and nineteenth centuries during the colonizing periods. ‘Settler’ countries like the Republic of South Africa and Mauritius have relatively lower settler mortality rates (respectively, 15.5 and 30.5 deaths per 1000 persons annually), while ‘extractive’ countries like Ghana and Gambia have relatively higher rates (respectively, 66.8 and 147 deaths per 1000 persons annually).

The geography of a country may also matter in its development. Recent findings show that isolated countries have lower GDP per capita [Sachs and Warner (1997) and Bloom and Sachs (1998)]. We use coastal access from the Harvard Center for International Development [Sachs and Warner (1997)]. This variable quantifies access to the coast, measured as the fraction of the country land area situated within 100 km of the sea coast and navigable waterways. Trade openness also seems to influence growth as evidenced from Sachs and Warner (1997) and Frankel and Romer (1999) The data on openness come from the Penn World Tables. In order to estimate the determinants of slopes, we estimate an index of openness for each country by taking the average value of openness over the years spanning the period 1963 to 2000.

3.2 Empirical Methods

The analysis of SSA limits data availability to 5-year intervals, or in some cases for a smaller period (as with bank credit). The model estimates a variant of a Cobb-Douglas specification. Following Jamison et al. (2004), we include time to capture cumulative progress or technical progress. Following their model, we allow for cross-country variation in technical progress by using a multi-level modeling technique. We also allow for the slope of financial development to vary with the country’s legal origin and the quality of its institutions.

We employed a multi-level modeling technique, the Hierarchical Linear Model (HLM) developed by Bryk and Raudenbusch (1992). It is a maximum likelihood procedure that allows us to model country-specific intercepts – this is similar to a GLS estimated random effects model when a common production function with varying intercepts is imposed across countries.

Usually, studies use either panel or cross section data with common coefficients across countries. However, following Jamison et al. (2004), the model takes into consideration the possibility that important sources of cross-country variations in income growth result from, among other things, persistent differences in the characteristics of countries. The aggregate production function is modeled in two separate steps. First by specifying an equation (3.1) below, supplemented with equations (3.3) and (3.4), followed by a further augmented model supplemented by equations (3.3), (3.4) and (3.6). All the equations are modeled simultaneously and explain the country specific intercepts, rates of technical progress and elasticity due to financial development in equation (3.1):

$$\ln YPC_{it} = \beta_0 + \beta_1 KPC_{it} + \beta_2 Edu_{it} + \beta_3 Time_{it} + \beta_4 FD_{it} + \epsilon_{it} \quad (3.1)$$

3 Judith Singer (1998) calls this an individual growth model.
The variables are:

\( l\gamma P C_{it} \): the natural log of average per capita GDP in country \( i \) over a 5-year period (t-2 to t+2).

\( lKPC_{it} \): the natural log of capital stock per capita over a 5-year period (t-2 to t+2). Capital stock is calculated by the Perpetual Inventory Method.

\( Educ_{it} \): average years of schooling attained by the population aged 15 and over. This is a measure of human capital at time \( t \).

\( Time_{it} \): the number of years elapsed since 1965, \( t-1965 \). 1965 is the first year of observation in the data set, and \( time = 0 \). Time is a proxy for technical progress.

\( lFD_{it} \): the natural log of the ratio of banks’ claims on the private sector to GDP, a measure of financial development.

\( \varepsilon_{it} \): unexplained residual for country \( i \) at time \( t \), assumed \( \sim N(0, \sigma^2) \).

The following supplementation makes the equation similar to a random-effect:

\[ \beta_{0i} = \gamma_{00} + \mu_0 \] (3.2)

\[ \text{Cov}(\mu_{0i}, \varepsilon_{it}) = 0, \quad \mu_{0i} \sim N(0, \sigma^2). \]

The random variable \( \mu_{0i} \) is the deviation of country \( i \)’s mean from the overall mean, and gives us an estimation of country-specific intercepts. On the other hand, the determinants of country intercept can be modeled by using the random-intercept specification in HLM:

\[ \beta_{0i} = \gamma_{00} + \gamma_{1i} \text{institutions}_i + \gamma_{02} \text{coastal}_i + \mu_{0i}, \quad (3.3) \]

where \( \text{institutions} \) will be measured by the log of settler mortality rates, \( \logsm \). The variable \( \text{coastal} \) is the fraction of the country’s land area located within 100 km of the sea coast or an ocean-navigable waterway.

