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Financial Sector Development and Productivity Growth

Subal C. Kumbhakar[1]
and George Mavrotas[2]

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Abstract

Recent years have witnessed important structural changes around the world as a result of the globalization process, the creation of new economic blocks and the liberalization of financial sector in many countries. Responding to these changes many sectors of the industrialized countries have gone through major deregulatory changes to acclimate themselves to new environments. At the same time, many countries have undertaken institutional reforms to build a market-orientated financial system in the hope that transition towards market economy will improve productivity. In the face of uncertainty resulting from changes in regulatory structure and the development of financial institutions to foster market economy, many countries may not be able to achieve their maximum growth potential. In other words, productivity growth is likely to depend on the development of financial institutions and the stage of economic development. …/…

Keywords: productivity growth, financial sector development

JEL classification: D24, E44, O16

[1] Corresponding author: Department of Economics, State University of New York, Binghamton, New York 13902, USA; E-mail: kkar@binghamton.edu [2] UNU-WIDER, Helsinki, Finland.

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That is, a less developed country is likely to benefit more (in terms of output growth rate) from the development of financial institutions than a developed economy with well-developed financial system. In this paper we document this by using data covering 65 countries, varying substantially in terms of level of development and geographic location, and spanning the period 1960-1999. Empirical results obtained from the estimation of two different empirical models regarding the measurement of total factor productivity growth seem to confirm *a priori* expectations about the overall positive influence of financial systems on productivity in line with previous work on this front. Our results remain robust with respect to alternative definitions of financial sector development we tried.

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UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

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1. Introduction

Recent years have witnessed important structural changes around the world as a result of the globalization process, the creation of new economic blocks and the liberalization of financial sector in many countries. In view of this, many sectors of the industrialized countries have gone through major deregulatory changes to acclimate themselves to new environments. At the same time, many countries have undertaken institutional reforms to build a market-orientated financial system in the hope that transition towards market economy will improve productivity. These changes often tend to distort the markets (in the short run), which affect allocation of resources. Furthermore, in the face of uncertainty resulting from changes in regulatory structure and the development of financial institutions to foster market economy, many countries may not be able to achieve their maximum growth potential. In other words, productivity growth is likely to depend on the development of financial institutions and the stage of economic development. That is, a less developed country is likely to benefit more (in terms of output growth rate) from development of financial institutions than a developed economy that has well-functioning and sound financial institutions.

Of particular relevance to the present paper is the empirical literature discussing the channels and mechanisms through which the impact of financial sector development operates in an economy. There exists a vast and still growing literature, both theoretical and empirical, regarding the impact of financial sector development on growth. Reviews of the above literature can be found in Fry (1988), Wachtel and Rousseau (1995), Hermes and Lensink (1996), Arestis and Demetriades (1997), Levine (1997), Rousseau (1998) World Bank (2001), Demirguc-Kunt and Levine (2001), Green and Kirkpatrick (2002) and Wachtel (2004) among others. On the relationship between financial sectors and productivity growth, King and Levine (1993) have argued that financial services can accelerate growth by improving the allocation of capital and by enhancing the productivity of firms. Within this context, the quality of financial institutions in an economy may crucially affect innovation by mobilizing resources to finance promising investment projects, evaluating prospective entrepreneurs and allowing investors to diversify the risks related to uncertain innovative activities. The above desirable effects on growth and productivity take place in a Schumpeterian environment in which well structured and functioning financial systems can have a crucial impact on technological innovation and productivity growth. Similarly, Bencivenga and Smith (1991) and Bencivenga et al. (1995) argue that sound financial institutions result in efficient allocation of resources in an economy and by doing so they enhance long-run growth. Neusser and

Kugler (1998), Benhabib and Spiegel (2000) and Beck et al. (2000) extend the argument further to consider the impact of financial sector development on total factor productivity growth. The study by Beck et al. (2000) reports an overall positive effect of financial sector development on total factor productivity growth.[1]

The impact of Foreign Direct Investment (FDI) on economic growth has also been the subject of a vast empirical literature. It is notable, however, that although there exists a voluminous literature on the relationship between FDI and growth only a fraction of it focuses on the impact of FDI on productivity growth. In neoclassical models of growth, FDI increases the volume of investment and its efficiency, and leads to long-term level effects and medium-term, transitional increases in growth. Endogenous growth models on the other hand consider long-run growth as a function of technological progress, and provide a framework in which FDI can permanently increase the rate of growth in the host economy through technology transfer, diffusion, and spillover effects. It is mainly through the spillover effects that FDI inflows are expected to affect productivity growth. A large number of empirical studies on the role of FDI in host countries suggest that FDI is an important source of capital, complements domestic private investment, is usually associated with new job opportunities and enhancement of technology transfer and boosts overall economic growth in host countries.[2] A number of firm-level studies, on the other hand, do not lend support for the view that FDI promotes economic growth - see Carkovic and Levine (2003) and the references therein. Hanson (2001) has also reported weak evidence that FDI generates positive spillovers for host countries. For a very recent, comprehensive discussion at the firm level see also Gorg and Greenaway (2004).

It is important to emphasize that the present paper is a first attempt (to the best of our knowledge) in the voluminous finance-growth literature to examine directly the link between financial sector development and total factor productivity by using two different modeling approaches. Instead of using the standard production function our modeling approach uses the rate of change in output (GDP) so that country-specific effects are controlled for. The first approach assumes that covariates related to financial sector development directly affect rates of change in

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[1] Another strand of the finance-growth literature focuses on the important relationship between stock market development and economic growth. Major studies in this area include Atje and Jovanovic (1993), Singh (1997), Levine and Zervos (1998), Rousseau and Wachtel (2000), Arestis et al. (2001), and more recently Beck and Levine (2004).

[2] See de Mello (1997 & 1999) for a comprehensive survey of the nexus between FDI and growth as well as for further evidence on the FDI-growth relationship, Mody and Murshid (2002) for a recent assessment of the relationship between domestic investment and FDI, Blomstrom and Kokko (1998) for a critical review of the role of FDI in technology transfer and spillover effects, and Asiedu (2002), Chakrabarti (2001) and Tsai (1994) on the determinants of FDI.

output and hence total factor productivity. The second approach assumes that the covariates related to financial sector development affect output (GDP) growth and hence total factor productivity indirectly through input factor (capital and labor) productivities. Since the covariates related to financial sector development are not standard inputs like capital and labor, the second approach might be useful to examine robustness of our results. Furthermore, impact of factors related to financial sector development on productivity (growth rate of GDP) and total factor productivity might differ depending on whether one is willing to adopt the assumption that markets are competitive. We argue that if markets are non-competitive it is better to focus on rates of output growth instead of total factor productivity growth.

The remainder of the paper is structured as follows: Section 2 discusses the standard production function and factor-augmenting approach, respectively, in measuring labor and total productivity growth. Data are described in Section 3. Estimation and results are discussed in Section 4. Section 5 concludes the paper.

2. The Production Function Approach

The production function approach is widely used to measure productivity growth as well as the impact of regulation and other policy variables (henceforth labeled as control variables) on growth rates. Here we consider two alternative methods, viz., the standard production function approach in which the control variables appear as arguments of the production function – just like the input variables such as capital and labor. We then consider a factor-augmenting approach in which the arguments are capital and labor but we append augmenting functions to the input variables. We use the control variables as well as capital and labor as the arguments in the factor-augmenting functions. If the augmenting functions are exponential in the control variables and the production function is Cobb-Douglas, then the standard and factor augmenting are identical. For other functional form such as the translog, the two specifications will be different. However, one form is not necessarily nested in the other and thus one can not test which specification fits the data better.

2.1 The standard production function approach

We consider the case where the producers are fully efficient technically.[3] We write the production technology as $Y = f(X, L, t)A(v)$ where Y is output, X is a vector of inputs except for labor (L), t is time trend (introduced to measure technical change), and v is all other un-measured factors.[4] We start with a partial factor (labor) productivity measure and define productivity as the average product of labor, i.e., Y/L. By differentiating the production function totally, we obtain:

$$\dot{Y} = \sum_j \lambda_j \dot{X}_j + \lambda_L \dot{L} + TC + \varepsilon \tag{1}$$

where $\dot{Y} = (1/Y)(dY/dt), \dot{X}_j = (1/X_j)(dX_j/dt), j = 1,\ldots,J; \dot{L} = (1/L)(dL/dt)$, are rates of change in Y, X_j and L; $\lambda_j = \partial \ln f(.)/\partial \ln X_j, \lambda_L = \partial \ln f(.)/\partial \ln L, TC = \partial \ln f(.)/\partial t$, and finally the residual component is $\varepsilon = \left(\partial \ln A(v)/\partial \ln v\right)\dot{v}$. The above equation decomposes sources of output growth rate into rates of change in inputs and technical change. The ε term is the residual component associated with un-measured inputs. For example, if production is technically inefficient and inefficiency is time-varying, the effect of technical efficiency on output growth will be captured by the ε term. It is likely to capture effects of other un-measured inputs that are time-varying. Since the λ_j terms are expected to be positive for a well-behaved production function, an input contributes positively (negatively) to output growth when its usage increases (decreases).

