SOAS University of London

Centre for Global Finance

Working Paper Series

No.7 / 2021

The impact of ICT and mobile money on inclusive growth and financial development. Is Africa different?

By Ahmad Hassan Ahmad, Christopher J. Green, Fei Jiang, and Victor Murinde

The Centre for Global Finance (CGF) Working Paper Series features recent studies by resident members of CGF as well as visiting researchers, altogether demonstrating the depth and breadth of research being undertaken at CGF. The papers are published to facilitate preliminary dissemination of ongoing research, enhance quality of work and contribute to the advancement of knowledge. We acknowledge, without implication, financial support from the DEGRP Research Grant (ES/N013344/2) on "Delivering Inclusive Financial Development and Growth", funded by the ESRC and the former UK Department for International Development, which merged with the Foreign & Commonwealth Office on 2 September 2020 to become the Foreign, Commonwealth & Development Office (FCDO), the ESRC-NSFC (ES/P005241/1) Research Grant on "Developing financial systems to support sustainable growth in China – The role of innovation, diversity and financial regulation", and the AXA Research Fund.

List of previous Working Papers of CGF:

No.11/2018 *Financial inclusion and economic growth: What do we know?* By Joshua Y. Abor, Haruna Issahaku, Mohammed Amidu, and Victor Murinde

No.12/2018 *Climate vulnerability and the cost of debt.* By Gerhard Kling, Yuen C Lo, Victor Murinde, and Ulrich Volz

No.13/2018 *Pan-African banks on the rise: Does cross-border banking increase firms' Access to finance in WAEMU?* By Désiré Kanga,Victor Murinde, Lemma Senbet, and Issouf Soumaré

No.14/2018 *The peer monitoring role of the interbank market and implications for bank regulation: Evidence from Kenya.* By Victor Murinde, Ye Bai, Christopher J. Green, Isaya Maana, Samuel Tiriongo, and Kethi Ngoka-Kisinguh

No.1/2019 *Central bank independence: What are the key issues*? By Désiré Kanga and Victor Murinde

No.2/2019 *Banking services and inclusive development in sub-Saharan Africa.* By Haruna Issahaku, Mohammed Amidu and Aisha Mohammed Sissy

No.3/2019 *A survey of literature on financial literacy and financial behaviour: Is there a gender gap*? By Maryam Sholevar and Laurence Harris

No.4/2019 *Capital adjustment over the cycle: Evidence from microfinance institutions*. By Issouf Soumaré, Hubert Tchakoute Tchuigoua, and Hélyoth T.S. Hessou

No.5/2019 *Provisioning and business cycle: Evidence from microfinance institutions*. By Hélyoth T.S. Hessou, Robert Lensink, Issouf Soumaré, and Hubert Tchakoute Tchuigoua

No.6/2019 *Lending and business cycle: evidence from microfinance institutions*. By Hubert Tchakoute Tchuigoua, Issouf Soumaré, and Hélyoth T.S. Hessou

No.7/2019 *Term structure of CDS spreads & risk-based capital of the protection seller: an extension of the dynamic Nelson-Siegel model with regime switching.* By Standley R. Baron and Issouf Soumaré

No.8/2019 *Confidence, financial inclusion and sustainable economic development.* By Ayse Demir, Reinhard Bachmann, Victor Murinde, Laurence Harris, Christine Oughton and Meng Xie

No.9/2019 *The network structure of the Malawi interbank market: implications for liquidity distribution and contagion around the banking system.* By Esmie Koriheya Kanyumbu

No.10/2019 *Aid and Exchange Rates in sub-Saharan Africa: No More Dutch Disease?* By Oliver Morrissey, Lionel Roger and Lars Spreng

No.11/2019 *Does credit deepening increase financial fragility*? By Peng Yiqing, Niels Hermes, and Robert Lensink

No.12/2019 *Does microcredit increase aspirational hope? Evidence from a group lending scheme in Sierra Leone.* By Adriana Garcia, Robert Lensink, and Maarten Voors

No.13/2019 *Do better formal institutions promote financial inclusion*? By Peng Yiqing, Niels Hermes, and Robert Lensink

No.14/2019 *Do interbank interest rates reflect the financial soundness of borrowing banks*? By Thomas Bwire, Martin Brownbridge, Doreen K. Rubatsimbira and Grace A. Tinyinondi

No.15/2019 *Institutional environment and the microstructure of the interbank market*. By Thomas Bwire, Martin Brownbridge, Doreen K. Rubatsimbira, and Grace A. Tinyinondi

No.16/2019 *Segmentation of the interbank money market in Zambia*. By Jonathan M Chipili, Francis Z Mbao, Alick B Lungu, Shula M Sikaona, Anthony Bwalya, and Cosam S Chanda

No.1/2020 *How has the rise of Pan-African banks impacted bank stability in WAEMU?* By Désiré Kanga, Victor Murinde, and Issouf Soumaré

No.2/2020 *Threshold effects of financial inclusion on income inequality.* By Ayse Demir, Vanesa Pesqué-Cela, and Victor Murinde

No.3/2020 *FinTech, financial inclusion and income inequality: A quantile regression approach.* By Ayse Demir, Vanesa Pesqué-Cela, Yener Altunbas, Victor Murinde

No.4/2020 *Director reputation and earnings management: evidence from the British honours system*. By Tolulola Lawal

No.5/2020 *Financial inclusion and the growth-inequality-poverty triangle: New evidence from Africa.* By Ayse Demir and Victor Murinde

No.6/2020 *Fellowship amongst peers: A systematic and selective survey of literature on the analysis of interbank lending networks*. By Anosi F. Ikimalo and Victor Murinde

No.7/2020 *Exploring the impact of COVID-19 pandemic on Africa's FinTech space*. By Joshua Yindenaba Abor

No.8/2020 *Financial market integration in sub-saharan Africa: How important is contagion*? By Robert Akunga, Ahmad Hassan Ahmad and Simeon Coleman

No.9/2020 *Finance and well-being in developing countries: Does access to mobile money improve household well-being*? By Fei Jiang, Christopher J. Green, Ahmad Hassan Ahmad and Carlos Sakyi-Nyarko

No.10/2020 *Mobile money, ICT, financial inclusion and inclusive growth: How different is Africa*? By By Fei Jiang, Christopher J. Green, Ahmad Hassan Ahmad and Victor Murinde

No.11/2020 *Financial inclusion and welfare improvement: Empirical evidence from A households survey data*. By Carlos Sakyi-Nyarko, Ahmad Hassan Ahmad and Christopher J. Green

No.12/2020 *The FinTech revolution: What are the opportunities and risks*? By Victor Murinde and Efthymios Rizopoulos

No.13/2020 *The COVID-19 pandemic and its impact on African economies and financial markets: A review*. By Elikplimi Komla Agbloyor and Joshua Yindenaba Abor

No.14/2020 *Online data collection for monitoring the impact of COVID-19*. By Victor Murinde, Athina Petropoulou and Meng Xie

No.15/2020 *Towards resolving the partner selection problem in venture capital syndication: new insights from a neural network based study*. By Qiong Ji, Xiaoming Ding and Victor Murinde

No.16/2020 *Government policy and financial inclusion: Analysing the impact of the Indian national mission for financial inclusion*. By Rachel Hadar and Ronny Manos

No.1/2021 *Forecasting the CBOE VIX with a hybrid LSTM-ARIMA model and sentiment analysis*. By Yossi Shvimer, Victor Murinde and Avi Herbon

No.2/2021 *A political economy analysis (PEA) of capital account management (CAM) measures in Ghana*. By Peter O'Flynn, Stephany Griffith-Jones, and Stephen Spratt

No.3/2021 *Does energy efficiency matter for prices of tenant-owned apartments*? By David Stenvall, Pontus Cerin, Bo Sjö, and Gazi Salah Uddin

No.4/2021 *Finance and well-being in developing countries: Does access to mobile money improve household well-being*? By Ahmad Hassan Ahmad, Christopher J. Green, Fei Jiang, and Carlos Sakyi-Nyarko

No.5/2021 *Mobile money access and usage: Evidence from household surveys*. By Carlos Sakyi-Nyarko, Ahmad Hassan Ahmad and Christopher J. Green

No.6/2021 *The Gender-Differential Effect of Financial Inclusion on Household Financial Resilience*. By Carlos Sakyi-Nyarko, Ahmad Hassan Ahmad, and Christopher J. Green

of the authors of this paper. The views expressed in the paper are those of the authors and do not necessarily reflect those of the CGF.

All CGF Working Papers can be downloaded from CGF Website.

Centre for Global Finance
SOAS University of London
10 Thornhaugh Street, Russell Square
London
WC1H 0XG

Email: cgf@soas.ac.uk
Website: https://www.soas.ac.uk/centreforglobalfinance/publications/

The Impact of ICT and Mobile Money on Inclusive Growth and Financial Development. Is Africa Different?*

by

Ahmad Hassan Ahmad[1], Christopher J. Green[1], Fei Jiang[1], and Victor Murinde[2]

Provisional Draft: Not for Quotation

Keywords: ICT, Mobile Money, Financial Inclusion, Africa

JEL Classification: O47, O43, O33

ABSTRACT

We investigate the contributions of telecommunications (ICT) and mobile money to economic growth and human development in a panel of 146 countries. We extend the Solow growth model to include human capital, money, institutional conditions, ICT and mobile money. We use several estimating techniques to obtain robust results. We split the sample into sub-Saharan Africa and the rest of the world (RoW) to identify if Africa is different. We find that the extended Solow model provides a good explanation of the determinants of growth and human development, although the impact of ICT and mobile money is quantitatively small. Mobile money also works indirectly by increasing financial development which in turn stimulates growth. There are differences and commonalities as between Africa and RoW. Mobile money is more effective in countries with better mobile phone penetration and more dispersed populations.

Correspondence to:

Christopher J. Green: School of Business and Economics, Loughborough University, Loughborough, Leicestershire, LE11 3TU, United Kingdom
Tel: +44 (0)1509 222711; *Fax:* +44 (0)1509 223910; *E-mail:* C.J.Green@lboro.ac.uk

[1] Christopher Green, Ahmad Ahmad and Fei Jiang: School of Business and Economics, Loughborough University, Loughborough, Leicestershire, LE11 3TU, United Kingdom

[2] Victor Murinde: School of Finance & Management, SOAS University of London, Thornhaugh Street, Russell Square, London, WC1H 0XG, United Kingdom

* This research was funded by the ESRC and the former UK Department for International Development, which merged with the Foreign & Commonwealth Office on 2 September 2020 to become the Foreign, Commonwealth & Development Office, Research Grant No. ES/N013344/2: "Delivering Inclusive Financial Development and Growth". Earlier versions of this paper were presented at the Joint 8th Africa Business and Entrepreneurship & 14th Makerere Leadership and Entrepreneurship Conference at the Virginia Commonwealth University, Richmond, Virginia, USA, on October 4-7, 2017; the Financial Inclusion Seminar at Loughborough University on December 5th, 2017; the DFID/ESRC Research Workshop on Inclusive Finance at SOAS on February 13th, 2018; and at the DFID/ESRC Research Workshop on Delivering Inclusive Financial Development and Growth at Loughborough University on January 25th 2019. We thank participants in these seminars for very some helpful comments on several earlier drafts. Murinde also acknowledges support under the ESRC-NSFC (ES/P005241/1) Research Grant on "Developing financial systems to support sustainable growth in China – The role of innovation, diversity and financial regulation", and AXA Research Fund.

1. Introduction

It is widely agreed that technical change is the wellspring of economic growth and improvements in living standards (Schumpeter, 1934; Solow, 1956; Romer, 1990). However, there is continuing debate about the relative importance of different types of technical change (Romer, 1993; Solow, 1987; Gordon, 2012). Recent attention has focussed on information and communication technologies (ICT), especially mobile communications, the impact of which is expected by many experts to be momentous. According to the World Bank: "Mobile communication has arguably had a bigger impact on humankind in a shorter period of time than any other invention in human history. As noted by Sachs (2008) […]: 'Mobile phones and wireless internet end isolation and will therefore prove to be the most transformative technology of economic development of our time'" (Minges, 2012). Few would dispute that mobile technologies have had some transformative effects, especially in developing countries where now, more households own a mobile phone than have access to electricity or healthy sanitation (World Bank, 2016). However, like the personal computer and the internet beforehand (Acemoglu, *et. al.*, 2014.), the exact contributions of mobile communications to growth and welfare have not yet been empirically established.

An important way in which mobile communications may help spur economic growth and improve well-being, particularly in poorer countries, is through the potential of mobile phones to promote financial inclusion. Financial inclusion is defined as a state in which everyone, including poor, rural and disabled people, has ready access to a range of quality financial services at affordable prices in a convenient manner (Beck, *et. al.,* 2007). Absence of financial inclusion is particularly acute in Africa. Allen *et. al.* (2014) identify the geographical dispersion of the population as being an important obstacle to financial inclusion. In geographically dispersed societies, such as in Africa where bank branch penetration is low, mobile phones can play a vital role in promoting financial inclusion, as they can be used to transmit market and other information (Jensen, 2007). They also enable the establishment of *mobile money* (m-money) services. M-money involves the use of mobile phone networks to make financial transactions using customers' funds maintained by mobile network operators (MNOs). M-money is distinct from mobile banking in that m-money customers transact only through MNOs and are not required to have an account with a financial institution (Aker and Mbiti, 2010). M-money can contribute to the economy particularly by fostering financial inclusion; this can improve household and entrepreneurial decisions, and therefore help promote economic development (Ahmad, *et. al.*, 2020). It does this by enlarging the choice set and permitting the use of a wider range of strategies to insure against adverse outcomes and to smooth consumption and production (Heltberg, *et. al.*, 2013).

However, sweeping claims were made for personal computers in the 1980s, and yet, as Solow (1987) memorably remarked, these personal computers were to be seen "… everywhere except in the productivity statistics." Solow's productivity paradox was subsequently thought to have been resolved by a jump in investment and productivity in the following decade (Jorgenson and Stiroh, 2000; Colecchia and Schreyer, 2001), but Gordon (2012) has pointed out that the productivity surge in the 1990s has largely disappeared, and has raised new doubts about the impact of modern digital technologies on long-term economic performance.

In this paper, we undertake a rigorous cross-country econometric investigation of the relationships among ICT, especially m-money, economic growth, human welfare and financial inclusion. There is a substantial literature on ICT and economic performance (Jorgenson and Stiroh, 2000; Colecchia and Schreyer, 2001; Jorgenson and Vu, 2007; Gordon, 2012, 2016; Acemoglu, et. al., 2014) but much of this literature concentrates on the US, predates the financial crisis of 2008, and is concerned with the general impact of ICT on productivity and growth rather than more specifically with mobile technology or m-money and their implications for financial development as well as for growth, welfare and financial inclusion.

To disentangle systematically the effects of m-money and ICT on growth, welfare and financial inclusion, we proceed in 3 stages. First, we estimate a standard cross-country model of growth in GDP *per capita* based on the Barro-Mankiw-Romer-Weil approach (Barro and Sala-i-Martin, 2004; Mankiw, *et al.*, 1992), but following Reynès (2017), we set up the model in log-difference form of an aggregate production function. We include physical and human capital and money-in-the-production-function, as well as controls for convergence and country factors such as institutional quality. We augment this basic model with measures of ICT capital and m-money penetration, paying attention to the way in which these innovations may be expected to interact in their influence on growth. One of the limitations of the earlier literature is that measures of technology have often been inserted solely on an additive basis into simple growth models[1]. However, an important argument about ICT is that it may have interactive effects: mobile technology may be a substitute for fixed-line telecommunications, and a complement to m-money. We specify the model in a way designed to test for such effects.

Second, we investigate the impact of a broadly similar set of variables on the UNDP's index of human development *(HDI*: UNDP, 2016), which is arguably a better index of inclusive growth than GDP *per capita*. We augment the growth model with variables which may help explain the elements of human development other than GDP growth.

At the third stage, we focus on the impact of ICT on financial inclusion. For this purpose we use the IMF's index of financial development (Svirydzenka, 2016). This includes components of access, efficiency and depth, and therefore encompasses the notion of financial inclusion, but also broader aspects of financial development. This index has its limitations as we explain later, but so do other more narrowly-focussed indices of financial inclusion (Sarma, 2015; Amidžić, *et. al.*, 2014; Cámara and Tuesta, 2014); and the IMF index has the advantage of being comprehensive and offering much greater coverage of countries and time periods. Nevertheless, to limit arguments over semantics, we refer to the IMF index as measuring "financial development" but as we explain in section 3.4, we believe it does have a good claim to be interpreted also as a measure of financial inclusion. In our analysis of financial development, we broaden and substantially extend the work of Andrianaivo and Kpodar (2012) by studying interactions among m-money, financial development, growth and HDI, seeking to test if m-money contributes directly to growth and human development or if it does so only indirectly by promoting financial development. As it has been argued that mobile technology

[1] For example, Choi and Yi (2009) conclude that internet penetration fosters growth on the basis of a single regression of growth on internet penetration and just 3 control variables.

is likely to be particularly potent in the more geographically dispersed societies of sub-Saharan Africa (SSA), we estimate simultaneous models for SSA and for the rest of the world (RoW), and compare how ICT affects growth and financial development in these regions.

The paper is divided into six sections: Section 2 provides an overview of relevant literature. Section 3 outlines the empirical model and discusses its theoretical underpinnings. Section 4 explains the data and estimation strategy adopted. Section 5 discusses the results; and Section 6 concludes. Details of data and some additional results are contained in two appendices.

2. *Overview of Relevant Literature*

In a seminal cross-country panel data study, Roller and Waverman (2001) investigated the impact of ICT on the level of GDP using a standard Cobb-Douglas production function extended to include fixed-line penetration as a measure of ICT capital. They found that, after factoring out the impact of other inputs, ICT infrastructure mostly did not have a significant effect on output in OECD countries. However, there was some evidence of an externality, in which a certain critical mass was necessary for ICT to stimulate higher output[2]. Meanwhile, several authors have attributed the resurgence in world-wide growth in the 1990s to the impact of investments in ICT (Jorgenson and Vu, 2007; Colecchia and Schreyer, 2001).