In order to allow for heterogeneity in the contribution of financial penetration, its coefficient is modeled as follows:

\[ \beta_{4i} = \gamma_{40} + \gamma_{41} \text{legal}_i + \gamma_{42} \text{institutions}_i + \mu_{4i}, \quad (3.4) \]

\[ \mu_{4i} \sim N(0, \upsilon^2), \]

Where \( \text{legal} \) is a dummy variable which takes the value of 1 if the country inherited Common Law and a value of 0 if it inherited Civil Law or its derivative legal systems.

Equation (3.5) below, which will be referred to as Model 1, shows heterogeneity in the intercept and the slope of financial development:

\[ l\gamma P C_{it} = \gamma_{00} + [\gamma_{1i} \text{institutions}_i + \gamma_{02} \text{coastal}_i + \mu_{0i}] + \beta_1 lKPC_{it} + \beta_2 Educ_{it} + \beta_3 Time_{it} + [\gamma_{40} + \gamma_{41} \text{legal}_i + \gamma_{42} \text{institutions}_i + \mu_{4i}] * lFD_{it} + \varepsilon_{it} \] (3.5)

When the quality of \( \text{institutions} \) is proxied by settler mortality rate, we expect the coefficient to be negative because a high mortality rate would imply that European colonizers established weak institutions that allowed them to extract resources from the country.

The coefficient of \( \text{coastal} \), or access to coastal waters and navigable waterways, is expected to be positive. The coefficient of \( \text{legal} \) is expected to be positive since the British
legal system fosters economic freedom and assures security of property rights. There might be heterogeneity in technical progress also as the diffusion of technology in each country will vary according to its degree of openness. By allowing for heterogeneity in technical progress we can also test whether the estimated effect of financial development changes. The coefficient on time is modeled as:

$$\beta_{3i} = \gamma_{30} + \gamma_{31} \text{open6300}_i + \mu_{3i}, \quad (3.6)$$

Where $\text{open6300}_i$ is the average value of openness over the period 1963 to 2000. The coefficient of $\text{open6300}_i$ is expected to be positive.

By allowing for heterogeneity in the intercept, technical progress and financial development, we can estimate a more elaborate model, which will be referred to as Model 2. Substituting equations (3.3), (3.4) and (3.6) in equation (3.1), we obtain Model 2, represented by equation (3.7) below:

$$\begin{align*}
\text{LYPC}_{it} &= [\gamma_{00} + \gamma_{01} \text{institutions}_i + \gamma_{02} \text{coastal}_i + \mu_{0i}] + \beta_4 \text{IKPC}_{it} + \beta_3 \text{Educ}_{it} + [\gamma_{30} + \gamma_{31} \text{open6300}_i + \mu_{3i}] \cdot \text{Time}_i + [\gamma_{40} + \gamma_{41} \text{legal}_i + \gamma_{42} \text{institutions}_i + \mu_{4i}] \cdot \text{IFD}_{it} + \epsilon_{it} \\
&= \mu_{00} + \mu_{3i} + \epsilon_{it},
\end{align*}
(3.7)$$

4. RESULTS

Table 3.1 below reports the results of Model 1 using HLM where the variable Time is assumed to have a common coefficient across all countries. The results in Table 3.1 are divided into three categories in the following order; time-invariant determinants of income level, time-varying determinants of income level, and determinants of the country-specific elasticity of financial development respectively.

From Model 1, the coefficient of settler mortality rate is as hypothesized: negative and significant at the 1 percent level. Countries that had a higher settler mortality rate have a lower income per capita.

Physical capital stock per capita is positive and significant at the 1 percent significance level and the elasticity is estimated at about 0.17. However, the effect of education on income per capita is not significant. The estimated coefficient of technical progress is negative at – 0.0057. This translates into a decrease in income levels of 0.57 percent per annum. Jamison et al. (2004) and Boskin and Lau (2000) suggest that since technology is an important positive driving force in explaining income growth, there must be an underlying heterogeneity in modeling technical progress which is not being captured here.