Using (1) we can express labor productivity growth as:

$$\dot{Y} - \dot{L} = \sum_j \lambda_j \dot{X}_j + (\lambda_L - 1)\dot{L} + TC + \varepsilon$$

which decomposes labor productivity growth into (i) growth rates of other inputs, (ii) growth rates of labor employment, (iii), technical change, and (iv) a miscellaneous component due to unmeasured inputs. Since λ_j are all positive, growth in input-usage increases labor productivity. However, growth in employment will reduce labor productivity since $\lambda_L \leq 1$.

To give familiar productivity decomposition we rewrite (1) as:

[3] See Kumbhakar (2000, 2005) for models with technical inefficiency.

[4] Here we assume, for simplicity, that the unmeasured/unobserved inputs are separable from the measurable/observed inputs.

$$\dot{Y}-\dot{L}=(RTS-1)\sum_{j=1}^{J+1}M_j\dot{X}_j+\sum_{j=1}^{J+1}M_j\dot{X}_j-\dot{L}+TC+\varepsilon \tag{2}$$

where $RTS=\sum_{j=1}^{J+1}\lambda_j$, and $M_j=f_jX_j/\sum_{j=1}^{J+1}f_jX_j=\lambda_j/\sum_{j=1}^{J+1}\lambda_j$. In the above expressions the (J+1)th input is labor. In (2) productivity growth is decomposed into scale, growth of input quantities, employment growth, technical change, and a residual component that takes into the effect of unobserved/unmeasured inputs. It is clear from (2) that productivity growth can be computed from the observed data (without estimating anything econometrically) but to make a meaningful use of it, one needs to know the sources of productivity growth. For example, if some firms in an industry are champions (performing better than others in terms of their labor productivity), it is essential to identify the sources so that one can examine why some firms (and which ones) are lagging behind. In sum, information about the sources of productivity growth always helps in making right policy prescriptions.

To estimate the components of productivity growth in (2), we rewrite (1) in the form of a familiar regression equation, i.e.

$$\dot{Y}=\beta(X,t)+\sum_{j=1}^{J+1}\beta_j(X,t)\dot{X}_j+\varepsilon\,. \tag{3}$$

Note that the coefficients of the above regression are functions of inputs and time. By assuming a functional form on the underlying production technology, we can derive a parametric form for each of these coefficients. For example, if the production function is translog, i.e.

$$\ln Y=\beta_0+\sum_j\beta_j\ln X_j+\beta_t t+\tfrac{1}{2}\sum_j\sum_k\beta_{jk}\ln X_j\ln X_k+\sum_j\beta_{jt}\ln X_j t+\tfrac{1}{2}\beta_{tt}t^2 \tag{4}$$

then

$$\beta(X,t)=\beta_t+\beta_{tt}t+\sum_{j=1}^{J+1}\beta_{jt}\ln X_j=TC\,, \tag{5}$$

and

$$\beta_j(X,t)=\beta_j+\beta_{jt}t+\sum_{k=1}^{J+1}\beta_{jk}\ln X_k=\lambda_j\,. \tag{6}$$

On the other hand, if the production function is Cobb-Douglas with neutral technical change, then $\beta(X,t) = \beta_t + \beta_{tt}t$ and $\beta_j(X,t) = \beta_j$. Thus, data on rates of change (as well as the level) in output and inputs can be used to estimate all the parameters of the translog production function in (4), except the intercept, simply by estimating the relationship in (3). In fact, it is not necessary to specify $\beta_j(X,t)$ and $\beta(X,t)$ in such a way that they are consistent with a specific form of production function. One can assume any functional form on $\beta_j(X,t)$ and $\beta(X,t)$. For example, it might be desired to assume a functional form that guarantees positive marginal product of capital and labor. This is not possible if one estimates the translog production function directly. Once the parameters are estimated, one can compute the components of productivity growth.

It is worth mentioning another advantage of estimating the growth equation in (3) instead of the production function in (4). In (3) producer- (country-) specific effects are automatically controlled whereas these effects are to be added in (4). If these effects are not added, parameter estimates are likely to be biased and contaminate the contribution of covariates of financial factor development. The main disadvantage of estimating (3) is that unless there are enough variations in input growth rates parameter estimates will be imprecise.

After estimating the production technology represented by either (3) or (4), one can compute labor productivity from (2). Although such a measure is widely used in practice it does not give the total picture. For example, labor productivity for a country can be high simply because the production process is capital intensive. Thus, unless one takes into account the other factors that are used in the production process, the estimated productivity is likely to be biased and a cross-country productivity comparison based on labor productivity might be misleading. One can avoid such problems by using what is called the Divisia or total factor productivity (TFP), which takes into account growth rates of all the inputs (weighted by their cost shares). TFP growth is defined as:

$$
\begin{aligned}
T\dot{F}P &= \dot{Y} - \sum_j S_j^a \dot{X}_j = \sum_j \{\lambda_j - S_j^a\}\dot{X}_j + TC + \varepsilon \\
&= (RTS-1)\sum_j M_j \dot{X}_j + TC + \sum_j \{M_j - S_j^a\}\dot{X}_j + \varepsilon,
\end{aligned}
\tag{7}
$$

where w_j is the price of input X_j, $S_j^a = w_j X_j / C^a$, and $C^a = \sum_j w_j X_j$. The last component in (7) (i.e., $\left(\sum_j \{M_j - S_j^a\}\dot{X}_j\right)$), often labeled as the price component) captures either deviations of input prices from the value of their marginal products, i.e., $w_j \neq pf_j$, or the departure of the marginal rate of technical substitution from the ratio of input prices ($f_j/f_k \neq w_j/w_k$). Thus, computation of the last component requires price information. It can, however, be dropped from the analysis if one assumes that firms are allocatively efficient (i.e., $f_j/f_k = w_j/w_k$ or $w_j = pf_j$).

If there are other covariates (Z) that affect output, as is the case in country studies, then the TFP growth equation in (7) can be expressed as:

$$T\dot{F}P = \dot{Y} - S_L\dot{L} - S_K\dot{K} = (\lambda_L - S_L)\dot{L} + (\lambda_K - S_K)\dot{K} + \sum_{q=1}^{Q}\gamma_q\dot{Z}_q + TC + \varepsilon \tag{8}$$

where $\gamma_q = \partial \ln Y / \partial \ln Z_q$, $q = 1,\ldots,Q$. If prices are not available and one makes the assumption that input markets are competitive and input allocations is efficient, the above formula reduces to

$$T\dot{F}P = (RTS - 1)\sum_j M_j\dot{X}_j + \sum_{q=1}^{Q}\gamma_q\dot{Z}_q + TC + \varepsilon \tag{9}$$

To estimate the components of TFP growth in (9), one can estimate either the translog production function in (4) after appending the country-specific effects or adding the necessary terms to accommodate the *Z* variables, or the growth equation in (10) below.

$$\dot{Y} = \beta(X,Z,t) + \sum_{j=1}^{2}\beta_j(X,Z,t)\dot{X}_j + \sum_{q=1}^{Q}\gamma_q(X,Z,t)\dot{Z}_q + \varepsilon \tag{10}$$

where $\beta(X,Z,t) = \beta_t + \beta_{tt}t + \sum_{j=1}^{2}\beta_{jt}\ln X_j + \sum_{q=1}^{Q}\delta_{qt}Z_q$,

$\beta_j(X,Z,t) = \beta_j + \beta_{jt}t + \sum_{k=1}^{2}\beta_{jk}\ln X_k + \sum_{q=1}^{Q}\delta_{jq}\ln Z_q \equiv \lambda_j$, and

$\gamma_q(X,Z,t) = \gamma_q + \delta_{qt} t + \sum_{k=1}^{2} \delta_{qk} \ln X_k + \sum_{q=1}^{Q} \gamma_{qq} \ln Z_q$, which are counterparts of (5) and (6). The only difference is that here we separated capital and labor (included in *X*) from the other control variables (*Z*). Once the parameters are estimated, TFP growth and its components of TFP growth in (9) can be obtained. In the standard approach one estimates the production function in (4) and computes the scale, TC and price components. The sum of these components differs from the Divisia index, which can be computed from the data. In our analysis we capture this deviation in the ε term, which is a part of the TFP growth equation and in the regression we run. We also give an interpretation of the ε term (miscellaneous component that arises from the non-traditional inputs). Note that the ε term cannot be computed from the residuals of the estimated production function (the mean of which is zero by construction), while the mean of it can be non-zero and obtained from the residuals of (3).