Subsequent cross-country research investigating the impact of ICT on economic growth has generally been based on variants of the Mankiw-Romer-Weil (1992) or Barro models (Barro and Sala-i-Martin, 2004). Waverman *et. al.* (2005) studied the determinants of *per capita* growth in a cross-section of 92 countries using a Barro-type growth model to explain the average growth in *per capita* GDP during 1980-2003, controlling for physical and human capital and initial output per head, as well as ICT. They found that mobile phone penetration had a somewhat larger impact on growth than fixed-line telephony, especially in low- and middle-income countries. The multipliers were not small even for developed countries. For example, the model suggests that Canada would have enjoyed average *per capita* GDP growth a full 1% higher than actually occurred, if it had achieved Swedish levels of mobile penetration

[2] Roller and Waverman refer to “growth” but their model actually explains the level of GDP, not its growth.

between 1996 and 2003. Choi and Yi (2009) reported that internet penetration helped explain *per capita* growth in a 10-year panel of 207 countries[3]; while the GSMA found that mobile phone penetration helped explain *per capita* growth in OECD countries (GSMA, 2012)[4].

A more comprehensive study was conducted by Andrianaivo and Kpodar (2012), using data on 44 African countries during 1988-2007. A Barro-type growth model was estimated using as controls initial GDP per head, human capital, government consumption, inflation and institutional quality. ICT was measured by mobile and fixed line penetration, a mobile price variable and various interaction terms. Like Waverman *et al.* (2005), they found that mobile penetration contributed significantly to growth, with coefficients of similar orders of magnitude. When the model was re-estimated on a broader sample of low- and middle-income countries including Africa, the Africa dummy was not significant suggesting that the estimated effects were common across developing countries. The fixed line effect was larger than mobile, but fixed and mobile were estimated to be substitutes for each other in promoting growth.

Lee *et al.* (2012) also found that fixed-line and mobile penetration were substitutes in their effects on growth, in a panel of 44 African countries from 1975-2006. Broadly comparable results were reported by Sassi and Goaied (2013) and by Ghosh (2016) in studies of Middle East and North African (MENA) countries. In addition, like Roller and Waverman (2001), Sassi and Goaied (2013) found evidence of positive network externalities in the effects of mobile penetration on growth in 17 MENA countries. However, Ghosh (2016) reported a negative externality in 12 MENA countries using the same test, ie. the sign of the coefficient on the square of mobile penetration. Meanwhile, Asongu *et. al.* (2016) concluded that, in Africa, mobile penetration helped explain cross-country variations in *per capita* growth, and in the UNDP inequality-adjusted index of human development (IHDI). Asongu and Nwachukwu (2016) reported that greater mobile penetration was associated with lower Gini coefficients across Africa.

Andrianaivo and Kpodar (2012) investigated interactions among mobile telephony, financial

[3] This presumably includes dependencies as there are fewer than 207 countries in the world.
[4] GSMA (Groupe Spéciale Mobile Association) is the association of mobile network operators world-wide.

inclusion and growth. When basic measures of financial inclusion were included in their model (number of deposits and loans per head), the impact of mobile penetration on growth was reduced. However, in separate regressions of financial inclusion on mobile penetration, the coefficient on mobile was significant and positive. These results suggest that mobile phones contribute to growth directly and indirectly through their impact on financial inclusion, or at least on the use of formal finance. Asongu (2013) also found that mobile penetration in Africa was positively associated with different measures of financial inclusion. Sassi and Goaied (2013) found that the impact of financial development on growth depended partly on the level of telephone penetration in MENA countries. However, Ghosh (2016) obtained conflicting results for his MENA sample. Financial inclusion and mobile penetration each contributed positively to growth, but mobile penetration was associated with reduced financial inclusion.

It is clear from this brief survey that there is still much to be learnt about the impact of ICT on growth, and about the inter-relationships among ICT, financial inclusion, growth and welfare. Mobile phones may contribute to growth and financial inclusion, and part of the benefit of mobile can be through its positive effect on financial inclusion, but this is far from conclusively established. Existing studies have mostly focussed on a relatively limited sample of countries and time periods, and some of the modelling has been *ad hoc*, making it difficult to compare results, especially across countries. Africa is a particularly important subject for this research as financial inclusion in the continent is generally agreed to be less than elsewhere (Allen *et. al.*, 2014). However, we would expect that there is also much to be learnt from other countries. Given the exceptionally rapid nature of mobile phone penetration in Africa and elsewhere (Evans and Pirchio, 2015; Ahmad, et. al. 2020), it can be argued that aggregate studies of mobile penetration should have a comparative element to identify clearly the impact of this technology.

3. Models of Growth and Financial Inclusion with ICT

3.1 The Basic Growth Model

Cross-country panel data studies of ICT and growth have mostly used variants of the Mankiw-Romer-Weil (1992) or Barro models (Barro and Sala-i-Martin, 2004); and we adopt this approach but with some modifications. Standard growth models are based on the aggregate production function, typically the Cobb-Douglas. The simplest version states that output is determined by capital and labour inputs; and this may be augmented to include inputs of human capital and money ("money in the production function": Finnerty, 1980; Evans *et al*., 2002):

$$Y_t = AL_t^{1-\beta_1-\beta_2-\beta_3} K_t^{\beta_1} H_t^{\beta_2} M_t^{\beta_3} \qquad \ldots(1)$$

where: Y_t = aggregate output; L_t = labour force; K_t = stock of fixed capital; H_t = stock of human capital; and M_t = stock of real money balances; $\beta_1, \beta_2, \beta_3$ are the elasticities.[5]

Using lower-case letters for natural logs per unit of labour and *d* to denote first differences, we can rewrite (1) in terms of growth rates, or differences of natural logs per unit of labour as:

$$g_t \equiv dy_t = \alpha + \beta_1 dk_t + \beta_2 dh_t + \beta_3 dm_t \qquad \ldots(2)$$

$g_t \equiv dy_t = (Ln(Y_t) - Ln(Y_{t-1})) - (Ln(L_t) - Ln(L_{t-1}))$; $dk_t = (Ln(K_t) - Ln(K_{t-1})) - (Ln(L_t) - Ln(L_{t-1}))$; $dh_t = (Ln(H_t) - Ln(H_{t-1})) - (Ln(L_t) - Ln(L_{t-1}))$; $dm_t = (Ln(M_t) - Ln(M_{t-1})) - (Ln(L_t) - Ln(L_{t-1}))$; and α is a constant.

Equation (2) is the basis for a standard minimalist growth model. The Mankiw-Romer-Weil-Barro approach typically involves estimation of the steady-state of this model using I_{t-1}/Y_{t-1} and h_{t-1} as regressors (Barro and Sala-i-Martin, 2004; Choi and Yi, 2009; Lee, et. al., 2012). We prefer instead to use the time difference of the production function directly following Reynès (2017), who has shown that the first difference of the Cobb-Douglas can be interpreted as a flexible functional form with constant or variable output elasticities. This formulation provides a clearer distinction in specification between the change over time in factor inputs and the level of any initial conditions or other controls. This approach bears some similarity to Roller and Waverman (2001) and Waverman *et al.* (2005) who estimate the aggregate production function directly but in levels rather than in first differences. The levels approach raises obvious issues concerning the order of integration of the variables that are not considered by these authors. The inclusion of human capital and a monetary factor in the production function (1) are standard extensions of the Solow growth model.

---

[5] The empirical measurement of all the variables in the model is set out in section 4 and Appendix I.

Equation (2) is sometimes estimated as a cross-section using a grouped dataset in which the annual rate of growth in *per capita* income is averaged over time and then regressed on a set of initial conditions and controls (eg. Waverman *et. al.*, 2005). There are several issues with cross-section estimation. First, averaging data over the time series essentially discards much of the available information; second, there are likely to be time-dependent omitted variables; and third some of the regressors may be endogenous (Hoeffler, 2002). For these reasons we prefer to estimate the model using annual data in a panel, following Hoeffler (2002) where the initial conditions and controls appear as lagged variables, dated at time t-1 in an extended version of (2). This is consistent with the most recent studies of ICT and growth (Choi and Yi, 2009; Andrianaivo and Kpodar, 2012; Lee, *et. al.*, 2012; Sassi and Goaied, 2013).

Extending (2) to include initial conditions and controls, we add the following variables:

$y_{t-1} \equiv Ln(Y_{t-1}) - Ln(L_{t-1})$ = The log of GDP per unit of labour. This is the standard test of convergence, measured by a negative coefficient on y_{t-1}, reflecting the Solow argument that countries with the same resources will converge on the same *per capita* GDP.

$disp_{t-1}$ = population dispersion (≡ – population density). Population dispersion is thought to have a negative effect on growth because countries with more rural, dispersed populations have more difficulty in communicating and therefore markets may operate less efficiently than in denser urban environments. Population dispersion in Africa is associated with low levels of bank penetration and financial inclusion (Allen *et. al.*, 2014).

$x_{t-1} = Ln((exports_{t-1} + imports_{t-1})) - Ln(Y_{t-1})$. The trade-GDP ratio measures the openness of an economy. More open economies are expected to have higher growth rates.

$inst_{t-1}$ = institutional quality. Countries with better legal and political institutions are expected to have higher growth rates, *ceteris paribus*.

rin_t = the rate of inflation. This is an inverse measure of the soundness of economic policy: higher inflation reflects more lax policy and so should be negatively related to growth.

$gpop_t$ = the rate of population growth. This is suggested by the Barro-Mankiw-Romer-Weil version of the Solow growth model and is expected to have a negative coefficient.

The benchmark growth model can therefore be summarised as:

$$g_t = \alpha + \beta_1 dk_t + \beta_2 dh_t + \beta_3 dm_t + \beta_4 y_{t-1} + \beta_5 disp_{t-1} + \beta_6 x_{t-1} + \beta_7 inst_{t-1} + \beta_8 rin_t + \beta_9 gpop_t \ldots (3)$$

3.2 The Impact of ICT and M-money

To identify the impact of ICT and m-money we begin by adding to (3), a set of regressors corresponding to the stocks of ICT capital: fixed-line (sf_{t-1}) and mobile (sm_{t-1}). Since total capital is included in the model as a factor of production, we follow previous studies (eg. Roller and Waverman, 2001; Waverman *et. al.*, 2005) and treat ICT as conditioning variables. We investigate externalities associated with phone penetration, by also including quadratic terms to test for economies of scale (sf_{t-1}^2, sm_{t-1}^2), and the interaction term, $sf_{t-1} \times sm_{t-1}$, to test for the substitutability of fixed and mobile. Dispersed populations may particularly benefit from mobile technology as the fixed costs of installation are lower than for fixed-line infrastructure; so we also interact sf_{t-1} and sm_{t-1} with $disp_{t-1}$ to test for externalities associated with population dispersion.

ICT may be expected to increase growth by augmenting the productivity of capital. M-money is more naturally thought of as a substitute for conventional money, and may be expected to increase growth by augmenting the productivity of money by reducing transactions costs. However, the direct quantitative effect of this on growth may be relatively small (Chadha, *et. al*., 1998). We treat m-money penetration (mm_{t-1}) as a conditioning variable in the model. M-money may also benefit from economies of scale; and be more effective the greater is the penetration of mobile telephony (Jack and Suri, 2011), and the more dispersed is the population. Therefore, we include linear and squared terms in m-money, (mm_{t-1}, mm_{t-1}^2), and interactions with mobile-phone penetration and population dispersion ($mm_{t-1} \times sm_{t-1}$, $mm_{t-1} \times disp_{t-1}$).

Finally, we include a dummy (*inc*) corresponding to the World Bank's country income groups (high, upper middle, lower middle, low).

These arguments yield the following estimating equation, with ε_t as the regression error:

$$g_t = \alpha + \beta_1 dk_t + \beta_2 dh_t + \beta_3 dm_t + \beta_4 y_{t-1} + \beta_5 disp_{t-1} + \beta_6 x_{t-1} + \beta_7 inst_{t-1} + \beta_8 rin_t + \beta_9 gpop_t$$
$$+\theta_1 inc + \varphi_1 sf_{t-1} + \tfrac{1}{2}\varphi_2 sf_{t-1}^2 + \varphi_3 sm_{t-1} + \tfrac{1}{2}\varphi_4 sm_{t-1}^2 + \varphi_5 mm_{t-1} + \tfrac{1}{2}\varphi_6 mm_{t-1}^2 + \phi_1(sf_{t-1} \times sm_{t-1})$$
$$+\phi_2(mm_{t-1} \times sm_{t-1}) + \phi_3(sf_{t-1} \times disp_{t-1}) + \phi_4(sm_{t-1} \times disp_{t-1}) + \phi_5(mm_{t-1} \times disp_{t-1}) + \varepsilon_t \quad \ldots(4)$$

The total impact of fixed-line telecoms on growth is given by:

$$\frac{\partial g_t}{\partial sf_{t-1}} = \varphi_1 + \varphi_2 sf_{t-1} + \phi_1 sm_{t-1} + \phi_3 disp_{t-1} \qquad (5)$$

Here $\varphi_1 > 0$, $\varphi_2 < 0$ would imply a positive impact of fixed-line penetration with diminishing returns; φ_1 </> 0, $\varphi_2 > 0$ is consistent with a critical mass effect (increasing returns): if $\varphi_1 < 0$ fixed-line usage is relatively ineffective at low rates of penetration but becomes increasingly effective as penetration increases (Roller and Waverman, 2001). If, as we expect, fixed and mobile are substitutes, then $\phi_1 < 0$: the larger is mobile penetration, the less the effect of fixed-line presence on growth and *vice versa*. The ϕ_3 parameter represents the interaction between fixed-line ICT and population dispersion. In principle, fixed-line penetration might be more effective in dispersed populations than urban settings ($\phi_3>0$), but if installation and maintenance costs are higher in rural areas, ϕ_3 could be negative, so *a priori*, its predicted sign is ambiguous.

The impact of mobile telecoms on growth is given similarly by:

$$\frac{\partial g_t}{\partial sm_{t-1}} = \varphi_3 + \varphi_4 sm_{t-1} + \phi_1 sf_{t-1} + \phi_2 mm_{t-1} + \phi_4 disp_{t-1} \qquad (6)$$

As before, $\varphi_3 > 0$, $\varphi_4 < 0$ imply a positive impact of mobile phone penetration with diminishing returns; while φ_3 </> 0, $\varphi_4 > 0$ are consistent with a critical mass effect. The sign of ϕ_1 is explained above; ϕ_2 is explained below. We might expect the impact of mobile telephony to be greater in more dispersed populations, implying $\phi_4 > 0$, but if installation and maintenance costs of mobile masts are higher in rural settings, we could also have $\phi_4 < 0$.

For m-money, its impact on growth is:

$$\frac{\partial g_t}{\partial mm_{t-1}} = \varphi_5 + \varphi_6 mm_{t-1} + \phi_2 sm_{t-1} + \phi_5 disp_{t-1} \qquad (7)$$

If there is a critical mass (economies of scale) effect, $\varphi_5 > 0$; $\varphi_6 > 0$. We expect the interaction term with mobile penetration to reflect the scaling hypothesis: m-money is likely to be more effective the greater is mobile penetration ($\phi_2 > 0$); and if m-money is more effective amidst dispersed populations, $\phi_5 > 0$.

3.3 Human Development

GDP *per capita* is a relatively narrow measure of human welfare. We therefore reran the growth regressions using the UNDP's index of human development (HDI) as the dependent variable instead of GDP. HDI is an equally-weighted geometric mean of three elements, normalised to vary between zero and unity: GNP *per capita*; education outcomes based on expected and mean years of schooling; and health outcomes based on life expectancy at birth (UNDP, 2016). HDI is evidently a broader measure of inclusive growth in a country than GDP *per capita*[6].

The variable to be explained is the change in HDI: $dhdi_t$ ($= LnHDI_t - LnHDI_{t-1}$). Beginning with (4) as a base model, we use as convergence measure hdi_{t-1} ($\equiv LnHDI_{t-1}$) instead of y_{t-1}. Otherwise, we include as determinants the same set of variables used to help explain the growth in GDP *per capita*. Since human capital is treated as an input to HDI in the model, but education outcomes are part of the HDI measure as output, there is an obvious risk that the input does not provide an independent explanation of the output. We limit this risk by measuring human capital as years of primary education. Since this is the initial education received by any population, we argue that this corresponds more nearly to human capital as a factor input, which is therefore distinct from the output measure used in HDI. In addition, we control for possible endogeneity within our estimation procedure. See section 4.

We also augment the growth model (4) by adding the following variables to help explain the additional factors that contribute to human development over and above GNP growth.

hxy_{t-1} = health spending as a proportion of GDP. This should have a positive impact on HDI.

[6] The UNDP's inequality-adjusted index (IHDI) may be a better measure of inclusive growth, but data for IHDI is of recent origin, and cannot yet be used to analyse a comprehensive panel of countries.

mxy_{t-1} = military spending as a proportion of GDP. Governments that spend more on the military may be expected to spend less on health and education and therefore have worse outcomes in these domains. The expected sign is negative.

nry_{t-1} = natural resource rents as a proportion of GDP. Resource-rich countries all too often fall victim to the "Dutch disease" or to problems of rent-seeking. The expected sign is negative.

fpy_{t-1} = (female participation rate/male participation rate). This is an indicator of access: the higher the proportion of female participation, the greater we would expect HDI to be.

$corr_{t-1}$ = control of corruption. The higher is *corr*, the better is corruption perceived to be controlled, and so the greater we would expect HDI to be.