The determinants of the slope of financial development reveal that $\gamma_{40}$, the component of the coefficient of financial development that is common across all countries, is at 1.25, positive and significant at conventional levels. This confirms our main hypothesis that private credit to GDP has a positive impact on income per capita. The magnitude of the elasticity of income due to financial development for each country will depend however, upon its legal origin and its quality of institutions.

The coefficient of the dummy variable for legal origin is 0.17 and significant. Since the variable is equal to 1 for countries that have adopted British Common Law, it means that the size of the coefficient for financial development is higher by 0.17 for these countries as opposed to countries that have adopted French Civil Law. This result supports the general consensus widely reported in the law and finance theory literature.

A significant coefficient of the logarithm of settler mortality rates of -0.20 confirms the findings of Beck et al. (2003). Countries which had high mortality rates do not have strong institutions that protect property rights and creditors, administer justice and
encourage competition, and thus bank credit to the private sector is not efficient at increasing GDP.

Table 3.1: Determinants of income levels for HLM Model 1; dependent variable is ln(GDP per capita) and coefficient for technical progress is homogeneous

| Variable                          | Parameter Estimate | t-Ratio | Pr > |t| |
|----------------------------------|--------------------|---------|------|---|
| Time-invariant                   |                    |         |      |   |
| determinants of income           |                    |         |      |   |
| Constant                         | 8.959***           | 10.48   | <0.000 |
| Coastal                          | 0.826**            | 2.39    | 0.029 |
| Log(Settler Mortality)           | -                  | -3.95   | 0.001 |
|                                  | 0.478***           |         |       |   |
| Time-varying                     |                    |         |      |   |
| determinants of income           |                    |         |      |   |
| Ln(KPC)                          | 0.165***           | 3.46    | 0.001 |
| Education                        | 0.046              | 1.08    | 0.285 |
| Time                             | -0.006**           | -2.02   | 0.046 |
| Determinants of financial        |                    |         |      |   |
| development                      |                    |         |      |   |
| Constant                         | 1.248***           | 3.83    | 0.000 |
| Legal Origin                     | 0.168*             | 1.85    | 0.068 |
| Log(Settler Mortality)           | -                  | -       | 0.000 |
|                                  | 0.203***           | 3.51    |       |

Model Statistics

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Countries</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Number of Observations</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>AIC</td>
<td>-9.3</td>
<td></td>
</tr>
<tr>
<td>Deviance</td>
<td>-15.3</td>
<td></td>
</tr>
</tbody>
</table>

*significant at 10%, ** significant at 5%, ***Significant at 1%

For a region that has such a low average financial development ratio (0.16 as compared to 0.60 in the United States, 0.57 in the United Kingdom and 1.49 in Hong Kong), an increase in bank lending to the private sector can spur economic growth. Uganda, for example, could benefit from encouraging an expansion of its very small financial sector (which has the lowest average at 0.03, calculated for data available over the period 1981-2000). Uganda has had above average settler mortality rates (280 deaths per 1000 persons annually) and an inherited British legal system (dummy variable = 1); its estimated coefficient for the logarithm of financial development (or elasticity) is 0.27. If Uganda had levels of settler mortality rates as low as that of the Republic of South Africa (15.5 per 1000 persons annually), its elasticity due to financial development would have been as high as 0.86.

In Uganda the banking sector was characterized by low domestic savings (Savings Deposit/M2 ratio of 0.12 in 1987) and low financial deepening (M2/GDP ratio of 0.073 in 1987). The Bank of Uganda itself was not totally independent – for example, government constrained it to finance crop production – and its authority on the supervision of financial institutions was not strong. The situation was also exacerbated by financial distress suffered by two of the biggest commercial banks – the Cooperative Bank and Uganda Commercial Bank – that accounted for more than 50 percent of assets in the domestic commercial banking system. The bank credit ratio stood at 0.029 in 1982, but had gradually fallen to 0.011 in 1987.
Reforms in the financial sector were initiated in 1987 – but actual implementation would start two years later. The credit ratio slowly climbed back to its 1982 level around 1992, and would reach 0.052 (an almost five-fold increase) in 2000. Sweeping reforms across the financial system, coupled with a market approach to interest rate determination, would lead to an increase in financial intermediation along with competition, efficiency and stability. These reforms included elimination of interest rate controls, removal of exchange rate controls, allowing entry of new financial institutions, strengthened supervision and regulation, developing the securities market and the inter-bank market, and a monetary policy aimed at market-based instruments. Here we should mention that, if the Ugandan financial penetration ratio were 0.65, as in South Africa, instead of 0.052, its per capita GDP might have been, ceteris paribus, almost twice as high at $1,857 instead of $940 given its elasticity of 0.27.