It should be noted here that algebraically the equations in (9) and (10) are the same. However, they differ in terms of interpretation of results, especially for the variable inputs. In equation (10) $\beta_j(X,Z,t)$ measures the marginal contribution of rates of change in input *j* to the output growth rate, while the contribution of rates of change in input *j* to total factor productivity growth from (9) is $(RTS-1)M_j$. The contributions of Z_q on output growth rate and total factor productivity growth are the same. It is worth noting here that the crucial assumption behind the computation of the TFP growth components is that markets are competitive. Under this assumption one can compute the TFP growth components without knowing the relevant prices. If the markets are not competitive, however, the TFP growth decomposition result in (9) will not hold. On the contrary, the decomposition result in (10) will hold irrespective of whether input markets are competitive or not. Based on this, one can argue that output growth decomposition might be preferred to TFP growth decomposition.

2.2 The factor-augmenting representation

The production function in factor-augmenting (FA) form (Beckmann and Sato (1969), Sato and Beckmann (1969), Kumbhakar (2002, 2004)) can be written as:

$$Y = f(AX) = f(A_1(t,Z,X)X_1,\ldots,A_J(t,Z,X)X_J) \equiv f(\tilde{X}_1,\ldots,\tilde{X}_J) = f(\tilde{X}), \qquad (11)$$

where $\tilde{X}_j = A_j(t,Z,X)X_j$ is the j^{th} variable input measured in efficiency units, and $f(\cdot)$ is the production technology. $A_j(t,Z,X) > 0$ is the efficiency factor associated with input j ($j = 1,\ldots,J$). It can also be viewed as an input-specific productivity/efficiency index. If $A_j(t,Z,X)$ increases with Z_q, then the productivity of input j will also increase meaning that, given everything else, output growth rate will go up with an increase in Z_q.

Using the same definition of technical change as before, TC in the FA model can be expressed as:

$$TC_p = \sum_j \frac{\partial \ln f(\tilde{x})}{\partial \ln \tilde{x}_j} \frac{\partial \ln \tilde{x}_j}{\partial t} = \sum_j \frac{\partial \ln f(\tilde{x})}{\partial \ln \tilde{x}_j} \dot{A}_j \equiv \sum_j \tilde{\lambda}_j \dot{A}_j = \sum_j TC_p^j. \tag{12}$$

where TC_p^j represents the contribution of the j^{th} input to the aggregate (overall) technical change TC_p. It is clear from (12) that TC_p^j depends on the rate of change of input productivity ($\dot{A}_j$) and $\frac{\partial \ln f(\tilde{x})}{\partial \ln \tilde{x}_j} = \tilde{\lambda}_j$, which under competitive market conditions, is the cost share of input j in total revenue.

TFP growth in this setup (counterpart of (8)) is:

$$T\dot{F}P = \dot{Y} - S_L\dot{L} - S_K\dot{K} = (\tilde{\lambda}_L - S_L)\dot{L} + (\tilde{\lambda}_K - S_K)\dot{K} + TC_p + \varepsilon \tag{13}$$

To examine these components in detail, we assume a translog functional form to represent the underlying production technology, i.e.

$$\ln Y = \alpha_0 + \sum_j \alpha_j \ln \tilde{X}_j + \frac{1}{2}\sum_j \sum_k \alpha_{jk} \ln \tilde{X}_j \ln \tilde{X}_k, \tag{14}$$

where $\tilde{X}_j = A_j(t, Z, X)X_j$. It is necessary to specify $A_j(.)$ in order to estimate the above model. We specify the A_j s as functions of *Z* as well as other *X* variables, i.e.

$$\ln A_j = t\left(a_j + \sum_{k=1} b_{jk} \ln X_k + \sum_{q=1} \gamma_{jq} Z_q\right) \qquad (15)$$

where a_j , b_{jk} and γ_{jq} are parameters to be estimated.

From the above specifications one can easily test whether the rate of change in efficiency factors are constant or not by restricting $b_{jk} = 0$ and $\gamma_{jq} = 0$ in (15).

3. Data Issues

In this section we discuss data issues of crucial importance for the paper in view of its empirical nature. Having already discussed issues related to the measurement of TFP in the previous section, here we focus *inter alia* on the other crucial variable, namely the one measuring financial sector development, as well as the rest of the (control) variables employed in the paper. It has been widely recognized that measuring financial sector development is not an easy procedure since an ideal index of financial sector development should attempt to measure both the various aspects of the deregulatory and the institution-building process in financial sector development; however, measuring the above aspects is a difficult if not an impossible task (see Bandiera *et al*. 2000 and Mavrotas and Son 2005 for a detailed discussion). Various measures of financial sector development have been used in the empirics of finance and growth. Common measures of financial development used in the literature have been financial depth or selected financial indicators. Financial depth in particular has been used extensively in much of the early as well as recent literature as a measure of financial sector development.

A comprehensive assessment of the development, structure and performance of the financial sector, has been provided recently by Beck, Demirguc-Kunt and Levine (2000). The above study provides also data sources regarding the size, activity and efficiency of various financial intermediaries and markets across a broad spectrum of countries and through time. In the present paper we employ some measures of financial sector development suggested by Beck *et al.* (2000)

but in the context of a database consisting of 65 countries (of which 24 OECD countries and 41 developing countries) spanning the period 1960-1999. The database and the methodology for constructing the financial sector development indicators draw on Mavrotas and Son (2005).

We use a Financial Sector Development Index (hereafter *FSDI*), following Mavrotas and Son (2005) who used principal component analysis to derive the above index as the linear combination of three financial indicators, namely *PCR*, *CMB* and *LQ*:

$$Z1_{it} = a_{1i\cdot}PCR_{it} + a_{2i\cdot}CMB_{it} + a_{3i\cdot}LQ_{it} = FSDI_{it}$$

where $Z1_{it}$ is the first principal component and coefficient vector ($a_{1i\cdot}$, $a_{2i\cdot}$, $a_{3i\cdot}$) calculated from the time-series data for each country. Thus, *FSDI* is the financial sector development index employed in this paper to encompass the three financial indicators below:

- Private Credit or *PCR* is the ratio of private credit by deposit money banks and other financial institutions to GDP and measures the activity of financial intermediaries i.e. this measure of financial sector development (FSD) isolates credit issued to the private sector as opposed to credit issued to governments and public enterprises; by doing so, it measures the mobilized savings that are channeled to private firms (see Beck *et al.* 2000 and Mavrotas and Son 2005).

- *CMB* stands for the ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets i.e. this indicator provides information regarding the relative importance of deposit money banks relative to central banks; by doing so it captures the relative size of financial intermediaries in the economy.

- The third indicator we employed (*LQ* - the ratio of liquid liabilities to GDP), is another measure of the size of financial intermediaries and indeed a standard indicator of financial depth used extensively in the empirical literature.

All raw data for the variables used in the empirical analysis have been obtained from the electronic version 2001 of the IMF's *International Financial Statistics* and the electronic version 2001 of World Bank's *World Development Indicators*, except Ethiopia's GDP data, which was obtained from UN's *Yearbook of National Accounts*. The raw data set covers 65 countries over the period 1960-1999 (40 years), but the time span of data employed after adjustment is 1961-99 (39 years) for 65 countries. The raw data can be distinguished into two main groups: stock variables and flow variables. Whereas stock variables are measured at the end of a period, flow variables are defined relative to a period. This presents problems in measuring both in terms of correct timing and in terms of deflating correctly. To address the above problems a data adjustment process is required. In line with Beck, Demirguc-Kunt and Levine (2000), Beck, Levine and Loayza (2000) and Mavrotas and Son (2005) we used the following data adjustment process to deal with the above problem. More precisely, we deflated the end-of-year financial balance sheet items (f) by the end-of-year consumer price indices (CPI) and also deflated the GDP series by the annual CPI. Then, we computed the average of the real financial balance sheet item in year t and t-1 and divided the average by real GDP measured in year t.

In view of this, *PCR* is calculated using IFS data and the following formula:

$$PCR_{it} = \{(0.5)*[\, f_{it} / CPI(e)_{it} + f_{i,t-1} / CPI(e)_{i,t-1} \,]\} / [GDP_{it} / CPI(a)_{it}]$$

where, f stands for credit by deposit money banks and other financial institutions to the private sector (IFS lines 22d +42d), *GDP* is from IFS (line 99b), $CPI(e)$ is end-of-period CPI (IFS line 64) and $CPI(a)$ is the average annual CPI. The f and end-of-period CPI are either the value for December or, where not available, the value for the last quarter. In case the end-of-period CPI in 1960 and 1961 is not available, the average annual CPI is used. In addition, some data on CPI were estimated using the average annual increase rate of the following 3 years[5], where CPI data in the early 1960s are missing or not available. It is useful to note that the data from 1999 in Euro-zone countries are reported in Euro currency, so the data were converted to the equivalent values in national currency.