The final augmented model of HDI can therefore be written:

$$\begin{aligned} dHDI_t &= \alpha + \beta_1 dk_t + \beta_2 dh_t + \beta_3 dm_t + \beta_4 hdi_{t-1} + \beta_5 disp_{t-1} + \beta_6 x_{t-1} + \beta_7 inst_{t-1} + \beta_8 rin_t \\ &+ \beta_9 gpop_t + \theta_1 inc + \varphi_1 sf_{t-1} + \tfrac{1}{2}\varphi_2 sf_{t-1}^2 + \varphi_3 sm_{t-1} + \tfrac{1}{2}\varphi_4 sm_{t-1}^2 + \varphi_5 mm_{t-1} + \tfrac{1}{2}\varphi_6 mm_{t-1}^2 \\ &+ \phi_1(sf_{t-1} \times sm_{t-1}) + \phi_2(mm_{t-1} \times sm_{t-1}) + \phi_3(sf_{t-1} \times disp_{t-1}) + \phi_4(sm_{t-1} \times disp_{t-1}) \\ &+ \phi_5(mm_{t-1} \times disp_{t-1}) + \omega_1 hxy_{t-1} + \omega_2 mxy_{t-1} + \omega_3 nry_{t-1} + \omega_4 fpy_{t-1} + \omega_5 corr_{t-1} + \varepsilon_t \qquad \ldots(8) \end{aligned}$$

3.4 Financial Inclusion and Financial Development

The final stage in the analysis is to explore how far ICT and m-money foster growth directly or indirectly through improvements in financial development. To do this, we estimate a model of financial development, including our measures of ICT and m-money as explanatory variables. We then compare the direct and indirect contributions of ICT/m-money to growth and HDI by re-estimating (4) and (8) with financial development as an additional explanatory variable. We then compare the two sets of estimates, including and excluding financial development. If financial development and ICT/m-money are distinct channels influencing growth and HDI; we would expect financial development to be significant (and positive) in these regressions, and for there to be little change in the impact of ICT/m-money as between the base estimates of (4) and (8) and the revised estimates including financial development. Alternatively, if financial development is the main channel through which ICT/m-money affects growth and HDI; then we would expect financial development to be significant in the growth and HDI regressions, and the impact of ICT/m-money to be attenuated in comparison with the base estimates.

Financial inclusion can be measured at the micro level by the availability of different forms of finance and the ways in which households and businesses use these forms of finance. At the macro level, measurement is reliant on broad indicators. One of the most widely-used indices of financial inclusion is that of Sarma (2012, 2015), based on 3 underlying indicators: bank penetration, availability and usage of banking services. These are combined into an equally-weighted index following OECD methodology (OECD, 2008). Sakyi-Narko (2018) finds that Sarma's index is as important as *per capita* growth rates in explaining cross-country variations in HDI in a panel of African countries.

We use instead the IMF index of financial development to correspond to financial inclusion (Svirydzenka, 2016). For each country, this is based on 20 underlying indicators which are combined into 6 indices measuring depth, access and efficiency: first, of financial markets, and second, of financial institutions. These indices are then used to create one index of financial market development and one of financial institution development, and these in turn are combined into a single index of financial development. Principal components are used to combine the indices at each level. See Svirydzenka (2016). An important limitation of the IMF index is that there are numerous missing data points given a weight of zero in the calculations. It is important to note that, although the IMF index is billed as "financial development" and the Sarma index as "financial inclusion", the IMF index includes 2 of Sarma's 3 indicators[7]. Sarma's third indicator is deposit accounts per 1000 adults, but the existence of a bank account is not synonymous with its active use (Kostov, Arun & Annim, 2015). We would therefore argue that the Sarma and IMF index each has a valid claim to be called either an index of financial development or an index of financial inclusion, but we also acknowledge that they are both imperfect in several respects. The IMF index has a broader coverage of indicators and a longer coverage over time, to match our existing dataset. Therefore we use the IMF index but

[7] Number of bank branches and ATMs per 100,000 adults; and the ratio of bank deposits plus credit to GDP.

we continue to refer to it as an index of "development" rather than one of "inclusion"[8].

Greater financial inclusion in Africa is associated with greater proximity to financial intermediaries, lower account costs, stronger legal rights, and politically stable environments (Allen *et al.*, 2014). Determinants of financial development are therefore likely to include: population dispersion, density of bank branches, costs such as net interest margin or loan-deposit spread, quality of institutions, regulatory regime, and ICT, including m-money, as well as controls such as GDP *per capita* and inflation.

The dependent variable is the change in financial development ($df_t \equiv (LnF_t - LnF_{t-1})$. For explanatory variables, we include: the growth of GDP *per capita* (g_t); the level of financial development to check for convergence ($f_{t-1} \equiv LnF_{t-1}$); inflation (rin_t); population dispersion ($disp_{t-1}$); mobile phone penetration (sm_{t-1}, sm_{t-1}^2); m-money penetration (mm_{t-1}, mm_{t-1}^2); and interaction terms ($mm_{t-1} \times sm_{t-1}$, $sm_{t-1} \times n_{t-1}$, $mm_{t-1} \times n_{t-1}$). The expected sign of most of these variables is positive except for f_{t-1}, dp_t and $disp_{t-1}$. We include the income dummy (*inc*); but exclude $gpop_t$ as any effect it may have on financial development is likely to be through its impact on growth or HDI. We also exclude $inst_{t-1}$ but include two variables measuring specific aspects of institutional quality that are most relevant to financial development. These are:

reg_{t-1} is a measure of regulatory quality. A higher value of *reg* signifies a more rigorous regulatory regime so that the coefficient is expected to be positive;

$corr_{t-1}$ is a measure of corruption control. A higher value of *corr* indicates better corruption control so the expected sign is positive.

The remaining variables are as follows:

rur_{t-1} = the proportion of the population classified as rural. This is an alternative measure of population dispersion which may be more relevant for financial development. The expected sign is negative.

[8] "Inclusion" and "development" are elided by Andrianaivo and Kpodar (2012). They use deposits or loans per head as indicators of financial inclusion but argue that, as a measure of financial inclusion, this variable is closely correlated with financial development as measured by the private credit/GDP ratio.

idmm is a cross-sectional, time-invariant dummy which equals unity if a country has an active m-money scheme at any time in the sample, and zero otherwise. Given the recent provenance and rapid growth of m-money, it is possible that its cross-sectional impact on financial inclusion is not fully captured by the subscription rates used to measure m-money capital *per se*.

net_t, net_t^2 are the actual and squared number of countries in the same region with an active m-money scheme, given that the specified country also uses m-money. These measure the network effect of m-money. The more countries in the vicinity that have m-money schemes, the more we would expect some cross-border benefit: through imitation, cross-border activity, learning, and information exchange.

The components of f_t as measured by the IMF include the ratio of private sector credit to GDP, so, to avoid double-counting we do not include any money or credit aggregates as explanatory variables[9]. Our base model of financial development can be written:

$$df_t = \alpha + \beta_1 dy_t + \beta_2 f_{t-1} + \beta_3 disp_{t-1} + \beta_4 rin_t + \theta_1 inc + \varphi_1 sm_{t-1} + \tfrac{1}{2}\varphi_2 sm_{t-1}^2 + \varphi_3 mm_{t-1} + \tfrac{1}{2}\varphi_4 mm_{t-1}^2$$
$$+\phi_1(sm_{t-1} \times disp_{t-1}) + \phi_2(mm_{t-1} \times sm_{t-1}) + \phi_3(mm_{t-1} \times disp_{t-1}) + \theta_1 inc + \theta_2 idmm$$
$$+\omega_1 net_t + \omega_2 net_t^2 + \omega_3 reg_{t-1} + \omega_4 corr_{t-1} + \omega_5 rur_{t-1} + \varepsilon_t \qquad \ldots(9)$$

4. Data and Estimation

The base model of growth is given by (4); HDI by (8) and financial development by (9). We seek to explain the change over time in the dependent variable, checking for long-term convergence using y_{t-1}, hdi_{t-1}, f_{t-1}. The production function determines output *per unit of labour*, whereas from the point of view of human development and inclusive growth, we may be more interested in GDP *per capita*, ie. *per unit of population*. Meanwhile, HDI includes *per capita* GNP. In any cross-section, countries with a higher proportion of dependent population (people under working age and inactive or retired people) may experience relatively high growth per unit of labour but relatively low growth per head of population, and *vice-versa*. To control for this, we ran the growth regressions twice: first using the labour force to scale data for GDP and

---

[9] Bank branch density and net interest margins cannot be used to explain df_t as they are part of the IMF index.

all the relevant explanatory variables, and second using population as the scaling factor for these variables. The HDI and financial development regressions were also run run twice using the labour force and then population to scale the relevant explanatory variables. We argue that both sets of estimates are of interest in their own right, and to compare with one another.

The data form an unbalanced panel with 146 countries, including 45 Sub-Saharan African countries, over the 23 years 1994 to 2016. The definitions of the variables used in the models, including their empirical counterparts are summarised in table 1. Appendix 1 shows in more detail the variable definitions and data sources.

Table 1 about here

We first performed diagnostics based on estimates of equations of the form:

$$g_{nt} = \sum_h \beta_h X_{h,nt} + \sum_j \gamma_j V_{j,n} + \varepsilon_{nt} \qquad \ldots(10)$$

$$\varepsilon_{n,t} = \mu_n + \rho_{nt} \qquad \ldots(11)$$

g_{nt} is the growth in *per capita* GDP (or HDI, financial inclusion) for country n at time t. Explanatory variables include H country- and time-specific variables such as dk_t represented by $X_{h,nt}$ ($h = 1,\ldots,H$); and J cross-sectional time-invariant variables represented by $V_{j,n}$ ($j = 1,\ldots,J$); $n = 1,\ldots,N$ is the country index (N = number of countries); and $t = 1,\ldots,T$ is the time index (T = number of years). The composed error term is given by $\varepsilon_{n,t}$, and is assumed to consist of a country-specific error (μ_n) and an idiosyncratic error ($\rho_{n,t}$).

Tests for country and time effects (Breusch and Pagan, 1980) confirmed the need to allow for these in the estimation process. This suggests use of fixed- or random- effects estimators. As some variables such as *inst* do not vary much over time, or not at all in the case of *inc*, the fixed effects estimator discards some information on country-specific effects. *A priori*, some of the explanatory variables, especially dk_t, dh_t, dm_t, $y_{t-1\ t}$, rin_t, dy_t, *inc* and *idmm* may be correlated with μ_n. This may constitute a problem for the use of either fixed or random effects and suggests instead the use of instrumental variables. Hausman tests (Hausman, 1978) suggested that there was, in fact, little evidence of correlation between the country effects and the explanatory variables. However, as a robustness check, we report results using fixed and (one-way) random effects estimators and the Hausman-Taylor estimator (Hausman and Taylor, 1981; Wooldridge, 2010)[10]. Given the variable quality of cross-country data of this kind, the differences among the parameter estimates produced by the different estimation procedures are mostly not large, and we therefore concentrate mainly on the Hausman-Taylor results.

From the initial estimates of each base model, Chow tests suggested that there was a significant difference between the parameters for SSA and those for RoW. So we split the data into SSA (subscript A: 45 countries) and RoW (subscript W: 101 countries), and stacked them as:

$$\begin{pmatrix} g_{A,t} \\ g_{W,t} \end{pmatrix} = \begin{pmatrix} \sum_h \beta_h X_{h,A,t} & 0 \\ 0 & \sum_h \lambda_h X_{h,W,t} \end{pmatrix} + \begin{pmatrix} \sum_j \gamma_j V_{j,A} & 0 \\ 0 & \sum_j \delta_j V_{j,W} \end{pmatrix} + \begin{pmatrix} \varepsilon_{A,t} \\ \varepsilon_{W,t} \end{pmatrix} \qquad \ldots(12)$$

There may be a gain in efficiency from estimating the SSA and RoW models simultaneously when using the random effects or Hausman-Taylor estimator, provided $\mathrm{Cov}(\varepsilon_{A,t}\ \varepsilon_{W,t}) \neq 0$. After estimating each general model (4, 8, 9) we tested down to a simplified model, first by deleting variables that were not significant in both the SSA and RoW equations. We then performed tests of equality between pairs of SSA-RoW coefficients (β_h-λ_h, γ_j-δ_j in (12)), and imposed any acceptable equality restrictions, again seeking efficiency gains in the estimation. We report estimates of the simplified model, tests of parameter restrictions and the Chow tests separating the SSA model from that of the RoW. Results of the general model are reported in appendix 2.

5. *Results*

5.1 Economic Growth

The estimates per unit of labour (Table 2) are broadly consistent with the modified production function approach. Physical and human capital and money are all significant and have the correct sign apart from human capital in the RoW which is however not significant. There are

[10] Time effects were included through a set of deterministic time dummies.

some significant difference in the magnitude of the coefficients as between SSA and RoW, notably for fixed capital which has a substantially smaller effect in SSA than in the RoW. Initial income has the expected negative sign. It is at the lower end of previously published estimates. Barro (2015) has argued that this coefficient tends to be lower when the regression includes more country- and time-varying conditioning explanatory variables. However, if conditioning variables do validly affect growth rates, it is hard to see why they should be excluded from the model just because the speed of convergence turns out to be low. Relatively few studies fully allow for the wide range of variables that in practise may be expected to affect economic growth in a country. An additional factor in our model is the inclusion of the income group (*inc*) variable. This has a positive effect on growth, implying that wealthier countries have tended to grow faster than poorer countries suggesting that, insofar as convergence does occur in this sample it may have done so more within income groups than across them. Institutional and policy variables, including trade, inflation and population growth all have a significant effect on growth, with the expected signs, and with the same quantitative effects for SSA and RoW. Freedom House's institutional quality was not significant. Population dispersion has a positive sign for RoW, although it is negative for SSA.

Table 2 about here

Turning next to ICT variables we see that their impact on growth is significant but varies considerably, both as among variables and as between SSA and RoW. For SSA, the linear impact of fixed-line telecoms (SFL) is negative, possibly reflecting the low level of investment in SSA, but the positive quadratic term is suggestive of unexploited economies of scale. For RoW, the linear impact of fixed-line is positive, and the insignificant quadratic suggests that any economies of scale were exhausted before this sample period. The significant effect of mobile subscriptions occurs through the quadratic term and, surprisingly, is negative. Likewise, the direct effect of m-money on growth is negative though only marginally significant.

The overall effect of ICT and m-money is determined also by the interaction terms, and the signs on these are more in line with the popular view that m-money is important in SSA. The negative sign on SFL×SML supports the substitutability between fixed and mobile telecoms world-wide; while positive signs for SML×MML confirm the complementarity between mobile telecom access and m-money. The interaction terms with population dispersion suggest that mobile phone access is less effective in geographically dispersed societies (SML×DISP < 0), possibly because of a cost effect in serving dispersed populations, whereas m-money is more effective in geographically dispersed societies as we would expect (MML×DISP > 0).

The parameter estimates imply a relatively small direct impact of telephony on growth. Considering only the linear term, our estimates imply that a 10% increase in landlines per unit of labour is associated with an increase in growth of about 0.07% (0.0007) in RoW and a decrease of about one half of one per cent (0.0048) in SSA. The former estimate is about the same order of magnitude as that implied by Lee *et al.* (2012) for SSA, but both figures are substantially smaller than Andrianaivo and Kpodar (2012) whose data imply that a 10% rise in fixed-line penetration was associated with an increase in growth in SSA of 7% or more (their column 4 Table 2). We believe that the smaller estimates are more realistic.

Table 3 about here

The estimates per head of population (*per capita*) (Table 3) are quite similar to those per unit of labour, although there are also some important differences. For the production function, institutional and policy variables, the signs are broadly the same as table 2. Population dispersion again has a positive impact on RoW growth, but a more significantly negative effect on SSA growth. This provides useful evidence in support of Allen *et. al.* (2014) that dispersed populations play a particularly important role in inhibiting development in SSA. For the ICT variables, overall their impact on growth is significant but there are some differences in sign and significance from the estimates per unit of labour. Mobile subscriptions again have a negative sign but through the linear rather than the squared term. The signs on the interaction terms correspond more closely to the per unit of labour estimates and tend to confirm that m-money is important in SSA. The interaction terms with population dispersion again suggest that mobile phone access has <u>less</u> impact on growth in geographically dispersed societies, but m-money has <u>more</u> impact. The *per capita* estimates also imply a small impact of telephony on growth. The linear term implies that a 10% increase in landlines *per capita* is associated with an increase in growth of about 0.1% (0.001) in RoW and a decrease of just over one half-of-one-per cent (0.0055) in SSA. These are slightly higher than that of Lee *et al.* (2012) for SSA but substantially smaller than Andrianaivo and Kpodar (2012).

It is not immediately obvious from these results if the overall effects of ICT and m-money on growth are positive, either in SSA or the RoW. We therefore calculated the total impact of fixed-line, mobile and m-money subscription rates on growth taking into account the country- and region-specific factors implicit in the non-linear and interaction terms: sf^2, sm^2, mm^2, $sf \times sm$, $sm \times mm$, $sm \times disp$, $mm \times disp$. The results of this exercise for m-money are shown for each SSA country in Table 4 columns 1 and 3. The total effect of m-money on growth is positive in most SSA countries. The average effect is positive for SSA and for RoW although, interestingly, the effect is larger for RoW. The impact on *per capita* growth is greater than on growth per unit of labour, for almost every SSA country as well as on average. This difference suggests that perhaps the impact of m-money has not been confined to the working population as is sometimes argued, in that countries with higher dependency rates have, according to these estimates, experienced a higher impact of m-money on growth.

Tables 4 and 5 about here

The country-specific, SSA and RoW averages reported in table 4 are calculated at the country means of the conditioning variables. Given the explosive growth of m-money in many countries, it is also of interest to calculate these derivatives using the most recent (2016) observations of the conditioning variables. We report these as “end-samp” SSA and RoW averages in table 4 where it can be seen that conditioning on recent data increases the impact of m-money in SSA and RoW by a factor of between 3 and 10, underlining the potential economies of scale in this technology. However, in the population-scaled regressions RoW end-samp derivatives are smaller than their mean-based equivalent. The arithmetic reason for this is that the RoW coefficient on the m-money/population-dispersion interaction is particularly large in this regression, and in RoW countries with m-money, there was a sharp increase in population density (fall in dispersion) over the sample, implying a smaller total effect of m-money on growth when conditioning on the most recent observation.