In the next step, Model 2 is estimated where, following Jamison et al. (2004), the rate of technical progress depends upon the degree of openness of the country. Model 2 therefore exhibits heterogeneity in determining three coefficients: the intercept, time and logarithm of financial development. The results are reported in Table 3.2. Allowing for heterogeneity in technical progress only slightly changes the magnitudes of the coefficients that determine the slope of financial development. The common component across all countries, $\gamma_40$, is nearly 1.20 which means that the pure effect of a one percent increase in the financial development ratio will result in an increase in income per capita by 1.2 percent.

The advantage of inheriting British Common Law over French Civil Law results in a further addition of 0.18 to the elasticity, which is now significant at the five percent level. This estimate is higher than its counterpart in Model 1 by only a very small amount. Further,
as reported by Beck et al. (2003), the quality of institutions established by colonizers can have a lasting effect on financial development. The estimate of the coefficient is -0.19.

The component of the rate of technical progress that is common across the sample of Sub-Saharan African countries, given by the coefficient $\gamma_{30}$, is negative and significant at -0.0121. The coefficient of $\text{Open}_{6300}$ is positive at 0.0001 and significant. This confirms Jamison et al. (2004) finding which suggests that trade openness can be a driving force in a country’s technical progress. We can note that elasticities calculated with Model 2 is not that different from the elasticities calculated with Model 1.

5. CONCLUSION

The main purpose of this paper is to assess whether financial development matters to GDP in Sub-Saharan African countries. Controlling for physical capital stock and human capital, the study finds that financial development has a positive and significant effect on income levels. The second purpose of the paper is to identify persistent country characteristics that determine the slope of financial development. Legal origin and quality of institutions, two factors which have explained the cross country variation in financial development, are identified as significant determinants of the slope.

The law and finance theory postulates that the countries that inherited British Common Law obtained a tradition that protects property rights and financial development more than French Civil Law. We confirm this theory as we estimate a positive and significant effect of operating under the British legal system. In particular, inheriting British Common Law increases the elasticity due to financial development by an amount between 0.168 and 0.175.

The endowment theory says that the natural environment that European settlers first experienced when they reached the colonies shaped the institutions that still exist in those countries today. This theory also is confirmed, as the results show that the elasticity will be smaller for countries with higher settler mortality rates. The findings in this paper are similar to those in Beck et al. (2003), Beck and Levine (2005), Bordo and Rousseau (2006) and Simplice and Asongu (2011). From the evidence, it can be inferred that both the identity of colonizers and the type of colonies established, determine the effects of financial development on income.

Incidentally, we also find that policy variables such as trade openness can affect the rate of technical progress due to acquisition and use of new technology. In theory, this process of diffusion allows the potential of comparative advantage to develop.

Encouraging financial intermediaries to increase lending to the private sector will have positive effects on income. While it is understood that a country can change neither its legal origin nor its institutional framework overnight, we nevertheless can recommend that countries implement reforms that ameliorate property rights and bring reforms within their legal and institutional frameworks. As the case of Uganda illustrates, there is a strong argument to pursue financial liberalization and increase bank lending to productive enterprises, especially in countries where bank lending to the private sector is low.

REFERENCES


APPENDICES

APPENDIX A1: Granger Causality Tests

A variable $x_t$ is said to Granger cause another variable $y_t$ (or $x_t \rightarrow y_t$) if $x_t$ helps predict $y_t$ at some stage in the future. In the context of this paper, we need to establish in fact whether financial development, measured by bank credit to the private sector as a ratio to GDP, causes income per capita. If the causality runs in the opposite direction, that is, it is income that causes bank lending, then it would be wrong to use bank lending as a determinant of GDP. The causality tests are run on yearly data for all countries in the sample. The sample size ranges from 8 to 38 pairs of yearly observations.