CMB, is calculated using IFS data and the following formula:

$$CMB_{it} = DB_{it} / [DB_{it} + CB_{it}]$$

[5] The employed method of estimation is $CPI(t) = CPI(t+1)/[CPI(t+4) / CPI(t+1)]^{1/3}$.

where *DB* is assets of deposit money banks (IFS lines 22a-d) and *CB* is central bank assets (IFS lines 12a-d).

The data on *LQ* is obtained from 'liquid liabilities (M3) as percent of GDP' in the World Development Indicators 2001 of the World Bank. If the data from the World Bank were not fully available for the period of 1961-99 we used money and quasi-money (M2), which is calculated using IFS data and the following formula:

$$LQ_{it} = \{(0.5)*[\, m_{it}/CPI(e)_{it} + m_{i,t-1}/CPI(e)_{i,t-1}\,]\}/[GDP_{it}/CPI(a)_{it}]$$

where *m* is money (IFS line 34) plus quasi-money (IFS line 35), *GDP* (IFS line 99b), *CPI*(*e*) is end-of-period CPI (IFS line 64), and *CPI*(*a*) is the average annual CPI.

The Financial Sector Development Index (*FSDI*) is calculated as the linear combination of the financial indicators *PCR*, *CMB* and *LQ* by using principal component analysis. Under the assumption of heterogeneity across countries we estimated coefficients of the principal components for each country in our sample.

<u>Input variables used</u>

The basic input variable is related to scale effects i.e. that an expansion of the aggregate labor force, *L*, raises the per capita growth rate for the economy in the endogenous growth model. In particular, under the assumptions of learning-by-doing and knowledge spillovers, the per capita growth rate would increase over time as the labor force grows over time. Data on this variable are obtained from 'Labor force, total' in the World Development Indicators 2001. The other input variable used is real gross fixed capital formation (also from the World Development Indicators of the World Bank). If they are not available from WDI, the data on capital were calculated using the raw data obtained from IFS (IFS line 93e, Gross Fixed Capital Formation).

Control variables

We also employed a number of control variables in the empirical analysis. These include two policy variables, namely, the inflation rate and the ratio of government expenditure to GDP as indicators of macroeconomic stability in the growth equation (although the latter could also be viewed as a measure of private sector activity). Government expenditure plays an important role in the overall growth process and it could affect economic growth positively or negatively. The relationship between inflation and economic growth is more complex because inflation affects economic growth indirectly through real money balances in saving or investment functions, rather than directly. The data source for both variables is the World Development Indicators. Furthermore, under the assumption of an open economy, our set of control variables includes two open economy variables: Openness to Trade (i.e. the share of the sum of exports and imports in GDP) and Foreign Direct Investment (FDI). Data on Trade Openness are obtained from IFS (IFS lines 90c+98c) and data on FDI are obtained from 'Foreign direct investment, net inflows (percent of GDP)' in the World Development Indicators 2001.

The summary statistics of these variables are given below (see Table 1) to give an idea of what the mean values of some of these variables are, how much are their spread and whether there are extreme values. It is clear that some of these variables vary substantially. Most of these variations are across countries instead of within countries. Also there are some extreme values, as can be seen from the maximum and minimum values of them.

Table 1: Summary Statistics

Variable	Mean	Std Dev	Minimum	Maximum
log(GDP)	18.6442470	3.0696180	9.7618317	27.4602475
log(labor)	8.3530134	1.6286445	4.2660825	12.9965772
log(capital)	11.1108635	2.6082834	4.7186024	18.6405343
fsdi index	0.6746334	0.5268480	-0.4754284	3.7601369
Govt expenditure to GDP	0.1430420	0.0585798	0	1.1213348
fdi	0.9112698	1.7429134	-15.5767889	24.8807983
openness to trade	0.5977038	0.3605824	0	2.3870007
inflation	11.4777150	26.5897779	-10.6861153	1133.83
PCR	0.3691556	0.3164437	0	1.8433036
CMB	0.7963952	0.1994530	0	1.0318389
LQ	0.4523717	0.3612355	0	5.2536891
TCR	0.9384277	2.4948443	0	29.9149165

4. Estimation and Results

4.1 Results from the standard production function model

Equation (4), specified in section 2, is estimated with country dummies.[6] Since input markets are likely to be non-competitive, especially in developing countries, we report growth decomposition results computed from (10). We focus on the contributions of the *Z* variables and technical change. Table 2 below reports empirical results from the estimation of the standard production function model. Here we report empirical findings related to the full sample of countries used in the empirical analysis under the assumption that the production function is the same for all countries, except for differences in the intercept (country-specific effects).

INSERT TABLE 2 ABOUT HERE

[6] In a linear model results from the growth (log differenced) model and the production function model are identical.

Since prices of capital and labor are not available we focus on the contribution of variable inputs (*X*) as well as the other covariates (*Z*) on the GDP growth rate[7], i.e., the estimates of $\beta_j(X,Z,t)$ and $\gamma_q(X,Z,t)$. Once the values of $\beta_j(.)$ are obtained, the contribution of variable inputs (*X*) on the total factor productivity (TFP) growth can be derived from $(RTS-1)M_j\dot{X}_j$ where $RTS=\sum\beta_j(X,Z,t)$ and $M_j=\beta_j(X,Z,t)/RTS$. Thus, no additional information is required to compute the impact of capital and labor (the variables inputs in this study) on the TFP growth. It can be seen from Table 2 that the most important factor behind GDP/TFP growth is technical change (hereafter TC). Its contribution, on average, for all the countries is 1.72% per year. There is, however, substantial variation from country to country. Average TC for the developed, African, Asia and the Pacific, South American and Middle Eastern countries as a group are 2.39%, 1.22%, 0.78%, 1.69% and 2.43%, respectively. Contributions of capital and labor to GDP growth ($\beta_j(X,Z,t)$ for $j=$ capital and labor) are in general positive. The mean values of $\beta_j(X,Z,t)$ for $j=$ labor for the developed, African, Asia and the Pacific, South American and Middle Eastern countries as a group are 0.71%, 1.39%, 2.18%, 1.13% and 1.56%, respectively. The mean values of $\beta_j(X,Z,t)$ for capital for these countries are 0.97%, 1.42%, 2.45%, 1.34% and 1.79%, respectively. Since *RTS* is found to be less than unity, the contributions of labor and capital to *TFP* growth (computed from $(RTS-1)M_j\dot{X}_j$) will be negative.

However, the focus of the present paper is the financial sector development index (FSDI), and, thus, we now turn to the impact of FSDI on GDP growth. Since the GDP variable in (10) is measured in percentage change and the FSDI variable is an index, we interpret the contribution of

[7] Note that the contribution of the Z variables on GDP growth rate as well as the total factor productivity growth rates is the same. Similar is the case with technical change and the residual components. Since the meaning of GDP growth rate is more transparent than the total factor productivity growth, we interpret our results in terms of the former. Also note that in order to give a total factor productivity growth interpretation we need to make the assumption that input markets are competitive and allocation of inputs is efficient (i.e. no distortions and allocative errors).

FSDI to GDP growth as follows. Since the mean value of $\gamma_q(X,Z,t)$ for FSDI for all the countries combined is .09, a 10-percentage point change in FSDI increases GDP growth by .9 percent. A substantial variation is found across countries. The mean values for the developed, African, Asia and the Pacific, South American and Middle Eastern countries as a group are -0.05, 0.10, 5.25, 0.01 and 1.91, respectively. Thus, a 10-percentage point change in FSDI decreases GDP growth by 0.5 percent in the developed countries. On the other hand, a 10-percentage point change in FSDI increases GDP growth by 1 percent in the African countries and 5.25 percent in the countries in Asia and the Pacific region. The effect of FDI is found to be negative for all countries taken together. It is the highest (-0.15) for the developed countries. This finding is in line with the empirical findings of recent studies on FDI (though at the firm level), which seem to suggest that FDI may not generate spillover effects in host countries (see section 1 for details).

Turning to the impact of the other measure of openness used in the paper, namely terms of trade (TOT), our findings clearly suggest that a 10 percentage point change in TOT increases GDP growth by 0.4 percent for all the countries together. Government expenditure has a clear negative effect (and of a large magnitude) on GDP growth and finally inflation affects total factor productivity positively with a 10 percentage point change increasing GDP growth by 0.8 percent.

INSERT TABLE 3 ABOUT HERE

The assumption that the production technology is the same for all countries, except for the intercepts) might not be appropriate. To avoid this misspecification problem we estimate the production technology separately for the developed, African, Asia and the Pacific, and the South American countries.[8] In each case we control for fixed country-specific effects. The results are reported in Table 3. Some results are different while others are somewhat similar. For example, the estimates of TC for the developed countries are quite similar, while for the African and South

[8] Since there are only two countries in the Middle East group, we decided not to estimate a separate production function for these two countries.