In contrast to previous researchers, we find the impact of mobile subscriptions (table 5) to be persistently negative on average and for most countries. The use of subscription rates to measure the mobile capital stock is standard in the literature but may involve a significant degree of error. It may also be that any positive impact of mobile is already accounted for by physical capital in the production function. The results for fixed lines are more as expected with a positive sign for RoW and negative for SSA, the latter reflecting their low penetration.

M-money may be expected to affect growth in several ways, interacting with other variables in the economy. One of these is through its impact in increasing financial development, a variable that does not appear in our growth and HDI regressions. We therefore re-ran the regressions in tables 2 and 3 adding the IMF measure of financial development (f_{t-1}) as an additional variable. The estimates of the coefficients for f_{t-1} (only) are shown at the foot of tables 2 and 3. In both cases, the SSA-RoW equality restriction was comfortably accepted and although there were changes in the other coefficients, none were substantive[11]. It can be seen that, even though the regressions include a monetary factor of production as well as fixed and mobile telephony and m-money, financial development, as a portmanteau variable, makes an additional, independent, positive and significant contribution to growth over and above these existing factors.

Next, we recalculated the impact of m-money on growth using the coefficients from the regression augmented by f_{t-1} (but excluding that on f_{t-1}), and found that adding financial development to the model does not substantially change the estimated impact on growth of m-

[11] We do not report all the separate coefficients for the m-money variables as the relevant comparison is between the overall impact of the two portmanteau measures, ie. between the total impact of m-money and that of financial development.

money (Table 4 columns 2 and 4). Therefore, we can conclude that there is a clear direct effect of m-money on growth even allowing for any indirect effect coming through its impact on financial development. Insofar as m-money also affects financial development, its effect on growth may be understated by this first set of regressions. We investigate the impact of m-money on financial development in Section 5.3. Taking the SSA average from the base regressions (table 4, columns 1 and 3), allowing for interaction effects, a 10% increase in m-money subscriptions as a proxy for the capital provided by m-money may be expected to raise the rate of growth in SSA by between 0.018% (0.0001769) and 0.38% (0.0038261). Clearly these effects are relatively small but broadly consistent with a "shoe-leather cost" view of m-money benefits (Chadha, *et. al*., 1998). Nevertheless, the results do suggest that overall, m-money does have a direct positive impact on growth, even if the size of the impact may be smaller and less all-encompassing than some more optimistic commentators have suggested.

5.2 HDI

The parameters in the HDI model (equation (8)) cannot be given the same quantitative interpretation as in the growth equation because of the manner in which HDI is computed and normalised. We therefore concentrate on the signs of the coefficients in the simplified estimates (Tables 6 and 7). We would expect most of the coefficients to have the same sign as in the growth equations, especially as *per capita* growth (in GNP rather than GDP) is one of the three components of the change in HDI. As for the growth equations, the factors of production are significant and of the correct sign; there is a significant convergence effect although this is again moderated by the positive coefficient on the income group variable (INC). However, the institutional and policy variables are generally less significant than before.

Tables 6 and 7 about here

As far as ICT and m-money variables are concerned, there are some differences in the signs of key coefficients as compared with the growth equations but generally, the results are broadly consistent with the growth model. Fixed and mobile subscriptions have a mostly negative effect but some positive coefficients on the squared terms are consistent with the critical mass effect (Roller and Waverman, 2001). The linear impact of m-money is again negative for SSA but the quadratic term is positive in both sets of regressions giving more evidence for a critical mass effect in m-money. For SSA, the interaction terms between m-money and mobile subscriptions are positive as expected, as is the interaction between m-money and population dispersion. Only some of the additional HDI-specific variables are significant: health spending, natural resource rents and corruption. However, resource rents and corruption are mostly signed counter-intuitively, the former contradicting the consensus view that there exists a "resource curse", especially in emerging markets (Frankel, 2012). Overall, the results for HDI are broadly comparable with those for growth, but the additional variables that are specific to HDI contribute less than might be expected to the model.

Table 8 about here

Surprisingly perhaps, the m-money derivatives for SSA are negative when calculated at the mean. However, they are positive when calculated at the most recent observations, underlining perhaps the importance of scale in the impact of m-money (Table 8). Mobile telephony mostly has a positive impact on HDI, whereas most of the fixed-line coefficients are negative.

5.3 Financial Development

Turning finally to financial development (equation 9) we again emphasise that like the HDI equations, the parameter estimates cannot be given a simple quantitative interpretation because of the manner in which financial development is computed and normalised. It is reassuring that the estimates per unit of labour (Table 9) are qualitatively very similar to those based on *per capita* explanatory variables, and so we concentrate on the *per capita* results (Table 10). A second interesting feature is that half the coefficients accept equality restrictions as between SSA and RoW, suggesting perhaps that the determinants of financial development may be somewhat more uniform in effect than those for growth or HDI.

The change in income is a primary determinant of financial development, and there is a significant convergence effect. Neither measure of geographic isolation (*disp* and *rur*) is significant, but the regulatory and corruption variables are significant and correctly-signed. Mobile subscriptions have a positive impact but with diminishing returns. M-money also has a positive though not significant effect with differing signs on the quadratic term as between SSA and RoW. The interaction terms with population dispersion are signed as expected apart from with m-money for SSA. The network variable (MMNET) is also counter-intuitively signed possibly due to the limitations of the measure, as in many cases, there are too few contiguous countries to identify network externalities with much confidence. However, m-money does have a significant positive effect on financial inclusion through the dummy variable that identifies if a country has had an m-money scheme (IDMM). The overall impact of m-money on financial development allowing for non-linear and interaction terms (but excluding MMNET and IDMM [12]) is positive as we would expect (table 11). The positive effect of IDMM reinforces this conclusion.

Tables 9, 10 and 11 about here

---

6. Conclusions

In this paper, we have adapted the methods of previous studies to investigate the contribution of ICT and m-money to growth, HDI and financial development in a panel of 146 countries covering 22 years. The preferred models for growth and HDI incorporate: factors of production, fixed and mobile ICT, m-money, and institutional and policy control variables. Financial development is explained by economic performance, institutional variables and m-money. Following Chow tests, the model is estimated by splitting the sample into SSA and RoW, and estimating the two sub-samples simultaneously.

The main conclusions of the paper are as follows. First, the qualitative results are broadly in

[12] MMNET and IDMM are measured using a different metric to other m-money variables so they cannot be used in the calculation of the total m-money effect.

line with previous studies, notwithstanding the larger dataset and regression model used here. Second, the standard factors of production are important in the determination of growth and HDI; underlining the value of our production function-convergence approach to the analysis. Third, there is evidence of convergence, in growth as we would expect, but also in HDI and financial development. However, convergence is moderated by income group: higher income countries tend to have higher growth rates of GDP per head, HDI and financial development, *ceteris paribus*. Fourth, there is no support for a single unified model for SSA and RoW, so that in the aspects covered by these regressions, it can be said that Africa is "different" to some extent[13]. However, there are many commonalties between the models of SSA and RoW, especially in the financial development regressions.

Fifth, the impact of ICT and m-money on growth in SSA and RoW occurs through several channels. There is a direct positive effect of fixed-line telephony for RoW, but the effects of mobile telephony and m-money occur more particularly through interactions with one another and with population dispersion, both in SSA and RoW. Overall, the quantitative impact of ICT on growth is much smaller than found by several previous researchers and in some cases is negative. We attribute this partly to a more complete consideration of the variables likely to impact economic growth in a country. The quantitative effect of m-money is also not large and it gains its main impact particularly through externalities in its interaction with mobile phone penetration and population dispersion. There is also some evidence of a critical mass effect both for the ICT variables and for m-money.

Finally, one of the most important findings is that financial development has a significant effect on GDP growth in SSA and RoW, even allowing for the direct effect on growth of m-money, although it is surprising that this effect is not reprised in the HDI equations. Since m-money also has a positive impact on financial development in SSA and RoW, m-money affects economic growth through two distinct channels: the direct impact and the indirect impact through its effect on financial development. Overall though, given that the impact of ICT and

[13] Other regions may also be "different" in the same sense. We have not investigated this point because the purpose of the paper is to focus particularly on ICT in SSA.

m-money on growth appears to be relatively small once other factors are partialled out, we would argue that further work needs to be done at the micro level to understand fully the effects of ICT and m-money on livelihoods and so on human development.

References

Acemoglu, D., Autor, D., Dorn, D., Hanson, G.H. and Price, B., 2014. Return of the Solow Paradox? IT, Productivity, and Employment in US Manufacturing. *American Economic Review: Papers & Proceedings*, Vol. 104 (5), pp. 394-399.

Ahmad, A.H., Green, C. and Jiang, F. (2020), Mobile Money, Financial Inclusion And Development: A Review With Reference To African Experience. Journal of Economic Surveys, 34: 753-792. https://doi.org/10.1111/joes.12372.

Aker, J. C. and Mbiti, I. M., 2010. Mobile Phones and Economic Development in Africa. *Journal of Economic Perspectives*, Vol. 24 (3), pp. 207-232.

Allen, F., Carletti, E., Cull, R., Qian, J., Senbet, L. and Valenzuela, P., 2014. The African Financial Development and Financial Inclusion Gaps. *Journal of African Economies*, Vol. 23 (5), pp. 614-642.

Amidžić, G., Massara, A. and Mialou, A., 2014. Assessing Countries' Financial Inclusion Standing - A New Composite Index. *IMF Working Paper*, WP/14/36, Washington DC, IMF.

Andrianaivo, M. and Kpodar, K., 2012. Mobile phones, financial inclusion, and growth. *Review of Economics and Institutions*, Vol. 3 (2), pp. 1-30.

Asongu, S.A., 2013. How has Mobile Phone Penetration Stimulated Financial Development in Africa? *Journal of African Business*, Vol. 14 (1), pp. 7-18.

Asongu, S.A. Boateng, A. and Akamavi, R., 2016. Mobile phone innovation and inclusive human development: evidence from Sub-Saharan Africa. *AGDI Working Paper WP/16/027*, Yaoundé, African Governance and Development Institute, March.

Asongu, S. A. and Nwachukwu, J. C., 2016. Mobile Phone Penetration and Inclusive Development in Africa. *African Finance Journal*, Vol. 18 (1), pp. 34-52.

Barro, R. 2015. Convergence and Modernisation. *Economic Journal*, 125, June, pp. 911-942.

Barro, R. and Sala-i-Martin, X. 2004. *Economic Growth*. 2nd Edition, Boston, Mass, MIT Press.

Beck, T., Demirguc-Kunt, A., and Honohan, P., 2007. Finance for All? *World Bank Policy Research Report*, Washington DC, World Bank.

Breusch, T.S. and Pagan, A.R., 1980. The Lagrange Multipler test and its application to model specification in econometrics. *Review of Economic Studies*, Vol. 47, pp. 239-253.

Cámara, N. and Tuesta, D., 2014. Measuring Financial Inclusion: A Multidimensional Index. *BBVA Working Paper*, No. 14/26, Madrid, BBVA.

Chadha, J.S., Haldane, A.G. and Janssen, N.G.J., 1998. Shoe-leather Costs Reconsidered. *Economic Journal*, 108, pp. 363-82.

Choi, C. and Yi, M.H., 2009. The effect of the Internet on economic growth: Evidence from cross-country panel data. *Economics Letters*, 105, 39–41

Colecchia, A. and Schreyer, P., 2001. ICT Investment and Economic Growth in the 1990s: Is the United States a Unique Case? A Comparative Study of Nine OECD Countries. *OECD STI Working Paper* DSTI/DOC(2001)7, Paris, OECD.

Evans, A.D., Green, C.J. and Murinde, V., 2002. Human capital and financial development in economic growth: new evidence using the translog production function. *International Journal of Finance and Economics*, 7 (2), pp.123-140.

Evans, D.S. and Pirchio, A., 2015. An empirical examination of why Mobile Money schemes ignite in some developing countries but flounder in most. *Coase-Sandor Working Paper Series in Law and Economics* No. 723, University of Chicago Law School, March.

Finnerty, J.D., 1980. Real Money Balances and the Firm's Production Function: A Note. *Journal of Money, Credit and Banking*, 12(4), Part 1, pp. 666-671.

Frankel, J.A., 2012. The Natural Resource Curse: A Survey of Diagnoses and Some Prescriptions. In: Arezki, R., Pattillo, C., Quintyn, M. and Zhu, M. (eds), *Commodity Price Volatility and Inclusive Growth in Low - Income Countries.* Washington D.C., International Monetary Fund.

Ghosh, G., 2016. How important is mobile telephony for economic growth? Evidence from MENA countries. *Info*, Vol. 18 (3), pp. 58-79.

Gordon, R.J., 2012. Is US Economic Growth Over? Faltering Innovation confronts the Six Headwinds. *NBER Working Paper* 18315, Cambridge, MA, NBER, August. Available at: http://www.nber.org/papers/w18315.

Gordon, R.J., 2016. *The rise and fall of American growth*. Princeton, New Jersey, Princeton University Press.

GSMA, 2012. *What is the impact of mobile telephony on economic growth?* London, GSMA.

Hausman, J.A., 1978. Specification tests in econometrics. Econometrica, Vol. 46, pp. 1251-1271.

Hausman, J.A. and Taylor, W.E., 1981. Panel data and unobservable individual effects. Econometrica, Vol. 49, pp. 1377-1398.

Heltberg, R., Oviedo, A.M. and Talukdar, F., 2013. What are the sources of risk and how do people cope? Insights from household surveys in 16 countries. *World Development Report Background Paper*, November, Washington D.C., World Bank.

Hoeffler, A.E., 2002. The augmented Solow model and the African growth debate. *Oxford Bulletin of Economics and Statistics*, Vol 64 (2), pp. 135-158.

Jack, W., and T. Suri., 2011. Mobile Money: The Economics of M-PESA. *NBER Working Paper* No. 16721, Cambridge, MA, National Bureau of Economic Research.

Jensen, R., 2007. The digital provide: information technology, market performance and welfare in the South Indian Fisheries Sector. *Quarterly Journal of Economics*, 122 (3), pp. 879-924.

Jorgenson, D.W. and Stiroh, K.J., 2000. Raising the Speed Limit: U.S. Economic Growth in the Information Age. *Brookings Papers on Economic Activity*, No. 1 , pp. 125-235; including comments by R.J. Gordon and D.E. Sichel.

Jorgenson, D.W. and Vu, K. 2007. Information Technology and the World Growth Resurgence. *German Economic Review*, 8 (2): 125–145.

Kostov, P., Arun, T. & Annim, S., 2015. Access to financial services: The case of the 'Mzansi' account in South Africa. *Review of Development Finance*, Vol. 5 (1), pp. 34-42.

Lee, S.H., Levendis, J. and Gutierrez, L., 2012. Telecommunications and economic growth: an empirical analysis of sub-Saharan Africa. *Applied Economics*, 44 (4), pp. 461-469.

Mankiw, N.G., Romer, D. and Weil, D.N., 1992. A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics*, 107 (2), pp. 407–438.

Minges, M., 2012. Overview. Chapter 1 in Kelly, T., Friederici, N., Minges, M. and Yamamichi, M., *Information and Communications for Development: Maximising Mobile*. Washington D.C., The World Bank

OECD/JRC, 2008. *Handbook on constructing composite indicators. Methodology and user guide*. Paris, Organisation for Economic Co-operation and Development.

Reynès, F., 2017. The Cobb-Douglas as a Flexible Function: Analyzing the substitution between capital, labor and energy. Sciences Po OFCE Working Paper No. 12, 2017/04/20

Roller, L-H. and Waverman, L., 2001. Telecommunications Infrastructure and Economic Development: A Simultaneous Approach, *American Economic Review*, 91 (4), pp. 909–23.

Romer, P., 1990. Endogenous Technological Change. *Journal of Political Economy*, 98 (2), S71-102.

Romer, P., 1993. Idea gaps and object gaps in economic development. *Journal of Monetary Economics*, 32, 543-573.

Sachs, J. 2008. The Digital War on Poverty. *The Guardian*, August 21. Available at: http://www.guardian.co.uk/commentisfree/2008/aug/21/digitalmedia.mobilephones.

Sakyi-Narko, C., 2018. Financial inclusion and human development in Africa. *Unpublished PhD thesis*, Loughborough University, December.

Sarma, M., 2012. Index of Financial Inclusion - A measure of financial sector inclusiveness. *Working Paper* No. 07/2012, Berlin Working Papers on Money, Finance, Trade and Development, July.

Sarma, M., 2015. Measuring Financial Inclusion. *Economics Bulletin*, 35 (1), pp. 604-611.

Sassi, S. and Goaied, M., 2013. Financial development, ICT diffusion and economic growth: Lessons from MENA region. *Telecommunications Policy*, 37, pp. 252-261.

Schumpeter, J., 1934. *The Theory of Economic Development*. Cambridge: Harvard University Press.

Solow, R.M., 1956. A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, 70, 65-94.

Solow, R.M. 1987. We'd Better Watch Out. Review of *Manufacturing Matters: The Myth of the Post-Industrial Economy*, by Stephen S. Cohen and John Zysman, *New York Times*, July 12.

Svirydzenka, K., 2016. Introducing a New Broad-based Index of Financial Development. *IMF Working Paper*, WP/16/5, Washington DC, IMF.

UNDP, 2016. *Human Development Report 2015*. New York, United Nations Development Programme; available at: http://hdr.undp.org/en/data.

Waverman, L., Meschi, M. and Fuss, M. 2005. The Impact of Telecoms on Economic Growth in Developing Countries. In: Africa, The Impact of Mobile Phones. *Vodafone Policy Paper* No. 3, pp. 10-23.

Wooldridge, J.M., 2010. *Econometric Analysis of Cross Section and Panel Data*. 2nd ed. Cambridge, Mass., MIT Press.

World Bank, 2016. *World Development Report 2016: Digital Dividends.* Washington DC: World Bank.