The model representation is as follows:

$$ lyc_i = \sum_{i=1}^{p} \alpha_i lyc_{t-i} + \sum_{j=1}^{n} \beta_j lfd_{t-j} + u_{it} \quad \text{(Ai)} $$

$$ lfd_t = \sum_{i=1}^{p} \gamma_i lfd_{t-i} + \sum_{j=1}^{n} \lambda_j lyc_{t-j} + u_{2t} \quad \text{(Aii)} $$

Where $lfd$ is natural log of financial development and $lyc$ is natural log of GDP per capita. $p$ is the number of lags of the dependent variable, and $n$ is the number of lags of the independent variable. If $lyc$ is independent of $lfd$, then the $\beta$’s should be zero. Of particular interest to us, if $lfd$ is independent of $lyc$, the $\lambda$’s should be zero.
Appendix 1: Granger causality results

<table>
<thead>
<tr>
<th>Country</th>
<th>IFD Lags</th>
<th>→</th>
<th>lYPC (P-Value)</th>
<th>No. of Lags</th>
<th>lYPC → IFD</th>
<th>χ² (P-Value)</th>
<th>No. of Lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burundi</td>
<td>Yes</td>
<td>→</td>
<td>20.10 (0.00)</td>
<td>p=3, n=1</td>
<td>No</td>
<td>0.23 (0.62)</td>
<td>p=1, n=2</td>
</tr>
<tr>
<td>Benin</td>
<td>Yes</td>
<td>→</td>
<td>3.24 (0.07)</td>
<td>p=1, n=1</td>
<td>Yes</td>
<td>7.75 (0.01)</td>
<td>p=1, n=2</td>
</tr>
<tr>
<td>Centre Afrique</td>
<td>Yes</td>
<td>→</td>
<td>7.33 (0.03)</td>
<td>p=2, n=3</td>
<td>No</td>
<td>3.27 (0.19)</td>
<td>p=2, n=1</td>
</tr>
<tr>
<td>Cameroun</td>
<td>No</td>
<td>→</td>
<td>0.00 (0.97)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>0.60 (0.74)</td>
<td>p=2, n=2</td>
</tr>
<tr>
<td>Congo</td>
<td>No</td>
<td>→</td>
<td>0.26 (0.61)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>0.43 (0.81)</td>
<td>p=2, n=2</td>
</tr>
<tr>
<td>Gabon</td>
<td>No</td>
<td>→</td>
<td>1.06 (0.57)</td>
<td>p=2, n=1</td>
<td>No</td>
<td>1.37 (0.50)</td>
<td>p=2, n=1</td>
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<tr>
<td>Ghana</td>
<td>Yes</td>
<td>→</td>
<td>6.71 (0.08)</td>
<td>p=3, n=1</td>
<td>No</td>
<td>0.30 (0.86)</td>
<td>p=2, n=1</td>
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<tr>
<td>Gambia</td>
<td>No</td>
<td>→</td>
<td>1.83 (0.17)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>0.03 (0.85)</td>
<td>p=1, n=1</td>
</tr>
<tr>
<td>Kenya</td>
<td>No</td>
<td>→</td>
<td>0.00 (0.97)</td>
<td>p=1, n=2</td>
<td>No</td>
<td>0.70 (0.80)</td>
<td>p=1, n=1</td>
</tr>
<tr>
<td>Mali</td>
<td>Yes</td>
<td>→</td>
<td>10.52 (0.01)</td>
<td>p=3, n=1</td>
<td>No</td>
<td>2.31 (0.12)</td>
<td>p=1, n=1</td>
</tr>
<tr>
<td>Mauritania</td>
<td>No</td>
<td>→</td>
<td>0.32 (0.57)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>3.50 (0.17)</td>
<td>p=2, n=1</td>
</tr>
<tr>
<td>Mauritius</td>
<td>No</td>
<td>→</td>
<td>0.49 (0.49)</td>
<td>p=1, n=3</td>
<td>No</td>
<td>3.17 (0.20)</td>
<td>p=2, n=1</td>
</tr>
<tr>
<td>Niger</td>
<td>No</td>
<td>→</td>
<td>0.03 (0.87)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>3.95 (0.14)</td>
<td>p=2, n=1</td>
</tr>
<tr>
<td>Rwanda</td>
<td>No</td>
<td>→</td>
<td>0.26 (0.61)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>1.46 (0.69)</td>
<td>p=3, n=1</td>
</tr>
<tr>
<td>Senegal</td>
<td>No</td>
<td>→</td>
<td>2.16 (0.14)</td>
<td>p=1, n=1</td>
<td>Yes</td>
<td>7.31 (0.06)</td>
<td>p=3, n=3</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>No</td>
<td>→</td>
<td>1.10 (0.29)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>1.06 (0.30)</td>
<td>p=1, n=1</td>
</tr>
<tr>
<td>Togo</td>
<td>No</td>
<td>→</td>
<td>0.29 (0.58)</td>
<td>p=1, n=1</td>
<td>No</td>
<td>1.63 (0.20)</td>
<td>p=1, n=1</td>
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<tr>
<td>Tanzania</td>
<td>No</td>
<td>→</td>
<td>1.16 (0.21)</td>
<td>p=1, n=2</td>
<td>No</td>
<td>0.18 (0.91)</td>
<td>p=2, n=1</td>
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<tr>
<td>Uganda</td>
<td>No</td>
<td>→</td>
<td>0.30 (0.96)</td>
<td>p=3, n=1</td>
<td>No</td>
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<td>p=2, n=1</td>
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<tr>
<td>R South Africa</td>
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<td>→</td>
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<td>p=1, n=1</td>
<td>No</td>
<td>0.32 (0.57)</td>
<td>p=1, n=1</td>
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</table>