American countries estimates of TC are negative. Similarly, the sign as well as the magnitude of the FSDI coefficients, except for the South American countries, are remarkably similar. For the developed country group a 10 percentage point increase in FSDI will decrease GDP growth by 0.5 percent. This is an interesting finding suggesting that a developing country is likely to benefit more (in terms of productivity growth) from financial sector development than a developed economy with well-functioning financial institutions. The signs of the other variables remain remarkably similar to the same technology case for both the developed and developing country groups except for the terms of trade coefficient which has now a negative sign for the developing country group (suggesting that openness may be harmful for GDP growth in the case of developing countries). Grouping countries in terms of geographic location reveals a similar positive effect of financial sector development on GDP growth as in the case of the African country group above, however, now the magnitude of the impact varies substantially among regions with the largest magnitude documented in the Asia and the Pacific group and the smallest one in the South America group of countries. It is also interesting that the coefficients for government expenditure and FDI are now positive in the case of the South America group as compared to the negative sign reported for the other regions.

4.2 Results from the factor-augmenting model

We now turn to empirical findings based on the factor-augmenting model (Table 4). As mentioned before the idea behind this approach is that the Z variables are not standard inputs like capital and labor but they can enhance productivity of labor and capital. Thus, the results from the factor-augmenting model should complement those from the standard production function models. Results from the factor-augmenting model in (14) and (15) are reported in Table 4. Here we assume that a single relationship holds for all countries, except for country-specific effects in the intercepts. A standard F test shows that the factor augmentations are not constant – they vary with *X*, *Z*, and *t*. Estimates of TC are found to be lower for all groups of countries (except for the Asia and the Pacific group), as compared to those from the standard production function model (reported in Table 2). Similarly, the contribution of labor is found to be much lower as compared to the standard production function model. The same applies to capital. This type of result is expected because the impact of the Z variables on productivity growth is now transmitted through the variable inputs labor and capital.

We now return to the central variable in the paper i.e. the financial sector development index FSDI. It shows a clear positive effect on GDP growth (i.e. a 10 percentage-point change increases productivity growth by 1.26 percent), a finding that remains stable when we group countries either in terms of level of development or geographic location.

INSERT TABLE 4 ABOUT HERE

Another interesting finding is the positive (though of negligible magnitude) impact of FDI on GDP growth in all country groups and the positive impact of the openness indicator, OTR, in all country classifications. Turning to the impact of inflation on GDP growth, Table 4 clearly shows that it is now negative in all country groups although of a very small magnitude. Finally, the government expenditure coefficient is now positive (around 0.32).

Some of these results differ substantially from those based on the standard production function. Since the factor-augmenting model is not a special case of the standard production model, one can not perform a nested test (F or likelihood ratio) to determine the appropriate functional form. Given that the Z variables are not direct inputs in the production process, but they affect productivity of the traditional inputs (labor and capital), we argue that the factor-augmenting approach is perhaps better suited for analyzing the present problem. The results from the factor-augmenting model are more intuitive. For example, FDI and FSDI are expected to complement capital thereby contributing positively to output growth. This is true in the factor-augmenting model for all groups of countries. Similarly, inflation is supposed to affect output growth adversely. This is documented in the factor-augmenting model for all country groups. Results from the standard production function models (Tables 2 and 3) do not support these conventional wisdoms.

It is often argued that results depend on how one defines FSDI. Note that we used the first principal component of the three financial indicators, viz., PCR, CMB, and LQ. To examine robustness of the results, we used an alternative definition, that is,

$$FSDI = \alpha_1 PCR + \alpha_2 CMB + (1 - \alpha_1 - \alpha_2) LQ$$

where α_1 and α_2 are the unknown parameters to be estimated along with the parameters of the production function. Magnitudes of these parameters are weights attached to the respective financial indicators. Note that this specification makes the model non-linear in the parameters, and all the parameters are estimated simultaneously. Results using this alternative definition of FSDI from the standard production model are reported in Table 5. A comparison between Tables 2 and 5 shows that results are quite similar so far as TC, contributions of labor and capital are concerned. Looking at the country group means for FSDI we observe some differences. The contribution of FSDI is found to be much larger and positive (at the mean) when the alternative definition is used. Similarly, the negative contribution of FDI is found to be much weaker when the alternative definition of FSDI is used. One could also see some minor differences in the contributions of government expenses, OTR, and inflation in these two alternative specifications of FSDI.

INSERT TABLES 5 AND 6 ABOUT HERE

Now we examine the robustness issue with respect to the alternative definition of FSDI in light of the factor-augmenting model for which the results are reported in Table 6. A comparison of results reported in Tables 4 and 6 show close similarity as far as TC and contributions of capital and labor are concerned. With the new definition of FSDI, its contribution is much larger for all country groups. This is what we found for the standard production function model as well. Contributions of other components are found to be quite robust to the alternative definition.

5. Concluding Remarks

The paper focused on an important economic relationship namely the impact of financial sector development (broadly defined to include different measures of the activity and the size of financial intermediaries) on productivity growth by a employing a large dataset of 65 countries, varying substantially in terms of level of development and geographic location, spanning the period 1961-1999. Empirical results obtained from the estimation of two different empirical models regarding the measurement of productivity growth seem to confirm *a priori* expectations about the overall positive influence of financial systems on productivity in line with previous work on this front.

We also found that productivity growth depends crucially on the stage of economic development. That is, a less developed country is likely to benefit more (in terms of output growth rate) from development of financial institutions than a developed economy that has well-functioning and sound financial institutions. This seems to confirm recent findings by Mavrotas and Son (2005) who, by using a similar dataset (within the context of the finance-growth nexus), seem to suggest that the effect of financial sector development in developing countries is more persistent and larger than those in industrial countries. The results seem to be robust with respect to alternative definitions of FSDI. The positive effect of FSDI on productivity growth is confirmed in terms of both the standard production function and factor-augmenting modeling approaches.

Table 2: Empirical results from the standard production function model

Label	Mean	Std. Dev	Minimum	Maximum
ALL COUNTRIES				
TC	1.7230622	1.4314054	-7.6674800	6.4562461
comp_labor	1.2471069	0.9992102	-7.7245371	7.4071055
comp_capital	1.3799202	5.4276002	-77.7626978	132.6835034
comp_fsdi	0.0902512	1.7432779	-42.8150243	11.6801622
comp_govt exp	-0.2339086	3.2465422	-82.0192171	17.8920584
comp_fdi	-0.0598560	2.0159033	-62.9049405	22.5246565
comp_otr	0.0435468	2.5378577	-24.5974077	91.7873270
comp_inflation	0.0868625	1.7895685	-13.5347138	54.4816035
GDP growth	4.0257724	4.8609316	-69.5255878	51.9542030
Residual	-0.0773472	7.2141947	-132.2822122	68.6798174
DEVELOPED				
TC	2.3881324	1.2838849	-1.1683285	6.2905564
comp_labor	0.7058739	0.7247746	-1.0849679	3.7952328
comp_capital	0.9712136	2.2700766	-7.6846901	13.9803674
comp_fsdi	-0.0547910	2.1938593	-42.8150243	11.6801622
comp_govt exp	-0.1740417	1.1540813	-8.9086841	12.8731527
comp_fdi	-0.1475717	1.7294026	-21.7231758	22.5246565
comp_otr	0.0517770	1.3055272	-12.0136092	6.4281266
comp_inflation	0.0675916	0.5829531	-3.5379224	3.8293532
GDP growth	3.9117751	3.2473256	-19.9539186	19.5661705
Residual	0.1853308	3.1473222	-11.7215605	44.3650666
AFRICA				
TC	1.2175579	1.1990945	-1.3191238	5.4345994
comp_labor	1.3926018	0.8439520	-7.7245371	7.4071055
comp_capital	1.4205390	8.0192270	-77.7626978	132.683503
comp_fsdi	0.0967689	1.1717961	-8.4610956	7.2850918
comp_govt exp	-0.3065358	4.3502871	-82.0192171	9.5611441
comp_fdi	-0.0997332	2.9379957	-62.9049405	13.4881448
comp_otr	-0.0849831	2.2912614	-18.0911978	21.2639893
comp_inflation	0.0453059	1.8370266	-12.9717198	14.3482457
GDP growth	3.0114134	7.1579383	-69.5255878	51.9542030
Residual	-0.8802261	10.5974667	-132.2822122	68.6798174
ASIA AND THE PACIFIC				
TC	0.7857571	1.2483917	-7.6674800	6.4562461
comp_labor	2.1836784	1.1202688	0.1718262	4.5145275
comp_capital	2.4558795	8.3330036	-19.8415344	118.3342270
comp_fsdi	0.5255424	2.0966871	-20.1453961	9.5870345
comp_govt exp	-0.6267892	5.5839206	-78.7873641	17.8920584
comp_fdi	-0.0343305	0.7309984	-9.4650780	3.0150248
comp_otr	0.3665246	4.9901111	-12.0482898	91.7873270
comp_inflation	0.2420452	3.4989525	-13.5347138	54.4816035
GDP growth	5.4839856	4.3660673	-13.6961946	24.6997236
Residual	0.0886522	9.8333263	-107.7265874	42.5609285