Table 1. Summary Variable Definitions

Model Variables		Empirical Counterparts	
Variable	**Mnemonic**	**Mnemonic**	**Short Empirical Definition**
GDP *per capita*	$g \equiv dy_t$	DYDL	Rate of change in GDP per unit of labour
		DYDP	Rate of change in GDP per head of population
Fixed capital *per capita*	dk_t	DKDL	Rate of change in real stock of fixed capital per unit of labour
		DKDP	Rate of change in real stock of fixed capital per head of population
Human capital *per capita*	dh_t	DH	Rate of change in gross primary school enrolment rate
Real money balances *per capita*	dm_t	DMDL	Rate of change in real M1 per unit of labour
		DMDP	Rate of change in real M1 per head of population
Initial income *per capita*	y_{t-1}	YL1	Ln(GDP per unit of labour)
		YP1	Ln(GDP per head of population)
Population dispersion	$disp_{t-1}$	DISP	– (population density) = – (population per 1000 square metres)
Openness	x_{t-1}	X	Ln((exports+imports)/GDP)
Institutional quality	$inst_{t-1}$	INST	Freedom House measure of institutional quality: higher values reflect better quality
Inflation rate	rin_t	RIN	Rate of change in retail prices
Rate of population growth	$gpop_t$	GLAB	Rate of change in Labour force
		GPOP	Rate of change in Population
Stock of ICT capital: fixed-line	sf_{t-1}	SFL	Fixed line subscriptions per unit of labour
		SFP	Fixed line subscriptions per head of population
Stock of ICT capital: mobile	sm_{t-1}	SML	Mobile subscriptions per unit of labour
		SMP	Mobile subscriptions per head of population
Mobile money	mm_{t-1}	MML	Mobile money subscriptions per unit of labour
		MMP	Mobile money subscriptions per head of population
Income group	*inc*	INC	Cross section dummy using World Bank classification of countries as: low income = 1; lower middle income = 2; upper middle income = 3; high income = 4
Quadratic terms	sf^2_{t-1}	SFL2;	SFP2
	sm^2_{t-1}	SML2;	SMP2
	mm^2_{t-1}	MML2;	MMP2
Interaction terms: ICT	$sf_{t-1} \times sm_{t-1}$	SFL×SML;	SFP×SMP
	$sm_{t-1} \times mm_{t-1}$	SML×MML;	SMP×MMP

Model Variables		Empirical Counterparts	
Variable	**Mnemonic**	**Mnemonic**	**Short Empirical Definition**
Interaction terms: population dispersion	$sf_{t-1} \times disp_{t-1}$	SFL×DISP; SFP×DISP	
	$sm_{t-1} \times disp_{t-1}$	SML×DISP; SMP×DISP	
	$mm_{t-1} \times disp_{t-1}$	MML×DISP; MMP×DISP	
Human development	$dhdi_t$	DHDI	Change in UNDP index of human development ($LnHDI_t - LnHDI_{t-1}$)
Initial level of HDI	hdi_{t-1}	HDI1	Ln(UNDP index of human development)
Health expenditure	hxy_{t-1}	HXY	Health expenditure in % of GDP
Military expenditure	mxy_{t-1}	MXY	Military expenditure in % of GDP
Natural resource rents	nry_{t-1}	NRY	Natural resource rents in % of GDP
Relative female participation rate	fpy_{t-1}	FPY	Economically active proportion of female population aged 15+/ Economically active proportion of male population aged 15+
Control of corruption	$corr_{t-1}$	CORR	World bank governance indicator: higher values reflect lower corruption, so better governance
Financial development	df_t	DF	Change in IMF index of financial development ($LnF_t - LnF_{t-1}$)
Initial level of financial development	f_{t-1}	F1	Ln(IMF index of financial development)
Rural population	rur_{t-1}	RUR	Rural population as % of total population
Regulatory quality	reg_{t-1}	REG	World bank governance indicator: higher values reflect better regulation
Mobile money dummy	$idmm$	IDMM	Cross-section dummy =1 if country has ever had an m-money scheme; =0 otherwise
Network effect	net_{t-1}	MMNET	number of adjacent countries with available m-money services (lagged one year)
	net^2_{t-1}	MMNET2	

Notes: For full definitions, sources of data, and list of countries in the analysis see Appendix 1. Time t rates of change for any variable (K_t) are calculated as $Ln(K_t) - Ln(K_{t-1})$.

Table 2 Growth, Simplified Model: scaled by Labour force

Observations =2209	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	RoW	SSA	RoW	SSA	RoW
DKDL	+	0.236291	0.697442	0.248578	0.691352	0.245198	0.692328
t		(2.99)	(10.01)	(3.03)	(10.17)	(3.52)	(10.47)
DH	+	0.009911	-0.002221	0.010015	-0.002160	0.010207	-0.002634
t		(2.88)	(0.85)	(2.89)	(0.83)	(2.92)	(1.00)
DMDL	+	0.029682	0.041357	0.030160	0.041338	0.028803	0.042862
t		(2.83)	(6.42)	(2.86)	(6.49)	(2.54)	(6.46)
YL1	-	-0.010882	-0.006061	-0.009318	-0.005754	-0.007340	-0.005346
t		(6.60)	(5.76)	(6.51)	(6.07)	(5.04)	(5.53)
DISP	-	-0.065263	0.033804	-0.050401	0.015535	-0.017709	0.014590
t		(2.69)	(2.21)	(2.46)	(2.26)	(0.89)	(2.79)
X	+	0.002947		0.003101		0.003248	
t		(3.19)		(3.71)		(5.16)	
RIN	-	-0.001008		-0.001031		-0.000537	
t		(1.79)		(1.83)		(2.10)	
SFL	+	-0.051618	0.006654	-0.047444	0.006901	-0.048048	0.007084
t		(4.16)	(2.70)	(4.16)	(2.70)	(3.65)	(2.71)
SFL2	+/-	0.049032	-0.001269	0.046469	-0.001487	0.049345	-0.001469
t		(3.92)	(0.85)	(4.28)	(0.98)	(3.82)	(0.92)
SML2	+/-	-0.000331	0.000004	-0.000284	-0.000004	-0.000329	-0.000055
t		(3.19)	(0.07)	(2.98)	(0.07)	(3.57)	(1.22)
MML	+	-0.007872		-0.007257		-0.007655	
t		(1.56)		(1.47)		(1.60)	
MML2	+/-	0.002666	-0.002163	0.002377	0.055197	0.002240	-0.020668
t		(1.14)	(0.01)	(1.05)	(0.14)	(0.99)	(0.87)
SFL×SML	-	-0.001330		-0.001205		-0.001236	
t		(3.81)		(3.95)		(4.28)	
SML×MML	+	0.008744	0.011796	0.008318	0.006772	0.008264	0.010868
t		(3.63)	(0.41)	(3.58)	(0.21)	(4.06)	(1.48)
SML×DISP	+	-0.001942		-0.001231		-0.001133	
t		(2.33)		(2.09)		(2.04)	
MML×DISP	+	0.029309		0.026396		0.019469	
t		(4.53)		(4.32)		(4.44)	
GLAB	-	-0.023352		-0.023592		-0.018784	
t		(3.08)		(3.10)		(2.40)	
INC	+?	na	na	0.012128	0.003118	0.013038	0.003891
t				(6.14)	(3.84)	(2.68)	(2.64)
Constant		na	na	0.012340	0.046472	0.006167	0.027526
				(1.13)	(6.57)	(0.50)	(3.85)
SSA params		χ^2 (20)	119.6 (0.00)	χ^2 (22)	117.8 (0.00)	χ^2 (22)	760.5 (0.00)
Hausman test (prob)				χ^2 (48)	22.15 (1.00)		
Hansen J test (prob)						χ^2 (16)	22.69 (0.12)
Zero Restrictions (prob)		χ^2 (6)	4.50 (0.61)	χ^2 (6)	4.05 (0.67)	χ^2 (6)	4.04 (0.67)
Equalities (prob)		χ^2 (7)	7.88 (0.34)	χ^2 (7)	5.05 (0.65)	χ^2 (7)	6.96 (0.43)
F1		0.004076		0.003993		0.002986	
		2.05		2.10		1.62	

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

SSA params: test on base model for the hypothesis that the SSA parameters are identical to those of RoW

Zero Restrictions: test to delete insignificant coefficients from base model

Equality Restrictions: test of equality between SSA and RoW parameters

Table 3 Growth, Simplified Model: scaled by Population

Observations = 2229	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	**RoW**	**SSA**	**RoW**	**SSA**	**RoW**
DKDP	+	0.202268	0.742178	0.227214	0.729591	0.229100	0.712120
t		(2.65)	(9.15)	(2.89)	(9.19)	(3.43)	(9.28)
DH	+	0.011401	-0.001906	0.011453	-0.001870	0.011872	-0.002734
t		(3.01)	(0.67)	(2.99)	(0.66)	(3.13)	(0.96)
DMDP	+	0.026340	0.039493	0.027122	0.039268	0.026143	0.040392
t		(2.70)	(6.02)	(2.76)	(6.03)	(2.50)	(5.91)
YP1	-	-0.013198	-0.007613	-0.011361	-0.007203	-0.008569	-0.006448
t		(6.90)	(6.66)	(7.66)	(6.95)	(4.96)	(6.13)
DISP	-	-0.078396	0.018656	-0.051357	0.009238	-0.013715	0.012434
t		(2.85)	(1.71)	(2.42)	(3.34)	(0.87)	(3.72)
X	+	0.002954		0.003114		0.003382	
t		(3.25)		(3.75)		(5.45)	
RIN	-	-0.001104		-0.001117		-0.000574	
t		(1.74)		(1.77)		(1.93)	
SFP	+	-0.048275	0.010579	-0.052086	0.010422	-0.055126	0.011330
t		(3.17)	(5.44)	(3.23)	(5.60)	(3.03)	(5.86)
SMP	+	-0.001798	0.000733	-0.001872	0.000555	-0.003659	-0.000567
t		(1.93)	(1.00)	(1.91)	(0.77)	(3.10)	(0.76)
MMP	+	-0.016532	1.061465	-0.013001	1.087324	-0.007443	0.600610
t		(1.37)	(3.83)	(1.06)	(3.95)	(0.61)	(1.96)
MMP2	+/-	0.013234	2.308028	0.010853	2.389408	0.004544	-0.265203
t		(1.08)	(1.91)	(0.92)	(2.00)	(0.37)	(3.29)
SFP×SMP	-	-0.006894		-0.006643		-0.006127	
t		(4.35)		(4.44)		(4.24)	
SMP×MMP	+	0.047491	-0.784180	0.043398	-0.796476	0.040099	-0.441347
t		(3.53)	(3.71)	(3.28)	(3.79)	(3.36)	(1.58)
SMP×DISP	+	-0.014905	-0.002770	-0.017140	-0.001820	-0.022179	-0.001643
t		(3.78)	(2.06)	(4.95)	(1.72)	(4.73)	(1.54)
MMP×DISP	+	0.090844	1.757646	0.088237	1.884027	0.084516	0.265318
t		(6.50)	(1.96)	(6.28)	(2.12)	(6.12)	(1.93)
GPOP	-	0.022362	-0.039560	0.027778	-0.039463	0.054459	-0.020081
t		(0.79)	(2.26)	(0.74)	(2.24)	(1.02)	(1.11)
INC	+?	na	na	0.013258	0.005048	0.013963	0.005642
t				(7.23)	(5.43)	(4.06)	(3.85)
Constant		na	na	0.012812	0.048703	0.003668	0.024815
t				(1.22)	(7.40)	(0.29)	(3.53)
SSA params		χ^2 (20)	150.3 (0.00)	χ^2 (22)	173.21 (0.00)	χ^2 (22)	395.6 (0.00)
Hausman test (prob)				χ^2 (50)	23.07 (1.00)		
Hansen J test (prob)						χ^2 (18)	23.02 (0.19)
Zero Restrictions (prob)		χ^2 (8)	10.56 (0.23)	χ^2 (8)	9.28 (0.32)	χ^2 (8)	4.97 (0.76)
Equalities (prob)		χ^2 (3)	4.33 (0.23)	χ^2 (3)	2.62 (0.45)	χ^2 (3)	3.17 (0.37)
F1		0.004860		0.004696		0.004144	
		(2.35)		(2.44)		(2.28)	

Notes
SSA: sub-Saharan Africa; RoW: Rest of World
SSA params: test on base model for the hypothesis that the SSA parameters are identical to those of RoW
Zero Restrictions: test to delete insignificant coefficients from base model
Equality Restrictions: test of equality between SSA and RoW parameters

Table 4 Estimated Impact of mobile money on growth

Country Sub-Saharan Africa	Per unit of Labour (1) Excl FI	Per unit of Labour (2) Incl FI	Per capita (Population) (3) Excl FI	Per capita (Population) (4) Incl FI
Benin	0.001013	0.001046	0.011800	0.011774
Botswana	0.006028	0.006028	0.024290	0.024249
Burkina Faso	-0.002224	-0.002198	0.005975	0.005945
Cameroon	-0.001996	-0.001976	0.005453	0.005420
Chad	-0.003886	-0.003878	-0.000293	-0.000332
Congo, Republic of	0.002667	0.002671	0.012005	0.011967
Cote d'Ivoire	0.004349	0.004379	0.015443	0.015410
Gabon	0.009218	0.009186	0.018430	0.018405
Ghana	0.002851	0.002901	0.017209	0.017182
Guinea	-0.002683	-0.002661	0.004564	0.004532
Guinea-Bissau	0.000571	0.000590	0.011067	0.011041
Kenya	0.002477	0.002530	0.011154	0.011108
Lesotho	0.002227	0.002274	0.012570	0.012529
Liberia	-0.000165	-0.000155	0.006750	0.006721
Madagascar	-0.004152	-0.004128	0.001524	0.001485
Malawi	-0.002785	-0.002724	0.008808	0.008803
Mali	0.002349	0.002350	0.008999	0.008962
Mauritania	0.007794	0.007767	0.013500	0.013470
Mauritius	0.016805	0.017034	0.068355	0.068468
Mozambique	-0.002424	-0.002399	0.003576	0.003534
Namibia	0.002283	0.002278	0.010102	0.010066
Niger	-0.003421	-0.003406	-0.000722	-0.000765
Nigeria	0.002570	0.002624	0.016207	0.016211
Rwanda	0.004852	0.005010	0.033165	0.033203
Senegal	0.002941	0.002963	0.011081	0.011055
South Africa	0.008124	0.008116	0.021946	0.021928
Sudan	0.000229	0.000229	0.004210	0.004176
Swaziland	0.003979	0.004002	0.012578	0.012553
Tanzania	0.001025	0.001086	0.008480	0.008416
Togo	-0.001025	-0.000981	0.011184	0.011171
Uganda	0.000786	0.000867	0.013792	0.013770
Zambia	-0.001339	-0.001321	0.004489	0.004445
Zimbabwe	-0.000658	-0.000632	0.008529	0.008488
Africa Average	**0.001769**	**0.001802**	**0.012613**	**0.012588**
RoW Average	**0.002083**	**0.002334**	**0.433111**	**0.437995**
end-samp Africa Average	**0.015099**	**0.015113**	**0.038261**	**0.038252**
end-samp RoW Average	**0.016512**	**0.017230**	**0.136137**	**0.137786**

Each individual country coefficient shows the impact of a unit increase in mobile money subscriptions per head on the growth rate in GDP per head. This is given by: $\frac{dg_t}{dmm_{t-1}} = \phi_1 + \phi_2 mm_{t-1} + \phi_3 sm_{t-1} + \phi_4 n_{t-1} + \theta_2$ calculated at the country mean taken over all non-zero observations using Hausman-Taylor estimates. Countries for which either there is no mobile money scheme or mobile money data is not available are excluded: Angola, Burundi, Cabo Verde, Central African Republic, Comoros, Democratic Republic of Congo, Equitorial Guinea, Ethiopia, The Gambia, Sao Tome and Principe, Sierra Leone, The Seychelles. The Africa and RoW averages are averages over all countries with mobile money data; the end-smp averages are averages of individual country coefficients, where these coefficients are calculated at the most recent values of the conditioning variables instead of the country means.

Excl FI: calculations based on regressions that exclude FI

Incl FI: calculations based on regressions that include FI

Table 5 Estimated Impact of ICT on growth

	Per unit of labour		Per capita (/Population)	
Derivative	**SSA**	**RoW**	**SSA**	**RoW**
Mobile	-0.000171	-0.000775	-0.001324	-0.024157
Fixed Line	-0.042946	0.004037	-0.057039	0.007697

Each coefficient shows the impact of a unit increase in mobile or fixed line subscriptions per head on the growth rate in GDP per head. These are calculated analogously to the mobile money derivatives, at the country means using Hausman-Taylor estimates. Calculations are based on regressions that exclude FI.