Using annual data and conducting a bivariate VAR to test the direction of causality shows that IFD might cause lYPC for only two countries (Benin and Senegal). Since we fail to find that financial development Granger causes GDP for the other eighteen countries in the sample, we can conclude that it is unlikely that financial development is endogenous in the model. We can therefore use IFD as a right-hand-side variable in the model.

**APPENDIX A2: Model Selection**

The Akaike’s Information Criterion (AIC) is calculated as \(-2 \times \text{log-likelihood} + 2k\), where \(k\) is the number of estimated parameters. The AIC penalizes the log likelihood for estimating more parameters. Lower values of AIC correspond to more desirable models. Deviance is simply calculated as \(-2 \times \text{log-likelihood}\). In the case of Model 1 from Table 2, for example, the number of parameters estimated is 6: \(\log sm\), coastal, lKPC, Educ, Time and lFD. The determinants of the coefficient of lFD are not considered parameters in estimating lYPC. Thus, the AIC is then calculated as the Deviance + 8. We would prefer Model 1 to Model 2 if parsimony is a big concern. We can argue however, that Model 1 is (structurally) different from Model 2 as it treats cumulative progress as uniform across all countries, while Model 2 does not.

**APPENDIX A3: Perpetual Inventory Method**

Physical Capital per capita is calculated from GDP per capita and the investment ratio from the Penn World Tables using the perpetual inventory method (PIM). The specific calculation is as follows: for the first year of observation available, a starting capital stock is estimated as (First year GDP* Average Investment Ratio for the First Five Years)/(Assumed Depreciation Rate). The depreciation rate used was 7%, in common with other studies. Subsequent years’ capital stock estimates were calculated as prior year capital stock + investment – depreciation.
**APPENDIX A4:** Correlation between Fixed Variables

Appendix 2: Correlation between persistent characteristics

Pearson Correlation Coefficients

<table>
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<th></th>
<th>Coastal</th>
<th>Open6300</th>
<th>Log(SM)</th>
<th>Legal Origin</th>
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<tr>
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<td>0.411</td>
<td>-0.111</td>
<td>-0.056</td>
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<tr>
<td>Open6300</td>
<td>0.411</td>
<td>1.000</td>
<td>0.099</td>
<td>0.220</td>
</tr>
<tr>
<td>Log(SM)</td>
<td>-0.111</td>
<td>0.099</td>
<td>1.000</td>
<td>0.108</td>
</tr>
<tr>
<td>Legal Origin</td>
<td>-0.056</td>
<td>0.220</td>
<td>0.108</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Prob > |r| under H0: Rho=0

All the correlations are quite small even if significant. We can therefore discount the problems associated with multicollinearity in the regressions.