Table 2 continues

Table 2 (con'd)

SOUTH AMERICA

TC	1.6923593	1.3643653	-2.4199129	4.1935882
comp_labor	1.1353568	0.8297097	0.000383527	3.3495599
comp_capital	1.3402734	3.3996177	-17.6397619	16.185629
comp_fsdi	0.0065360	0.9548353	-7.3730052	5.0616020
comp_govt exp	0.0263287	1.9671719	-18.2374833	15.4657473
comp_fdi	0.1214476	1.9361492	-10.1739143	22.0577787
comp_otr	-0.0379961	1.7248753	-24.5974077	7.8368469
comp_inflation	0.0653324	1.3716542	-9.0898208	16.7428978
GDP growth	4.1345796	4.2474055	-14.3638340	21.5358304
Residual	0.2675233	4.3447900	-24.0127644	15.9521559

MIDDLE EAST

TC	2.4349466	1.7813039	-1.0178532	5.2569918
comp_labor	1.5658028	0.2980453	0.9776340	2.1427032
comp_capital	1.7882103	3.6224623	-4.6461089	17.7008221
comp_fsdi	0.1914242	1.1040531	-2.6932691	3.4537585
comp_govt exp	-0.2648654	0.9556841	-2.1254078	3.0500614
comp_fdi	-0.1049428	1.5433747	-6.1569592	7.5642152
comp_otr	-0.1353309	1.9656297	-5.1543150	7.4036646
comp_inflation	0.0045854	0.6009572	-2.8258210	1.5458643
GDP growth	4.9487144	4.1595314	-5.9477259	13.6515301
Residual	0.4769381	6.1422191	-15.0565261	15.8470215

Table 3: Empirical results based on estimating each group of countries separately

Label	Mean	Std Dev	Minimum	Maximum
DEVELOPED				
TC	1.9809876	0.5479028	0.3598739	3.4921902
comp_labor	0.2212992	0.1818998	-0.4839714	1.1226895
comp_capital	1.9646769	3.9974210	-23.5074462	23.8256259
comp_fsdi	-0.0408594	1.6777959	-35.6701242	11.2585105
comp_govt exp	-0.0654075	0.7084500	-6.6975272	2.8546823
comp_fdi	-0.0540792	1.6765257	-11.0958431	26.7785847
comp_otr	0.0461478	0.8409297	-4.9861583	6.7681701
comp_inflation	-0.0421874	0.5884847	-5.6740054	5.2950729
GDP growth	3.9117751	3.2473256	-19.9539186	19.5661705
Residual	-0.0988028	3.6844229	-29.6455068	33.5423939
AFRICA				
TC	-1.1722390	4.0436037	-9.5360098	10.1390588
comp_labor	3.9709897	3.2091045	-9.9873808	12.1747823
comp_capital	2.1889083	10.0213834	-27.6269641	169.5666667
comp_fsdi	0.0582476	1.6974238	-17.1698460	8.2158972
comp_govt exp	1.0803697	17.1946118	-14.1682947	310.7426356
comp_fdi	0.1364250	3.1368934	-45.2522756	20.7396568
comp_otr	-0.0530656	5.4687620	-62.0489580	25.5333159
comp_inflation	0.2062665	3.1662286	-21.8519901	33.9103051
GDP growth	3.0114134	7.1579383	-69.5255878	51.9542030
Residual	-0.6772901	8.1182803	-46.5368372	49.0423586
ASIA AND THE PACIFIC				
TC	1.5986334	1.4564068	-3.0160198	9.9193774
comp_labor	2.4620472	0.9687233	0.5591036	5.1216537
comp_capital	1.8080414	5.2339565	-35.1056142	57.3091902
comp_fsdi	0.5447061	4.6938673	-41.4487948	28.9300024
comp_govt exp	-0.1909776	7.2985576	-77.5472896	87.0432632
comp_fdi	0.5816589	3.3578802	-11.5626321	42.0396312
comp_otr	-0.6957350	6.8468471	-88.8336610	52.5783421
comp_inflation	0.2416159	4.9757680	-41.1445383	57.9311190
GDP growth	5.4839856	4.3660673	-13.6961946	24.6997236
Residual	-0.0710412	10.4610140	-53.0463028	98.4485386
SOUTH AMERICA				
TC	-1.3033771	1.3398756	-5.2991595	1.4829007
comp_labor	3.6343187	1.8387057	0.1020631	10.4915530
comp_capital	1.6793002	3.9652608	-14.9436633	25.4136791
comp_fsdi	0.0503387	1.6872040	-18.8509454	10.2210130
comp_govt exp	0.1878347	2.5494866	-11.1936354	19.3511968
comp_fdi	-0.5823213	4.6728767	-40.6697289	17.6892701
comp_otr	-0.0019206	3.0297017	-22.7143802	16.9620601
comp_inflation	0.0929794	2.8226921	-13.3331589	22.3684064
GDP growth	4.1345796	4.2474055	-14.3638340	21.5358304
Residual	0.6270859	6.7057967	-18.9479671	48.0750678

Table 4: Empirical results from the factor-augmenting model

Label	Mean	Std Dev	Minimum	Maximum
TC	1.3729829	0.9564126	-2.3678750	3.5020288
comp_labor	0.5746097	0.3424443	-0.5299020	1.6528625
comp_capital	0.1630520	0.1354050	-0.2085164	0.5645891
comp_fsdi	0.1265543	0.0786396	0.0044670	0.3712103
comp_govt exp	0.3307761	0.1790461	0.0233712	0.8771256
comp_fdi	0.0015499	0.0010764	0.000014972	0.0055520
comp_otr	0.1235086	0.0730826	0.0059534	0.3219373
comp_inflation	-0.000537977	0.000458434	-0.0025311	0.000107057
GDP growth	4.0257724	4.8609316	-69.5255878	51.9542030
Residual	0.2005874	6.5360839	-144.1980283	50.5334971
DEVELOPED				
TC	1.7831016	0.8386366	-0.5180358	3.5020288
comp_labor	0.5960832	0.3838861	-0.5299020	1.4522731
comp_capital	0.1494119	0.1355740	-0.0973902	0.5645891
comp_fsdi	0.1261115	0.0790462	0.0044670	0.3426420
comp_govt exp	0.3206583	0.1697221	0.0265866	0.8663410
comp_fdi	0.0015589	0.0011081	0.000014972	0.0050566
comp_otr	0.1224990	0.0724603	0.0059534	0.2998951
comp_inflation	-0.000549737	0.000485386	-0.0022717	0.000107057
GDP growth	3.9117751	3.2473256	-19.9539186	19.5661705
Residual	0.7575121	2.8071810	-16.1196064	13.6669246
AFRICA				
TC	0.9046253	0.8988802	-1.2121245	2.7764094
comp_labor	0.5428044	0.2352651	0.0354143	1.1537544
comp_capital	0.1776860	0.1093026	-0.0997917	0.3995127
comp_fsdi	0.1252270	0.0759487	0.0076934	0.3069630
comp_govt exp	0.3370894	0.1744320	0.0278939	0.7808150
comp_fdi	0.0015180	0.0010075	0.000078869	0.0041710
comp_otr	0.1228436	0.0715258	0.0080099	0.2830699
comp_inflation	-0.000517441	0.000406772	-0.0016949	-3.715901E-7
GDP growth	3.0114134	7.1579383	-69.5255878	51.9542030
Residual	-0.8944332	9.9703385	-144.1980283	49.0760426
ASIA AND THE PACIFIC				
TC	1.5342596	0.7762007	-2.3678750	3.3382055
comp_labor	0.7840386	0.4007073	0.0420187	1.6528625
comp_capital	0.1148263	0.1782410	-0.1625110	0.4597357
comp_fsdi	0.1466456	0.0880729	0.0089338	0.3712103
comp_govt exp	0.3430735	0.2000242	0.0272616	0.8771256
comp_fdi	0.0018606	0.0012253	0.000073176	0.0055520
comp_otr	0.1405250	0.0812560	0.0101723	0.3219373
comp_inflation	-0.000684613	0.000535022	-0.0025311	-3.633013E-6
GDP growth	5.4839856	4.3660673	-13.6961946	24.6997236
Residual	0.3654147	8.5455046	-99.5143980	50.5334971

Table 4 continues

Table 4 (con't)