Table 6 HDI, Simplified Model: scaled by Labour force

Observations = 2207	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	RoW	SSA	RoW	SSA	RoW
DKDL	+	0.327380		0.314522		0.351136	
t		(2.83)		(2.71)		(3.83)	
DH	+	0.046096	0.013001	0.047484	0.014033	0.044615	0.013754
t		(3.77)	(2.26)	(3.85)	(2.37)	(6.68)	(2.29)
DMDL	+	0.064414	0.003276	0.065548	0.005556	0.049441	0.006772
t		(1.69)	(0.33)	(1.67)	(0.57)	(3.23)	(0.55)
HDI1	-	-0.068641		-0.054565		-0.052890	
t		(5.27)		(5.45)		(10.61)	
DISP	-	-0.093731	0.084658	-0.059188	0.033537	-0.000430	0.022106
t		(1.87)	(3.92)	(2.36)	(3.64)	(0.02)	(2.05)
SFL	+	-0.016848		-0.015200		-0.012354	
t		(2.57)		(2.51)		(2.33)	
SFL2	+/-	0.016310		0.014073		0.011275	
t		(3.72)		(3.49)		(3.07)	
SML	+	0.001279	-0.005183	0.002014	-0.004971	0.001954	-0.004620
t		(0.47)	(3.71)	(0.78)	(3.69)	(1.15)	(4.43)
SML2	+/-	-0.000783	0.000742	-0.000939	0.000766	-0.000932	0.000732
t		(0.95)	(2.78)	(1.14)	(2.97)	(1.81)	(3.18)
MML	+	-0.051285	0.314616	-0.050555	0.309115	-0.040909	0.071218
t		(4.93)	(3.44)	(4.91)	(3.30)	(3.07)	(0.43)
MML2	+/-	0.016206	0.429347	0.016598	0.523721	0.010086	-0.046732
t		(3.80)	(2.03)	(3.69)	(2.31)	(1.36)	(0.89)
SFL×SML	-	0.014226	-0.001140	0.014629	-0.000430	0.011438	-0.000166
t		(1.95)	(1.03)	(2.28)	(0.42)	(2.30)	(0.22)
SML×MML	+	0.018145	-0.126683	0.017937	-0.134052	0.015412	-0.005706
t		(3.62)	(3.01)	(3.68)	(2.92)	(3.20)	(0.08)
SML×DISP	+	0.019748	-0.007134	0.017940	-0.003115	0.011320	-0.001462
t		(2.41)	(2.34)	(2.67)	(1.28)	(1.90)	(1.06)
MML×DISP	+	0.020716		0.022914		0.019568	
t		(1.32)		(1.43)		(1.07)	
GLAB	-	-0.008419		-0.009758		-0.005570	
t		(0.36)		(0.41)		(0.40)	
INC	+?	na	na	0.008974	0.004365	0.017212	0.004652
t				(3.63)	(2.96)	(2.98)	(1.45)
HXY	+	0.044629	0.027485	0.062202	0.044288	0.105730	0.041519
t		(0.50)	(1.17)	(0.69)	(2.08)	(3.26)	(1.63)
NRY	-	0.006154		0.005128		0.006354	
t		(0.84)		(0.74)		(1.27)	
CORR	+	-0.006737	0.000463	-0.007006	0.000620	-0.007849	0.000489
t		(2.24)	(0.38)	(2.62)	(0.56)	(3.91)	(0.43)
Constant		na	na	-0.036531	-0.027332	-0.049921	-0.097398
t				(3.54)	(3.41)	(3.49)	(5.46)
SSA params (prob)		χ^2 (25)	243.2 (0.00)	χ^2 (27)	251.5 (0.00)	χ^2 (27)	280.1 (0.00)
Hausman test (prob)				χ^2 (52)	31.44 (0.99)		
Hansen J test (prob)						χ^2 (23)	54.80 (0.00)
Zero Restrictions (prob)		χ^2 (12)	16.12 (0.19)	χ^2 (12)	14.69 (0.25)	χ^2 (12)	17.50 (0.13)
Equalities (prob)		χ^2 (7)	11.18 (0.13)	χ^2 (7)	7.69 (0.36)	χ^2 (7)	5.42 (0.61)
FI1		0.001408		0.002061		0.002125	
t		0.34		0.54		0.51	

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

SSA params: test on base model for the hypothesis that the SSA parameters are identical to those of RoW

Zero Restrictions: test to delete insignificant coefficients from base model

Equality Restrictions: test of equality between SSA and RoW parameters

Table 7 HDI, Simplified Model: scaled by population

Observations = 2222	Sign	Fixed Effects SSA	Fixed Effects RoW	Random Effects SSA	Random Effects RoW	Hausman-Taylor SSA	Hausman-Taylor RoW
DKDP	+	0.351626		0.339956		0.371808	
t		(3.33)		(3.22)		(4.36)	
DH	+	0.045142	0.014500	0.046025	0.015556	0.043148	0.015236
t		(3.48)	(2.48)	(3.55)	(2.57)	(6.48)	(2.53)
DMDP	+	0.050477	0.004006	0.052065	0.005392	0.040052	0.006090
t		(1.58)	(0.45)	(1.58)	(0.61)	(3.09)	(0.55)
HDI1	-	-0.074379		-0.061716		-0.054857	
t		(5.57)		(5.60)		(11.05)	
DISP	-	-0.150639	0.085086	-0.104196	0.044962	-0.020395	0.046556
t		(3.00)	(3.58)	(3.38)	(3.26)	(1.00)	(3.05)
SFP	+	-0.046521		-0.045900		-0.044051	
t		(3.68)		(3.69)		(4.04)	
SFP2	+/-	0.073784		0.071912		0.065417	
t		(4.65)		(4.64)		(4.44)	
SMP	+	-0.005112		-0.004698		-0.003914	
t		(2.72)		(2.56)		(2.94)	
MMP	+	-0.068033	0.659456	-0.062936	0.678225	-0.049710	0.533065
t		(3.71)	(2.81)	(3.63)	(3.22)	(1.85)	(1.67)
MMP2	+/-	0.045862	0.495619	0.045444	1.013286	0.024222	-0.501691
t		(1.91)	(0.69)	(1.93)	(1.52)	(0.65)	(1.71)
SFP×SMP	-	0.095013	-0.006371	0.090540	-0.004312	0.057047	-0.004778
t		(4.44)	(1.11)	(4.43)	(0.80)	(2.95)	(1.51)
SMP×MMP	+	0.057254	-0.322053	0.053721	-0.391203	0.043508	-0.256835
t		(2.62)	(3.27)	(2.60)	(4.21)	(2.00)	(1.07)
SFP×DISP	+?	-0.058117		-0.037725		-0.044528	
t		(1.85)		(1.27)		(1.46)	
SMP×DISP	+	0.056544	-0.011581	0.046000	-0.005631	0.021530	-0.004132
t		(3.91)	(2.13)	(3.58)	(1.32)	(1.68)	(1.39)
MMP×DISP	+	0.053124	1.114551	0.063924	1.047990	0.050977	0.573938
t		(1.46)	(1.47)	(1.74)	(1.59)	(1.31)	(1.86)
GPOP	-	0.238536	-0.006330	0.226508	-0.008938	0.250129	-0.001954
t		(2.76)	(0.25)	(2.57)	(0.35)	(3.30)	(0.08)
INC	+?	na	na	0.010301	0.006661	0.019602	0.005805
t				(4.36)	(3.99)	(3.53)	(1.66)
HXY	+	0.025300		0.041005		0.060632	
t		(0.76)		(1.23)		(2.90)	
NRY	-	0.030552	-0.010010	0.027689	-0.009953	0.020397	-0.004416
t		(2.46)	(1.32)	(2.28)	(1.40)	(2.85)	(0.67)
CORR	+	-0.005960	-0.000297	-0.006366	-0.000159	-0.007336	-0.000116
t		(2.22)	(0.25)	(2.59)	(0.14)	(3.64)	(0.10)
Constant		na	na	-0.046885	-0.035256	-0.061554	-0.109267
t				(5.73)	(3.53)	(4.09)	(5.57)
SSA params (prob)		χ^2 (25)	234.4 (0.00)	χ^2 (27)	262.7(0.00)	χ^2 (27)	290.9 (0.00)
Hausman test (prob)				χ^2 (52)	30.49 (0.99)		
Hansen J test (prob)						χ^2 (23)	53.82 (0.00)
Zero Restrictions (prob)		χ^2 (12)	15.31 (0.22)	χ^2 (12)	17.96 (0.12)	χ^2 (12)	15.73 (0.20)
Equalities (prob)		χ^2 (7)	4.10 (0.77)	χ^2 (7)	4.72 (0.69)	χ^2 (7)	9.87 (0.20)
F1		0.000502		0.001139		0.001703	
		(0.11)		(0.29)		(0.40)	

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

SSA params: test on base model for the hypothesis that the SSA parameters are identical to those of RoW

Zero Restrictions: test to delete insignificant coefficients from base model

Equality Restrictions: test of equality between SSA and RoW parameters

Table 8 Estimated Impact of ICT and Mobile Money on HDI

Country	Labour Force (3) Excl FI	Labour Force (4) Incl FI	Population (1) Excl FI	Population (2) Incl FI
Mobile Money				
Africa Average	-0.021772	-0.021795	-0.027060	-0.028183
end-samp Africa Average	0.005210	0.005727	0.003462	0.004074
RoW Average	0.057735	0.060993	0.476660	0.477103
end-samp RoW Average	0.043965	0.045169	0.295812	0.295358
Mobile Telephony	**Excl FI**		**Excl FI**	
Africa Average	0.122354		0.002118	
RoW Average	0.146608		-0.017951	
Fixed Line Telephony	**Excl FI**		**Excl FI**	
Africa Average	0.018585		-0.026144	
RoW Average	-0.000632		-0.016424	

Africa and RoW averages are calculated as in tables 4 and 5.

Table 9 Financial Development, Simplified Model: scaled by Labour force

Observations = 2899	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	RoW	SSA	SSA	SSA	RoW
DYDL	+	3.491430	1.952217	3.474614	1.948776	3.507976	1.979506
t		(3.83)	(2.62)	(3.84)	(2.64)	(5.83)	(2.84)
F1	-	-0.354707	-0.211978	-0.339719	-0.203619	-0.343276	-0.209815
t		(3.26)	(11.52)	(3.41)	(11.96)	(16.08)	(13.70)
RIN	-	0.000512	-0.030984	0.000479	-0.030771	0.000667	-0.031118
t		(0.14)	(1.91)	(0.13)	(1.91)	(0.23)	(3.76)
SML	+	0.068741	0.020263	0.067079	0.018950	0.068367	0.019174
t		(3.37)	(1.65)	(3.40)	(1.59)	(5.64)	(1.77)
SML2	+/-	-0.005575		-0.005287		-0.005271	
t		(2.57)		(2.51)		(2.41)	
MML	+	0.183027		0.180499		0.178590	
t		(2.23)		(2.27)		(1.46)	
MML2	+/-	-0.107149		-0.106811		-0.104553	
t		(2.70)		(2.71)		(1.67)	
SML×MML	+	-0.049934	-0.011630	-0.048331	-0.011486	-0.050220	-0.014358
t		(1.34)	(0.37)	(1.34)	(0.37)	(1.24)	(0.30)
MML×DISP	+	-0.176798	0.316511	-0.172351	0.312624	-0.174196	0.295070
t		(1.34)	(3.80)	(1.34)	(3.89)	(1.07)	(1.09)
INC	+	na	na	0.078828		0.131125	
t				(4.50)		(5.55)	
IDMM	+	na	na	0.036348		0.114537	
t				(2.34)		(3.33)	
MMNET	+	-0.009326	0.000250	-0.009316	0.000449	-0.009203	0.000628
t		(2.34)	(0.04)	(2.35)	(0.08)	(4.65)	(0.13)
REG	+	0.012601		0.014038		0.015810	
t		(0.72)		(0.84)		(1.33)	
CORR	+	0.038602		0.040090		0.035684	
t		(2.59)		(3.01)		(3.04)	
Constant		na	na	-0.442642	-0.582558	-0.398432	-1.034084
t				(1.93)	(9.05)	(6.24)	(9.48)
SSA params (prob)		χ^2 (16)	154.8 (0.00)	χ^2 (19)	2819.1 (0.00)	χ^2 (19)	288.0 (0.00)
Hausman test (prob)				χ^2 (39)	16.44 (1.00)		
Hansen J test (prob)						χ^2 (11)	3.04 (0.99)
Zero Restrictions		χ^2 (8)	6.09 (0.64)	χ^2 (8)	8.62 (0.38)	χ^2 (8)	5.80 (0.67)
Equality Restrictions		χ^2 (5)	1.71 (0.13)	χ^2 (7)	10.01 (0.19)	χ^2 (7)	8.84 (0.26)

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

SSA params: test on base model for the hypothesis that the SSA parameters are identical to those of RoW

Zero Restrictions: test to delete insignificant coefficients from base model

Equality Restrictions: test of equality between SSA and RoW parameters

Table 10 Financial Development, Simplified Model: scaled by population

Observations = 2920	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	**RoW**	**SSA**	**RoW**	**SSA**	**RoW**
DYDP	+	2.959302	2.020176	2.945197	1.998171	2.979411	1.985831
t		(3.76)	(2.67)	(3.77)	(2.67)	(5.52)	(2.94)
F1	-	-0.352274	-0.215738	-0.337396	-0.206268	-0.339275	-0.211130
t		(3.29)	(11.41)	(3.45)	(11.89)	(16.12)	(13.75)
RIN	-	0.000355	-0.030105	0.000324	-0.029957	0.000454	-0.030434
t		(0.10)	(1.89)	(0.09)	(1.89)	(0.16)	(3.68)
SMP	+	0.178821	0.074219	0.174582	0.070013	0.179298	0.072552
t		(3.62)	(2.26)	(3.65)	(2.19)	(6.08)	(2.69)
SMP2	+/-	-0.045677		-0.043943		-0.046199	
t		(2.88)		(2.84)		(3.36)	
MMP	+	0.137880		0.139964		0.124600	
t		(0.71)		(0.72)		(0.67)	
MMP2	+/-	-0.470623	0.087081	-0.470464	0.071442	-0.454001	0.085948
t		(1.89)	(0.19)	(1.89)	(0.15)	(1.42)	(0.14)
SMP×DISP	+	0.016559		0.013549		0.008600	
t		(0.49)		(0.42)		(0.42)	
MMP×DISP	+	-0.482545	0.515814	-0.463440	0.529759	-0.443287	0.532233
t		(1.37)	(1.86)	(1.34)	(1.96)	(1.33)	(0.86)
INC	+	na	na	0.083481		0.123869	
t				(4.61)		(5.83)	
IDMM	+	na	na	0.036962		0.112899	
t				(2.26)		(3.30)	
MMNET	+	-0.009153	-0.000572	-0.009125	-0.000342	-0.008960	-0.000325
t		(2.39)	(0.11)	(2.39)	(0.07)	(4.71)	(0.07)
REG	+	0.008702		0.010463		0.014932	
t		(0.50)		(0.63)		(1.29)	
CORR	+	0.037351		0.039164		0.037104	
t		(2.53)		(2.98)		(3.19)	
Constant		na	na	-0.424041	-0.602534	-0.391308	-1.009630
t				(1.89)	(9.00)	(6.30)	(9.82)
SSA params (prob)		χ^2 (16)	154.8 (0.00)	χ^2 (19)	3810 (0.00)	χ^2 (19)	287.8 (0.00)
Hausman test (prob)				χ^2 (40)	17.30 (1.00)		
Hansen J test (prob)						χ^2 (11)	5.94 (0.88)
Zero Restrictions		χ^2 (8)	4.84 (0.77)	χ^2 (8)	5.77 (0.67)	χ^2 (8)	5.98 (0.65)
Equality Restrictions		χ^2 (5)	3.30 (0.65)	χ^2 (7)	4.51 (0.72)	χ^2 (7)	7.65 (0.36)

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

SSA params: test on base model for the hypothesis that the SSA parameters are identical to those of RoW

Zero Restrictions: test to delete insignificant coefficients from base model

Equality Restrictions: test of equality between SSA and RoW parameters

Table 11 Estimated Impact of Mobile Money on Financial Inclusion

Country	Population	Labour Force
Africa Average	0.112773	0.188587
end-samp Africa Average	0.024591	0.069378
RoW Average	0.345490	0.307847
end-samp RoW Average	0.362219	0.280605

Africa and RoW averages are calculated as in tables 4 and 5.

Appendix 1: Data Sources and Definitions

The data were collected from the World Bank World Development Indicators 2018 (WDI), World Bank Financial Development and Structure Dataset 2018 (FDSD), World Bank Global Financial Development Database 2018 (GFDD), IMF International Financial Statistics 2017 (IFS), IMF Financial Access Survey 2017 (FAS), IMF Financial Development Index 2016, BIS Debt Securities Database 2018 (BIS), Thomson Reuters Datastream (DS), Penn World Tables 9.0 (PWT), Freedom House 2018 (FH), Pippa Norris 2009, and the UNDP Human Development Index 2018 (HDI).

WDI reported 216 countries in the world; 38 were missing from FDSD and FAS and were excluded. A further 22 countries were dropped due to missing data. Iraq, Libya, South Sudan, Syrian Arab Republic, Republic of Yemen were dropped due to war and instability. Canada, Hong Kong, Luxembourg, Singapore, and the USA were also dropped because of their special features (financial size in the case of the US and connection to the US in the case of Canada). The final sample consists of 146 countries, including 45 Sub-Saharan African countries. Among these countries, 35 have mobile money data reported until 2016.

Exhibit A1.1 lists the sample countries sorted by region and income group, based on the classification of the World Bank FDSD[1].

Table A1.1 summarises the variables, definitions and data sources. The base variables in the model in equations (4), (8), (9) are all expressed in real constant dollar terms. To measure the impact of ICT we used the standard measure of penetration which is the number of subscriptions per head of population or labour force. Hence: *sf* = fixed-line subscriptions per head; *sm* = mobile subscriptions per head; *mm* = m-money subscriptions per head. It is well-known that these measures can be problematic, especially for mobile telephony and especially in Africa. Subscription data depend in part on network coverage. There can be high levels of penetration and usage in urban areas combined with much lower usage in rural areas where infrastructure is less well-developed. In such areas, fixed line facilities are often non-existent, especially in poorer

[1] Malta was reclassified as in Europe & Central Asia instead of in Middle East & North Africa.

countries, particularly in Africa. Mobile facilities are also subject to network investment in masts and generators, and it is invariably harder to access a signal in rural areas. African mobile data is further complicated by the almost universal use of pay-as-you-go and the widespread sharing of phones and SIM cards. Penetration data may grossly overstate or equally understate the true extent of usage (Aker and Mbiti, 2010). Similar considerations apply to the use of m-money facilities, which are additionally dependent on access to a mobile phone and mobile agent as well as the mobile network. Nevertheless, as penetration data are those that are most readily available for any cross-country study we use these to calculate our ICT variables.

Exhibit A1.1. Sample Countries

Sub-Saharan Africa, Low income: Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Ethiopia, Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Uganda, Zimbabwe

Sub-Saharan Africa, Lower middle income: Cabo Verde, Cameroon, Republic of Congo, Cote d'Ivoire, Ghana, Kenya, Lesotho, Mauritania, Nigeria, Sao Tome and Principe, Sudan, eSwatini (formerly Swaziland), Zambia

Sub-Saharan Africa, Upper middle income: Angola, Botswana, Equatorial Guinea, Gabon, Mauritius, Namibia, South Africa

Sub-Saharan Africa, High income: Seychelles

Middle East & North Africa, Lower middle income: Djibouti, Egypt, Morocco, Tunisia

Middle East & North Africa, Upper middle income: Algeria, Iran, Jordan, Lebanon

Middle East & North Africa, High income: Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates

Latin America & Caribbean, Low Income: Haiti

Latin America & Caribbean, Lower middle income: Bolivia, El Salvador, Guatemala, Honduras, Nicaragua

Latin America & Caribbean, Upper middle income: Argentina, Belize, Brazil, Colombia, Costa Rica, Dominican Republic, Jamaica, Mexico, Panama, Paraguay, Peru, Suriname, Venezuela

Latin America & Caribbean, High income: Chile, Uruguay

South Asia, Low income: Nepal

South Asia, Lower middle income: Bangladesh, Bhutan, India, Pakistan, Sri Lanka, Maldives

East Asia & Pacific, Lower middle income: Cambodia, Indonesia, Lao People's Democratic Republic, Mongolia, Myanmar, Philippines, Vietnam

East Asia & Pacific, Upper middle income: China, Fiji, Malaysia, Thailand

East Asia & Pacific, High income: Australia, Japan, Republic of Korea, New Zealand

Europe & Central Asia, Lower middle income: Armenia, Kyrgyz Republic, Moldova, Tajikistan, Ukraine, Uzbekistan

Europe & Central Asia, Upper middle income: Albania, Azerbaijan, Belarus, Bulgaria, Georgia, Kazakhstan, Macedonia, FYR, Romania, Russian Federation, Turkey

Europe & Central Asia, High income: Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom

Table A1.1. Variable Definitions and Sources

Model Variables	Mnemonic	Short Empirical Definition	Source
GDP *per capita*	y_t	GDP per unit of labour	PWT (rgdpna[1]), WDI (SP.POP.TOTL[2]; SL.TLF.TOTL.IN[3])
		GDP per head of population	
Fixed capital *per capita*	k_t	Real stock of fixed capital per unit of labour	PWT (rkna[4])
		Real stock of fixed capital per head of population	
Human capital *per capita*	h_t	Gross primary school enrolment rate	WDI (SE.PRM.ENRR[5])
Real money balances *per capita*	m_t	Real M1 per unit of labour	IFS (M1 – L34[6]), DS
		Real M1 per head of population	
Population dispersion	$disp_t$	– (population density) = – (population per 1000 square metres)	WDI (EN.POP.DNST[7])
Openness	x_t	Ln((exports+imports)/GDP)	WDI (NE.TRD.GNFS.ZS[8])
Institutional quality	$inst_t$	Freedom House measure of institutional quality	FH 2018[9], Pippa Norris 2009

1 rgdpna: Real GDP at constant 2011 national prices (in mil. 2011US$) – PWT.

2 SP.POP.TOTL: Total population, based on the *de facto* definition of population, which counts all residents regardless of legal status or citizenship. The values shown are mid-year estimates – WDI.

3 SL.TLF.TOTL.IN: Total labour force, comprises people ages 15 and older who supply labour for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers. Not everyone who works is included. Unpaid workers, family workers, and students are often omitted, and some countries do not count members of the armed forces. Labour force size tends to vary during the year as seasonal workers enter and leave – WDI.

4 rkna: Capital stock at constant 2011 national prices (in mil. 2011US$) – PWT.

5 SE.PRM.ENRR: Gross enrolment ratio, is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music – WDI.

6 M1 L34: Money line 34 equals the sum of currency outside deposit money banks (line 14a) and demand deposits other than those of the central government (lines 14d, 14e, 14f, 14g, and 24) plus, where applicable, lines 24..i and 24..r. demand deposits of sectors other than the central government held by the central bank (lines 14d, 14e, 14f, and 14g are not published series) – IFS.
PWT reports rgdpna – Real GDP at constant 2011 national prices in millions 2011 US$. WDI reports NY.GDP.MKTP.CN – GDP (current LCU) and IFS reports M1 – L34 (current LCU), which are both at the nominal prices for each year in the value of the national currency for that particular year. A deflator is calculated as WDI GDP/(PWT GDP * 1 mil.), M1 in current LCU is then divided by the deflator so that it is converted to constant 2011 US$ (mil.). https://datahelpdesk.worldbank.org/knowledgebase/articles/114942-what-is-the-difference-between-current-and-constant.

7 EN.POP.DNST: Population density, is mid-year population divided by land area in 1000 square metres. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship – except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes – WDI. The original data is in square kilometres. It was divided by 1000.

8 NE.TRD.GNFS.ZS: Trade (% of GDP), trade is the sum of exports and imports of goods and services measured as a share of gross domestic product – WDI.

9 Calculated based on the Political Rights (PR) rating and Civil Liberties (CL) rating published by Freedom House 2018 (FH 2018), where PR carries a weight of 40% and CL carries a weight of 60%. The aggregate score of FH 2018 covers the period from 2003 to 2016.
Freedom House Reports two summary measures of political rights and civil liberties on a scale of 1-7, and then averages the two measures to obtain a single index of freedom. The two summary measures are based on

Model Variables	Mnemonic	Short Empirical Definition	Source
Inflation rate	rin_t	Retail prices	WDI (FP.CPI.TOTL.ZG[10])
Rate of population growth	$gpop_t$	Labour force	WDI
		Population	
Stock of ICT capital: fixed-line	sf_t	Fixed line subscriptions per unit of labour	WDI (IT.MLT.MAIN.P2[11])
		Fixed line subscriptions per head of population	
Stock of ICT capital: mobile	sm_t	Mobile subscriptions per unit of labour	WDI (IT.CEL.SETS.P2[12])
		Mobile subscriptions per head of population	
Mobile money	mm_t	Mobile money subscriptions per unit of labour	FAS (Mobile money accounts: registered per 1,000 adults)[13]
		Mobile money subscriptions per head of population	
Income group	inc	World bank classified countries as: low income = 1; lower middle income = 2; upper middle income = 3; high income = 4	FDSD
Human development	HDI_t	UNDP index of human development	UNDP's HDI
Health expenditure	hxy_t	Health expenditure in % of GDP	WDI (SH.XPD.TOTL.ZS[14])

aggregate scores ranging from 1-40 (political rights) and 1-60 (civil liberties). It can be argued that compressing the scales into the summaries simply throws away information. For example, a country classified as "partly free" (3-5 on the single compressed scale), could have an underlying aggregate score ranging from 24/100 to 77/100 (from less to more free. Furthermore, because of the implied weighting in the averaging process, a country classified as "not free" could have an aggregate score that is higher (up to 36/100) than the lowest possible score of a country classified as "partly free" (24/100). For these reasons, we prefer not to use the summary measures provided by Freedom House. We use instead the actual aggregate score divided by 100, which weights political rights and civil liberties 40-60, according to the maximum scores attainable under each metric. We do not claim that this is "better" than the summary measures, but that it makes fuller use of the information collected.
The aggregate score of Pippa Norris 2009 covers the period before 2006. The two data series were combined and spliced based on 2003 and 2004.

10 FP.CPI.TOTL.ZG: Inflation, measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used – WDI.

11 IT.MLT.MAIN.P2: Fixed telephone subscriptions (per 100 people), fixed telephone subscriptions refers to the sum of active number of analogue fixed telephone lines, voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents and fixed public payphones – WDI. SF_P = IT.MLT.MAIN.P2/100; SF_L = IT.MLT.MAIN.P2/100*(population/labour).

12 IT.CEL.SETS.P2: Mobile cellular subscriptions (per 100 people) are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology. The indicator includes (and is split into) the number of post-paid subscriptions, and the number of active prepaid accounts (that have been used during the last three months). The indicator applies to all mobile cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging and telemetry services – WDI. SM_P= IT.CEL.SETS.P2/100; SM_L= IT.CEL.SETS.P2/100*(population/labour).

13 Registered mobile money accounts refers to accounts with a resident MMSP that is primarily accessed by a mobile phone and is useable or has been used for mobile money transactions – FAS. MM_P = (Mobile money accounts: registered per 1,000 adults)/1000*(labour/population), MM_L = (Mobile money accounts: registered per 1,000 adults)/1000.

14 SH.XPD.TOTL.ZS: Total health expenditure (% of GDP), is the sum of public and private health expenditure. It covers the provision of health services, family planning activities, nutrition activities, and emergency aid designated for health, but does not include provision of water and sanitation. – WDI

Model Variables	Mnemonic	Short Empirical Definition	Source
Military expenditure	mxy_t	Military expenditure in % of GDP	WDI (MS.MIL.XPND.GD.ZS[15])
Natural resource rents	nry_t	Natural resource rents in % of GDP	WDI (NY.GDP.TOTL.RT.ZS[16])
Female participation rate/male participation rate	fpy_t	Economically active proportion of female population aged 15+/ Economically active proportion of male population aged 15+	WDI (SL.TLF.CACT.FE.ZS[17], SL.TLF.CACT.MA.ZS[18])
Control of corruption	$corr_t$	World bank governance indicator: higher values reflect lower corruption, so better governance	WDI (CC.EST[19])
Financial development	f_t	IMF index of financial development	IMF's FDI, GFDD, BIS
Rural population	rur_t	Rural population as % of total population	WDI (SP.RUR.TOTL.ZS[20])
Regulatory quality	reg_t	World bank governance indicator: higher values reflect better regulation	WDI (RQ.EST[21])
Network effects	net_t	Number of adjacent countries with available m-money services (lagged one year)	FAS, FDSD

15 MS.MIL.XPND.GD.ZS: Military expenditure (% of GDP), military expenditures data from SIPRI are derived from the NATO definition, which includes all current and capital expenditures on the armed forces, including peacekeeping forces; defence ministries and other government agencies engaged in defence projects; paramilitary forces, if these are judged to be trained and equipped for military operations; and military space activities. Expenditures include military and civil personnel, including retirement pensions of military personnel and social services for personnel; operation and maintenance; procurement; military research and development; and military aid (in the military expenditures of the donor country). Excluded are civil defence and current expenditures for previous military activities, such as for veterans' benefits, demobilization, conversion, and destruction of weapons. This definition cannot be applied for all countries, as that would require more detailed information than is available about military budgets and off-budget military expenditure items. – WDI

16 NY.GDP.TOTL.RT.ZS: Total natural resources rents (% of GDP), are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. – WDI

17 SL.TLF.CACT.FE.ZS: Labour force participation rate, female (% of female population ages 15+) (modelled ILO estimate), is the proportion of the population ages 15 and older that is economically active: all people who supply labour for the production of goods and services during a specified period. – WDI

18 SL.TLF.CACT.MA.ZS: Labour force participation rate, male (% of male population ages 15+) (modelled ILO estimate), is the proportion of the population ages 15 and older that is economically active: all people who supply labour for the production of goods and services during a specified period. – WDI

19 CC.EST: Control of Corruption: World Bank governance indicator captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the state by elites and private interests. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5. Higher values reflect lower corruption, so better governance – WDI

20 SP.RUR.TOTL.ZS: Rural population (% of total population), refers to people living in rural areas defined by national statistical offices; calculated as the difference between total population and urban population. – WDI

21 RQ.EST: Regulatory Quality: Estimate, captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5. Higher values reflect better regulation. – WDI

Appendix 2: Base Model Estimates

Appendix Table A2.1 Determinants of Growth, Base Model: scaled by Labour force

Observations = 2209	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	RoW	SSA	RoW	SSA	RoW
DKDL	+	0.212908	0.717856	0.221360	0.707220	0.010987	0.690259
t		(1.87)	(10.19)	(1.94)	(10.05)	(3.15)	(10.25)
DH	+	0.008857	-0.002088	0.009133	-0.002068	0.029856	-0.002651
t		(2.52)	(0.81)	(2.53)	(0.80)	(2.83)	(1.03)
DMDL	+	0.025226	0.042115	0.026367	0.042089	-0.007240	0.040880
t		(2.07)	(6.65)	(2.14)	(6.72)	(4.77)	(6.17)
YL1	-	-0.011611	-0.006387	-0.010233	-0.005984	0.019816	-0.005217
t		(6.03)	(5.49)	(5.96)	(5.63)	(0.78)	(4.98)
DISP	-	-0.081086	0.035253	-0.060011	0.016527	-0.004816	0.016471
t		(2.75)	(2.43)	(2.34)	(2.15)	(3.07)	(1.93)
X	+	0.001873	0.003268	0.002352	0.003315	0.000169	0.002390
t		(1.10)	(3.54)	(1.46)	(3.80)	(0.05)	(3.06)
INST	+	0.001752	0.002117	0.002070	0.001877	-0.000179	0.001699
t		(0.67)	(1.06)	(0.78)	(1.00)	(0.52)	(0.95)
RIN	-	-0.004536	-0.001009	-0.004593	-0.001024	-0.059743	-0.000960
t		(1.13)	(1.72)	(1.17)	(1.76)	(3.60)	(1.79)
SFL	+	-0.054678	0.007269	-0.051965	0.007454	0.095523	0.007141
t		(3.23)	(2.92)	(3.18)	(2.98)	(2.64)	(2.67)
SFL2	+/-	0.081658	-0.001487	0.088433	-0.001785	-0.000173	-0.001661
t		(2.05)	(0.96)	(2.10)	(1.17)	(0.20)	(0.97)
SML	+	0.000141	0.000442	0.000265	0.000332	-0.000277	-0.000191
t		(0.15)	(0.79)	(0.29)	(0.61)	(1.29)	(0.38)
SML2	+/-	-0.000334	-0.000099	-0.000324	-0.000078	-0.008351	-0.000020
t		(1.33)	(0.98)	(1.36)	(0.80)	(1.78)	(0.24)
MML	+	-0.007296	-0.154616	-0.007099	-0.138044	0.002417	-0.123350
t		(1.52)	(0.94)	(1.52)	(0.82)	(1.12)	(0.74)
MML2	+/-	0.002385	-0.198010	0.002432	-0.166956	-0.002028	-0.028866
t		(1.11)	(0.67)	(1.19)	(0.55)	(0.62)	(2.65)
SFL×SML	-	0.001672	-0.001406	0.000628	-0.001233	0.008419	-0.001241
t		(0.44)	(3.62)	(0.17)	(3.62)	(4.64)	(3.81)
SML×MML	+	0.008332	0.075251	0.007935	0.071611	-0.066010	0.057518
t		(3.60)	(1.12)	(3.54)	(1.04)	(1.55)	(0.95)
SFL×DISP	?	0.044763	0.002842	0.063654	0.001467	-0.004439	-0.001717
t		(1.26)	(0.54)	(1.40)	(0.32)	(1.46)	(0.38)
SML×DISP	+	0.002211	-0.002268	-0.000008	-0.001362	0.023592	-0.001194
t		(0.51)	(2.67)	(0.00)	(2.38)	(5.13)	(2.31)
MML×DISP	+	0.023773	-0.103274	0.023756	-0.007364	0.033412	0.014551
t		(3.72)	(0.16)	(3.96)	(0.01)	(1.73)	(0.37)
GLAB	-	-0.053323	-0.018953	-0.052592	-0.020063	0.016984	-0.018801
t		(3.29)	(2.24)	(3.25)	(2.32)	(3.56)	(2.20)
INC	+?	na	na	0.013439	0.002958	-0.000153	0.003578
t				(5.34)	(3.03)	(0.01)	(2.23)
Constant		na	na	0.017149	0.048024	0.204917	0.024418
t				(1.30)	(5.96)	(2.38)	(2.58)
Hausman test (prob)				χ^2 (61)	20.49 (1.00)		
Hansen J test (prob)						χ^2 (28)	33.01 (0.24)