Label	Mean	Std Dev	Minimum	Maximum
SOUTH AMERICA				
TC	1.0434303	1.0015173	-1.2842143	2.7766549
comp_labor	0.4488870	0.2471884	-0.0779682	1.3961169
comp_capital	0.1963589	0.1190849	-0.2085164	0.4011789
comp_fsdi	0.1161277	0.0714537	0.0065595	0.2916162
comp_govt exp	0.3299166	0.1820087	0.0233712	0.8139512
comp_fdi	0.0013799	0.000943723	0.000050061	0.0041474
comp_otr	0.1150335	0.0678299	0.0076159	0.2879327
comp_inflation	-0.000453471	0.000386691	-0.0019927	8.0793037E-7
GDP growth	4.1345796	4.2474055	-14.3638340	21.5358304
Residual	0.1927939	4.5291128	-22.2082334	23.2262210
MIDDLE EAST				
TC	1.4647263	0.8190107	-0.3177249	2.9440735
comp_labor	0.3883824	0.1540386	0.1708701	0.6184459
comp_capital	0.2249576	0.0360777	0.1338321	0.2827457
comp_fsdi	0.1143514	0.0748139	0.0066290	0.2896537
comp_govt exp	0.3493699	0.1876498	0.0262874	0.6919269
comp_fdi	0.0013194	0.000935812	0.000066792	0.0036521
comp_otr	0.1148526	0.0723308	0.0070469	0.2784851
comp_inflation	-0.000409234	0.000339121	-0.0013305	-0.000014536
GDP growth	4.9487144	4.1595314	-5.9477259	13.6515301
Residual	0.9605645	5.3480605	-13.3749071	16.6354788

Table 5: Empirical results from the standard production function model with an alternative definition of FSDI

Label	Mean	Std Dev	Minimum	Maximum
ALL COUNTRIES				
TC	1.7209370	1.3674783	-2.8278559	5.8301351
comp_labor	1.1589663	0.9524816	-7.1460261	6.0776133
comp_capital	1.4210378	5.4282495	-80.0974100	134.4266403
comp_fsdi	0.4893206	3.3880755	-112.2816611	35.2404879
comp_govt exp	-0.2628218	3.5755706	-126.0861497	21.7193804
comp_fdi	-0.0186875	1.5562879	-60.1936608	10.7667326
comp_otr	0.1560437	1.7773556	-16.2744448	33.7098243
comp_inflation	0.0703105	3.5244188	-30.4182087	149.6781008
GDP growth	4.0257724	4.8609316	-69.5255878	51.9542030
Residual	-0.4055988	7.6751515	-94.4355304	113.0085068
DEVELOPED				
TC	2.3824701	1.1445920	-0.6123761	5.8301351
comp_labor	0.6544532	0.6777996	-1.0206034	3.5988262
comp_capital	0.9578644	2.2995890	-10.4622580	14.9224202
comp_fsdi	0.6137233	4.7420118	-112.2816611	35.2404879
comp_govt exp	-0.1949228	1.5078523	-14.1597966	21.7193804
comp_fdi	-0.0496972	1.0686735	-13.4041869	10.7667326
comp_otr	0.0654008	0.6643739	-4.4339985	3.8880299
comp_inflation	-0.0066081	0.4827331	-8.9410560	6.6484389
GDP growth	3.9117751	3.2473256	-19.9539186	19.5661705
Residual	-0.3159821	5.4677322	-26.2682582	113.0085068
AFRICA				
TC	1.2233565	1.3469081	-2.8278559	4.7218419
comp_labor	1.3120113	0.8069781	-7.1460261	6.0776133
comp_capital	1.5891896	8.3238423	-80.0974100	134.4266403
comp_fsdi	0.2906822	1.8374135	-6.9226440	9.3825295
comp_govt exp	-0.4293935	5.9598580	-126.0861497	9.8325361
comp_fdi	-0.0720776	2.6849982	-60.1936608	8.0607232
comp_otr	0.1530027	2.3123760	-16.2744448	17.7327638
comp_inflation	-0.0336219	1.6386159	-30.4182087	8.0077529
GDP growth	3.0114134	7.1579383	-69.5255878	51.9542030
Residual	-0.8439618	10.2572473	-71.4668817	110.7089232
ASIA AND THE PACIFIC				
TC	0.8055303	1.1452454	-2.0104040	4.5362776
comp_labor	2.0520895	1.0993747	0.2666651	4.3248811
comp_capital	2.4189103	7.8141986	-15.5497001	106.6971435
comp_fsdi	0.9887743	3.2139108	-27.0990890	16.1867319
comp_govt exp	-0.5399732	4.5846576	-58.7812213	18.5068242
comp_fdi	-0.0186789	0.6243619	-7.4026008	3.4786240
comp_otr	0.3586440	2.3639961	-10.3741017	33.7098243
comp_inflation	0.5433436	8.6536554	-25.1302567	149.6781008
GDP growth	5.4839856	4.3660673	-13.6961946	24.6997236
Residual	-0.6468466	10.5201815	-94.4355304	51.9385101

Table 5 continues

Table 5 (con'd)

Label	Mean	Std Dev	Minimum	Maximum
SOUTH AMERICA				
TC	1.6893948	1.2262897	-1.5736549	4.2638582
comp_labor	1.0235305	0.7704192	0.0013600	3.0850989
comp_capital	1.4325703	3.6421794	-18.6127166	17.1085160
comp_fsdi	0.1345641	1.7040130	-9.3435555	10.7357449
comp_govt exp	-0.0057871	1.5207472	-12.4170913	9.3970358
comp_fdi	0.0889882	1.0885899	-5.1114846	7.8730854
comp_otr	0.1798486	1.9609630	-6.4625228	30.9777813
comp_inflation	-0.0075668	1.0532888	-12.4589511	6.6935760
GDP growth	4.1345796	4.2474055	-14.3638340	21.5358304
Residual	0.0875452	4.5291096	-34.0907659	16.9158371
MIDDLE EAST				
TC	2.2499001	1.7002497	-0.8661844	5.2219263
comp_labor	1.3796027	0.2654769	0.8447201	1.8682760
comp_capital	1.8100612	3.7139633	-4.7028461	17.2983544
comp_fsdi	0.4815641	1.8092486	-5.1708587	5.2050623
comp_govt exp	-0.2615143	1.2686455	-2.9914625	3.8817725
comp_fdi	-0.0027282	0.9303341	-2.9793235	4.6658010
comp_otr	0.0947665	1.5811712	-4.8275414	6.8863371
comp_inflation	-0.0339958	0.2918205	-0.8466381	0.8229576
GDP growth	4.9487144	4.1595314	-5.9477259	13.6515301
Residual	-0.0000180	5.9579787	-14.9828805	14.1209441

Table 6: Empirical results from the factor-augmenting model with an alternative definition of FSDI

Label	Mean	Std Dev	Minimum	Maximum
ALL COUNTRIES				
TC	1.3718503	1.0230565	-1.9751614	3.7680630
comp_labor	0.6196674	0.4102627	-0.6498069	1.8910839
comp_capital	0.1606408	0.1246716	-0.1480301	0.5143946
comp_fsdi	0.2750725	0.1868528	0.0028586	0.9801129
comp_govt exp	0.2836088	0.2298126	-0.4211287	1.3698552
comp_fdi	0.000825008	0.0026941	-0.0091883	0.0149671
comp_otr	0.0962500	0.0606859	0.0026871	0.2967878
comp_inflation	0.000423022	0.000252303	0.000018315	0.0011264
GDP growth	4.0257724	4.8609316	-69.5255878	51.9542030
Residual	0.2012001	7.8296657	-141.3237538	131.0178294
DEVELOPED				
TC	1.9401752	0.8264115	-0.0570462	3.7680630
comp_labor	0.6381244	0.4734914	-0.6498069	1.6535771
comp_capital	0.1497338	0.1301420	-0.0826034	0.5143946
comp_fsdi	0.2742243	0.1923711	0.0028586	0.8940862
comp_govt exp	0.2680674	0.2426079	-0.2834672	1.3698552
comp_fdi	0.000945681	0.0030665	-0.0091883	0.0128074
comp_otr	0.0954802	0.0612324	0.0026871	0.2739849
comp_inflation	0.000417816	0.000250007	0.000018315	0.0010543
GDP growth	3.9117751	3.2473256	-19.9539186	19.5661705
Residual	0.5752754	2.8227846	-15.7047738	13.7849511
AFRICA				
TC	0.8303226	1.0590964	-1.9751614	2.7574842
comp_labor	0.5798151	0.2730857	-0.1674330	1.2357791
comp_capital	0.1753346	0.0979508	-0.0750912	0.3756619
comp_fsdi	0.2691480	0.1703882	0.0135962	0.7343763
comp_govt exp	0.3038392	0.1896309	0.0098291	0.9423317
comp_fdi	0.000585964	0.0018977	-0.0044362	0.0069333
comp_otr	0.0950262	0.0570022	0.0051744	0.2388073
comp_inflation	0.000420919	0.000242477	0.000024350	0.000986159
GDP growth	3.0114134	7.1579383	-69.5255878	51.9542030
Residual	-0.8225226	11.1090839	-141.3237538	58.3463560
ASIA AND THE PACIFIC				
TC	1.1839684	0.7606490	-1.1601436	3.1897655
comp_labor	0.9183452	0.4385497	0.1707660	1.8910839
comp_capital	0.1029320	0.1595796	-0.1480301	0.3839855
comp_fsdi	0.3449151	0.2154096	0.0176560	0.9801129
comp_govt exp	0.2255092	0.2608936	-0.4211287	0.9460416
comp_fdi	0.0021275	0.0032688	-0.0026131	0.0149671
comp_otr	0.1164933	0.0690533	0.0074215	0.2967878
comp_inflation	0.000495815	0.000283497	0.000036179	0.0011264
GDP growth	5.4839856	4.3660673	-13.6961946	24.6997236
Residual	0.6401060	11.7425890	-93.1877652	131.0178294

Table 6 continues

Table 6 (con'd)

SOUTH AMERICA

TC	1.0785330	0.9980314	-1.5599564	3.1494236
comp_labor	0.4520933	0.2595080	-0.0673770	1.3017448
comp_capital	0.1958720	0.1002867	-0.1129473	0.3609338
comp_fsdi	0.2396711	0.1593541	0.0098619	0.6893678
comp_govt exp	0.3185843	0.2177197	-0.3782089	0.8960680
comp_fdi	0.000118359	0.0019643	-0.0035229	0.0105943
comp_otr	0.0861673	0.0538709	0.0046261	0.2400189
comp_inflation	0.000387596	0.000232350	0.000024864	0.0010503
GDP growth	4.1345796	4.2474055	-14.3638340	21.5358304
Residual	0.2242864	5.9581441	-36.4112822	46.5642045

MIDDLE EAST

TC	1.5701206	0.8313597	0.1964770	2.8760007
comp_labor	0.3863969	0.2834589	0.0342288	0.7341378
comp_capital	0.2217420	0.0306954	0.1537877	0.2717925
comp_fsdi	0.2307282	0.1726412	0.0100381	0.6692097
comp_govt exp	0.3628182	0.1816592	0.0278835	0.6985736
comp_fdi	-0.000357538	0.0013875	-0.0020609	0.0036094
comp_otr	0.0847617	0.0590554	0.0040778	0.2280121
comp_inflation	0.000388065	0.000255373	0.000020102	0.000978408
GDP growth	4.9487144	4.1595314	-5.9477259	13.6515301
Residual	0.9975294	5.6626023	-15.6348250	18.0919811

References

Atje, R. and Jovanovic, B. (1993), "Stock Markets and Development", *European Economic Review*, 37, pp.632-640.

Arestis, P. and Demetriades, P. (1997), "Financial Development and Economic Growth: Assessing the Evidence", *Economic Journal*, vol.107 (May), pp.783-99.

Arestis, P., Demetriades P. and K. Luintel (2001), "Financial Development and Economic Growth: The Role of Stock Markets", *Journal of Money, Credit and Banking*, Vol. 33, pp. 16-41.

Asiedu, E. (2002), "On the Determinants of Foreign Direct Investment to African Countries: Is Africa Different?", *World Development*, 30, pp. 107-19.

Bandiera, O., G. Caprio, P. Honohan, and F. Schiantarelli, (2000), "Does Financial Reform Raise or Reduce Saving?", *The Review of Economics and Statistics*, May, 82(2), pp.239-263.

Beck, T. and R. Levine (2004), "Stock Markets, Banks and Growth: Panel Evidence", *Journal of Banking and Finance*, vol. 28, pp. 423-442.

Beck, T., A. Demirguc-Kunt and R. Levine (2000**)**, "A New Database on the Financial Development and Structure", *World Bank Economic Review,* Vol. 14, pp. 597-605.

Beck, T., R. Levine and N. Loayza (2000), "Finance and the Sources of Growth", Journal of Financial Economics, Vol. 58, pp. 261-300.

Beckmann, M. J. and Sato, R. (1969), Aggregate Production Functions and Types of Technical Progress: A Statistical Analysis, *American Economic Review*, 59, 88-101.

Bencivenga, V.R. and B.D. Smith (1991), "Financial Intermediation and Endogenous Growth", *Review of Economic Studies*, Vol. 58, pp. 195-209.

Bencivenga, V.R., B.D. Smith and R. Starr (1995), "Transaction Costs, Technological Choice and Endogenous Growth", *Journal of Economic Theory*, Vol. 67, pp. 53-117.

Blomstrom, M. and A. Kokko (1998), "Multinational Corporations and Spillovers", *Journal of Economic Surveys*, 12, pp. 247-77.

Carkovic, M. and R. Levine (2003), "Does Foreign Direct Investment Accelerate Economic Growth?" Working Paper, University of Minnesota.

Chakrabarti, A. (2001), "The Determinants of Foreign Direct Investment: Sensitivity Analysis of Cross-Country Regressions", *KYKLOS*, 54, pp. 89-114.

Demirguc-Kunt, A. and R. Levine (eds.) (2001), *Financial Structure and Economic Growth*, Cambridge, Mass: MIT Press.

de Mello, L. (1997), “Foreign Direct Investment in African Countries and Growth: A Selective Survey”, *Journal of Development Studies*, 34, pp. 1-34.

de Mello, L. (1999), “Foreign Direct Investment Led Growth: Evidence from Time-Series and Panel Data”, *Oxford Economic Papers*, 51, pp. 133-51.

Fry, M.J. (1988), *Money, Interest, and Banking in Economic Development*, Baltimore and London: Johns Hopkins University Press.

Green, C.J. and C. Kirkpatrick (2002), “Finance and Development: An Overview of the Issues”, *Journal of International Development*, vol. 14, No.2, pp.207-210.

Gorg, H. and D. Greenaway (2004), “Much Ado about Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment?”, World Bank Research Observer, 19:171-197.

Hanson, G. (2001) “Should Countries Promote Foreign Direct Investment?” UNCTAD: G-24 Discussion Paper Series, No. 9, February.

Hermes, N. and Lensink, R. (eds.) (1996), *Financial Development and Economic Growth: Theory and Experience from African Countries*, Routledge Studies in Development Economics.

King, R.G. and R. Levine (1993), “Finance and Growth: Schumpeter Might be Right”, *Quarterly Journal of Economics*, 108, pp. 717-38.

Kumbhakar, S.C. (2000), Estimation and Decomposition of Productivity Change When Production is not Efficient: A Panel Data Approach, *Econometric Reviews*, 19, 2000, pp.425-460.

Kumbhakar, S.C. (2002), Decomposition of Technical Change into Input-Specific Components: A Factor-Augmenting Approach, *Japan and the World Economy*, 14, 243-264.

Kumbhakar, S.C. (2004), Estimation of Factor-augmenting Technical Change: The Case of US Agriculture, *Indian Economic Review*, volume 39, pp. 31-54.

Kumbhakar, S.C. (2005), Productivity and efficiency measurement using parametric econometric methods, in Bagella, Becchetti, and Hasan (eds.) *Transparency, Governance and Markets*, forthcoming, Elsevier Publishers.

Levine, R. and S. Zervos (1998), “Stock Markets, Banks and Economic Growth”, *American Economic Review*, Vol.88, pp. 537-558.

Mavrotas, G. and S. Son (2005), “Financial Sector Development and Growth: Re-examining the Nexus”, in M. Bagella, L. Becchetti and I. Hasan (eds.) *Transparency, Governance and Markets*, forthcoming, Elsevier Publishers.

Mody, A. and A. Murshid (2002), “Growing Up with Capital Flows”, IMF Working Paper WP/02/75, IMF: Washington DC.

Neusser, K. and M. Kugler (1998), “Manufacturing Growth and Financial Development: Evidence from OECD Countries”, *Review of Economics and Statistics*, pp. 638-646.

Rousseau, P. (1998), “The Permanent Effects of Innovation on Financial Depth: Theory and US Historical Evidence from Unobservable Components Models”, *Journal of Monetary Economics*, vol.42, pp. 387-425.

Rousseau, P. and P. Wachtel (2000), “Equity Markets and Growth: Cross-country Evidence on Timing and Outcomes, 1980-1995”, *Journal of Banking and Finance*, vol.24, pp. 1933-1957.

Sato, R. and Beckmann, M. J. (1968), Neutral Inventions and Production Functions, *Review of Economic Studies*, 35, 57-66.

Singh, A. (1997), “Financial Liberalization, Stock Markets and Economic Development”, *Economic Journal*, vol.107, pp. 771-782.

Tsai, P. (1994), “Determinants of Foreign Direct Investment and Its Impact on Economic Growth”, *Journal of Economic Development*, 19, pp. 137-63.

Wachtel, P. (2004), “How Much Do We Really Know About Growth and Finance?”, *Research in Banking and Finance*, vol. 4, pp.91-113.

Wachtel, P. and P. Rousseau (1995), “Financial Intermediation and Economic Growth: A Historical Comparison of the US, UK and Canada” in M. Bordo and R.S. Irwin (eds), *Anglo-American Finance*.

World Bank (2001), *Finance for Growth: Policy Choices in a Volatile World*, New York: Oxford University Press.