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

Appendix Table A2.2 Determinants of Growth, Base Model: scaled by population

Observations = 2229	Sign	Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	RoW	SSA	RoW	SSA	RoW
DKDP	+	0.233629	0.742658	0.239009	0.736373	0.220863	0.707859
t		(2.29)	(9.50)	(2.34)	(9.46)	(2.96)	(9.41)
DH	+	0.009559	-0.001804	0.009834	-0.001776	0.012765	-0.002483
t		(2.68)	(0.64)	(2.65)	(0.63)	(3.33)	(0.90)
DMDP	+	0.022390	0.039815	0.023293	0.039699	0.026318	0.038015
t		(2.01)	(6.19)	(2.08)	(6.18)	(2.65)	(5.55)
YP1	-	-0.015188	-0.007821	-0.013653	-0.007613	-0.008025	-0.006767
t		(7.68)	(6.75)	(7.76)	(6.90)	(4.39)	(6.55)
DISP	-	-0.107944	0.016178	-0.079962	0.010351	-0.015580	0.015625
t		(4.13)	(1.44)	(3.30)	(1.84)	(0.78)	(2.41)
X	+	0.000749	0.003800	0.001328	0.003756	0.004547	0.002837
t		(0.42)	(4.05)	(0.80)	(4.12)	(3.41)	(3.49)
INST	+	0.001060	0.001631	0.001553	0.001473	0.000076	0.001435
t		(0.38)	(0.77)	(0.55)	(0.72)	(0.02)	(0.75)
RIN	-	-0.005325	-0.001132	-0.005236	-0.001131	-0.000132	-0.001098
t		(1.30)	(1.72)	(1.28)	(1.73)	(0.32)	(1.80)
SFP	+	-0.145257	0.011022	-0.135009	0.010834	-0.101766	0.011228
t		(3.14)	(2.18)	(3.16)	(2.19)	(2.49)	(2.36)
SFP2	+/-	0.122875	-0.001202	0.143513	-0.000984	0.094637	-0.002397
t		(1.04)	(0.20)	(1.20)	(0.17)	(0.79)	(0.42)
SMP	+	0.000509	0.002142	0.000175	0.001895	-0.002365	0.000897
t		(0.18)	(1.51)	(0.06)	(1.35)	(0.83)	(0.71)
SMP2	+/-	-0.001827	-0.000989	-0.001390	-0.000905	-0.000771	-0.000965
t		(0.74)	(1.31)	(0.59)	(1.21)	(0.34)	(1.40)
MMP	+	-0.014026	1.047724	-0.013052	1.066234	-0.012480	0.562137
t		(1.05)	(3.57)	(0.98)	(3.68)	(0.92)	(1.86)
MMP2	+/-	0.005455	2.217968	0.006606	2.277455	0.005946	-0.239969
t		(0.46)	(1.76)	(0.58)	(1.83)	(0.50)	(3.37)
SFP×SMP	-	0.020459	-0.006325	0.010821	-0.006154	-0.012520	-0.005715
t		(1.31)	(3.92)	(0.79)	(3.96)	(1.14)	(3.63)
SMP×MMP	+	0.048872	-0.759274	0.045500	-0.769476	0.044114	-0.413259
t		(2.94)	(3.45)	(2.83)	(3.53)	(3.12)	(1.50)
SFP×DISP	?	-0.110436	0.005954	-0.068186	0.005699	-0.024675	-0.002931
t		(1.98)	(0.52)	(1.26)	(0.54)	(0.51)	(0.31)
SMP×DISP	-	0.006685	-0.002669	-0.001190	-0.002096	-0.021749	-0.001852
t		(0.68)	(2.02)	(0.15)	(1.83)	(4.24)	(1.61)
MMP×DISP	+	0.074218	1.826750	0.075318	1.905382	0.081596	0.260077
t		(4.72)	(1.98)	(5.10)	(2.08)	(6.29)	(1.81)
GPOP	-	0.017178	-0.039256	0.019991	-0.039426	0.065500	-0.021721
t		(0.66)	(2.24)	(0.67)	(2.24)	(1.23)	(1.24)
INC	+	na	na	0.017307	0.005208	0.016877	0.005510
t				(7.38)	(4.71)	(3.92)	(3.19)
Constant		na	na	0.022178	0.050941	-0.007722	0.025573
t				(1.83)	(7.01)	(0.58)	(2.89)
Hausman test (prob)				χ^2 (61)	16.89 (1.00)		
Hansen J test (prob)						χ^2 (28)	33.85 (0.21)

Notes
SSA: sub-Saharan Africa; RoW: Rest of World

Appendix Table A2.3 Determinants of HDI, Base Model: scaled by Labour force

Observations = 2207		Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	**RoW**	**SSA**	**RoW**	**SSA**	**RoW**
DKDL	+	0.088044	0.423739	0.057858	0.408675	0.050231	0.405400
t		(1.15)	(3.22)	(0.34)	(3.43)	(0.33)	(2.84)
DH	+	0.021278	0.013444	0.059206	0.014428	0.059272	0.013504
t		(5.72)	(2.57)	(6.65)	(2.63)	(7.16)	(2.21)
DMDL	+	0.031348	0.000103	0.079915	0.000825	0.069070	0.000104
t		(1.79)	(0.02)	(1.74)	(0.10)	(3.98)	(0.01)
HDI1	-	-0.063524	-0.068456	-0.038937	-0.040458	-0.046448	-0.052388
t		(3.86)	(4.87)	(3.91)	(3.74)	(6.87)	(7.43)
DISP	-	-0.069400	0.027397	-0.052591	0.019748	0.023834	0.045908
t		(2.87)	(1.16)	(2.53)	(2.38)	(0.93)	(2.47)
X	+	0.002193	0.000473	0.000528	0.000095	0.007721	-0.000606
t		(1.12)	(0.46)	(0.12)	(0.08)	(2.47)	(0.38)
INST	+	-0.005676	-0.003845	-0.003144	-0.006241	-0.002650	-0.004958
t		(1.54)	(1.68)	(0.39)	(2.10)	(0.50)	(1.44)
RIN	-	0.001366	-0.000431	-0.003772	-0.000446	-0.000663	-0.000498
t		(0.30)	(1.63)	(0.35)	(1.29)	(1.12)	(0.69)
SFL	+	-0.011402	-0.009192	0.017701	-0.019008	-0.037549	-0.015839
t		(0.37)	(2.32)	(0.37)	(3.30)	(1.06)	(2.75)
SFL2	+/-	0.000408	0.007385	-0.047579	0.013396	-0.012463	0.011269
t		(0.01)	(3.04)	(0.57)	(3.81)	(0.16)	(2.90)
SML	+	0.000052	-0.001234	0.000123	-0.003773	0.000023	-0.004183
t		(0.03)	(1.70)	(0.05)	(3.37)	(0.01)	(3.62)
SML2	+/-	-0.000137	0.000165	-0.000558	0.000541	-0.000378	0.000629
t		(0.30)	(1.10)	(0.73)	(2.41)	(0.62)	(2.55)
MML	+	-0.020761	0.360178	-0.039067	0.526720	-0.034857	0.213576
t		(4.16)	(3.05)	(3.64)	(3.17)	(2.55)	(1.09)
MML2	+/-	0.006295	0.372133	0.010738	0.704029	0.007117	-0.083248
t		(2.80)	(1.76)	(1.95)	(2.21)	(0.94)	(1.47)
SFL×SML	-	0.012126	-0.001017	0.020677	-0.000371	0.010688	-0.000465
t		(2.76)	(1.58)	(3.37)	(0.38)	(1.85)	(0.56)
SML×MML	+	0.008482	-0.125592	0.017766	-0.206137	0.014702	-0.045591
t		(3.38)	(2.70)	(3.56)	(3.00)	(2.90)	(0.60)
SFL×DISP	+/-	-0.009594	-0.017000	-0.011762	-0.021296	-0.076456	-0.026398
t		(0.13)	(2.12)	(0.14)	(2.16)	(0.86)	(1.63)
SML×DISP	+	0.012124	-0.004098	0.016865	-0.005745	0.009447	-0.005969
t		(3.00)	(1.74)	(2.75)	(1.82)	(1.34)	(2.38)
MML×DISP	+	0.014772	0.459317	0.044742	0.509551	0.027713	0.230420
t		(1.63)	(1.70)	(2.07)	(1.45)	(1.35)	(1.53)
GLAB	-	0.043084	0.002078	0.065487	-0.018864	0.071695	-0.015552
t		(2.42)	(0.14)	(2.00)	(0.54)	(1.64)	(0.88)
INC	+/-	na	na	0.001719	0.004226	0.022471	0.005745
t				(0.75)	(3.12)	(3.44)	(1.72)
HXY	-	0.024167	0.030589	0.120192	0.043086	0.148631	0.031132
t		(0.64)	(1.88)	(1.19)	(1.86)	(3.95)	(1.08)
MXY	-	0.051161	0.005933	0.088251	0.018651	0.004748	0.011556
t		(1.15)	(0.37)	(0.89)	(0.74)	(0.08)	(0.38)
NRY	-	0.014319	-0.002760	0.025606	-0.002563	0.024447	0.001340
t		(2.12)	(0.44)	(1.98)	(0.35)	(2.67)	(0.19)
FPY	+	-0.015032	0.000865	-0.021376	-0.003159	-0.014424	-0.006025
t		(0.92)	(0.17)	(1.31)	(0.73)	(1.06)	(0.90)
CORR	+	-0.000679	-0.000316	-0.004593	0.000342	-0.006078	0.000204
t		(0.49)	(0.40)	(1.72)	(0.31)	(2.75)	(0.17)
Constant		na	na	-0.012093	-0.016286	-0.051109	-0.094935
t				(0.83)	(2.38)	(2.35)	(5.06)
Hausman test (prob)				χ^2 (71)	48.54 (0.98)		
Hansen J test (prob)						χ^2 (38)	65.92 (0.01)

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

Appendix Table A2.4 Determinants of HDI, Base Model: scaled by population

Observations = 2222		Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	RoW	SSA	RoW	SSA	RoW
DKDP	+	0.193639	0.387316	0.077011	0.375373	0.050756	0.365115
t		(1.11)	(3.02)	(0.47)	(3.17)	(0.37)	(2.69)
DH	+	0.058522	0.013202	0.061189	0.014061	0.060948	0.013577
t		(7.21)	(2.56)	(7.04)	(2.61)	(7.36)	(2.22)
DMDP	+	0.067789	-0.001367	0.067547	0.000711	0.057190	0.000009
t		(1.74)	(0.17)	(1.68)	(0.09)	(3.84)	(0.00)
HDI1	-	-0.065793	-0.068971	-0.044152	-0.047861	-0.048576	-0.056706
t		(4.78)	(3.20)	(4.01)	(3.52)	(7.13)	(7.92)
DISP	-	-0.175371	0.049476	-0.070727	0.019965	0.016400	0.045194
t		(2.58)	(1.34)	(2.57)	(2.08)	(0.59)	(2.43)
X	+	0.001405	0.000219	0.000067	0.000033	0.008423	-0.000761
t		(0.32)	(0.13)	(0.02)	(0.03)	(2.68)	(0.47)
INST	+	-0.008908	-0.007490	-0.003689	-0.006805	-0.004497	-0.005183
t		(0.89)	(2.05)	(0.41)	(2.18)	(0.85)	(1.49)
RIN	-	0.002009	-0.000384	-0.000458	-0.000370	-0.000427	-0.000432
t		(0.18)	(1.09)	(0.04)	(1.07)	(0.72)	(0.60)
SFP	+	-0.066199	-0.040702	-0.009311	-0.040711	-0.118254	-0.036033
t		(0.49)	(3.09)	(0.08)	(3.32)	(1.39)	(3.09)
SFP2	+/-	-0.354881	0.062196	-0.264385	0.059695	0.015717	0.053191
t		(0.68)	(4.19)	(0.59)	(4.25)	(0.03)	(3.38)
SMP	+	0.003543	-0.006141	0.004253	-0.006300	0.004179	-0.006624
t		(0.43)	(2.43)	(0.59)	(2.57)	(0.74)	(2.50)
SMP2	+/-	-0.006682	0.001642	-0.005742	0.001809	-0.006222	0.001663
t		(1.01)	(1.19)	(0.93)	(1.34)	(1.31)	(1.14)
MMP	+	-0.074031	1.449108	-0.068812	1.365563	-0.066950	0.525628
t		(3.36)	(2.57)	(3.50)	(2.90)	(2.26)	(1.48)
MMP2	+/-	0.031392	2.511157	0.038099	3.041983	0.024815	-0.519048
t		(1.19)	(2.21)	(1.46)	(2.99)	(0.63)	(1.78)
SFP×SMP	-	0.138197	-0.004720	0.113840	-0.002182	0.067894	-0.002424
t		(2.59)	(0.70)	(2.88)	(0.38)	(2.06)	(0.64)
SMP×MMP	+	0.082450	-0.911531	0.069724	-0.946362	0.064637	-0.243395
t		(2.79)	(2.75)	(2.45)	(3.20)	(2.31)	(0.89)
SFP×DISP	?	-0.287211	-0.078835	-0.126692	-0.052507	-0.158237	-0.057473
t		(1.16)	(2.81)	(0.59)	(2.36)	(0.64)	(1.70)
SMP×DISP	-	0.062175	-0.012925	0.042904	-0.010246	0.023375	-0.011175
t		(2.96)	(1.62)	(2.85)	(1.64)	(1.34)	(2.12)
MMP×DISP	+	0.089245	2.811292	0.089705	2.401183	0.060295	0.563602
t		(2.10)	(1.74)	(2.00)	(1.91)	(1.34)	(1.68)
GPOP	-	0.405078	-0.032459	0.345132	-0.029627	0.322731	-0.020890
t		(3.32)	(0.94)	(3.05)	(0.98)	(3.26)	(0.65)
INC	+	na	na	0.004110	0.005263	0.031369	0.005697
t				(1.75)	(3.36)	(4.43)	(1.61)
HXY	+	0.056544	0.035242	0.094416	0.040961	0.130911	0.028073
t		(0.61)	(1.32)	(0.98)	(1.68)	(3.38)	(0.97)
MXY	+	0.161629	0.018193	0.094579	0.023055	0.004211	0.015773
t		(1.50)	(0.70)	(0.96)	(0.94)	(0.07)	(0.51)
NRY	+	0.033256	-0.003489	0.025871	-0.002253	0.022931	0.001777
t		(2.66)	(0.40)	(2.09)	(0.31)	(2.49)	(0.25)
FPY	+	-0.030917	-0.001109	-0.025503	-0.001012	-0.011113	-0.003941
t		(0.90)	(0.14)	(1.25)	(0.21)	(0.81)	(0.58)
CORR	+	-0.003337	-0.000111	-0.003932	0.000118	-0.005082	0.000056
t		(1.16)	(0.09)	(1.51)	(0.10)	(2.29)	(0.05)
Constant		na	na	-0.014776	-0.024441	-0.071027	-0.107662
t				(0.82)	(2.47)	(3.13)	(5.21)
Hausman test (prob)				χ^2 (71)	40.98(1.00)		
Hansen J test (prob)						χ^2 (38)	55.05 (0.04)

Notes
SSA: sub-Saharan Africa; RoW: Rest of World

Appendix Table A2.5 Financial Development, Base Model: scaled by Labour force

Observations = 2899		Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	**RoW**	**SSA**	**RoW**	**SSA**	**RoW**
DYDL	+	3.613441	2.081152	3.480196	2.074217	3.480196	2.074217
t		(3.79)	(2.70)	(3.83)	(2.73)	(3.83)	(2.73)
F1	-	-0.359024	-0.213124	-0.344194	-0.199149	-0.344194	-0.199149
t		(3.30)	(10.87)	(3.39)	(11.29)	(3.39)	(11.29)
DISP	-	-0.037415	0.072206	-0.209352	-0.047286	-0.209352	-0.047286
t		(0.09)	(0.33)	(0.97)	(0.91)	(0.97)	(0.91)
RIN	-	0.001264	-0.030662	0.000848	-0.030582	0.000848	-0.030582
t		(0.40)	(1.90)	(0.26)	(1.91)	(0.26)	(1.91)
SML	+	0.077308	0.022159	0.081290	0.020287	0.081290	0.020287
t		(1.89)	(1.68)	(2.21)	(1.68)	(2.21)	(1.68)
SML2	+/-	-0.008189	-0.005246	-0.008212	-0.004869	-0.008212	-0.004869
t		(1.40)	(2.34)	(1.53)	(2.32)	(1.53)	(2.32)
MML	+	0.197930	0.428164	0.188432	0.399404	0.188432	0.399404
t		(1.99)	(1.27)	(1.93)	(1.23)	(1.93)	(1.23)
MML2	+/-	-0.127420	0.162869	-0.123586	0.161173	-0.123586	0.161173
t		(3.29)	(0.85)	(3.21)	(0.89)	(3.21)	(0.89)
SML×MML	+	-0.045990	-0.201166	-0.041258	-0.189634	-0.041258	-0.189634
t		(1.06)	(2.10)	(0.99)	(2.02)	(0.99)	(2.02)
SML×DISP	+	0.024107	0.006447	0.042851	0.012417	0.042851	0.012417
t		(0.37)	(0.39)	(0.68)	(1.03)	(0.68)	(1.03)
MML×DISP	+	-0.236052	0.236665	-0.201838	0.253473	-0.201838	0.253473
t		(1.74)	(1.59)	(1.70)	(1.91)	(1.70)	(1.91)
INC	+	na	na	0.100310	0.042172	0.100310	0.042172
t				(1.66)	(2.39)	(1.66)	(2.39)
IDMM	+			0.046082	0.017079	0.046082	0.017079
t		na	na	(0.91)	(3.80)	(0.91)	(3.80)
MMNET	+	-0.014545	0.010802	-0.014403	0.010728	-0.014403	0.010728
t		(1.74)	(1.02)	(1.74)	(1.02)	(1.74)	(1.02)
MMNET2	+	0.000393	-0.001841	0.000383	-0.001791	0.000383	-0.001791
t		(0.53)	(1.10)	(0.52)	(1.07)	(0.52)	(1.07)
REG	+	0.024802	0.009079	0.032139	0.010914	0.032139	0.010914
t		(0.38)	(0.60)	(0.54)	(0.79)	(0.54)	(0.79)
CORR	+	0.048736	0.035780	0.053446	0.037046	0.053446	0.037046
t		(1.85)	(1.96)	(2.11)	(2.39)	(2.11)	(2.39)
RUR	-	-0.229394	-0.202185	-0.060432	-0.151337	-0.060432	-0.151337
t		(0.72)	(1.52)	(0.28)	(1.87)	(0.28)	(1.87)
Constant		na	na	-0.631909	-0.402212	-0.631909	-0.402212
t		na	na	(1.33)	(5.04)	(1.33)	(5.04)
Hausman test (prob)				χ^2 (51)	22.38 (1.00)		
Hansen J test (prob)						χ^2 (22)	25.88 (0.26)

Notes

SSA: sub-Saharan Africa; RoW: Rest of World

Appendix Table A2.6 Financial Development, Base Model: scaled by population

Observations = 2920		Fixed Effects		Random Effects		Hausman-Taylor	
		SSA	**RoW**	**SSA**	**RoW**	**SSA**	**RoW**
DYDP	+	3.048560	2.229125	2.963092	2.196224	2.951467	2.175182
t		(3.56)	(2.87)	(3.69)	(2.86)	(5.41)	(3.14)
F1	-	-0.358637	-0.214142	-0.346467	-0.202507	-0.335298	-0.204797
t		(3.31)	(10.84)	(3.40)	(11.18)	(15.30)	(12.83)
DISP	-	-0.093686	0.052972	-0.214250	-0.044012	-0.255672	-0.052597
t		(0.21)	(0.24)	(0.92)	(0.75)	(1.70)	(0.89)
RIN	+	0.000905	-0.029688	0.000612	-0.029682	0.000417	-0.029989
t		(0.28)	(1.86)	(0.19)	(1.87)	(0.15)	(3.63)
SMP	-	0.230449	0.067042	0.236466	0.063938	0.239745	0.078461
t		(2.13)	(2.02)	(2.41)	(2.06)	(4.63)	(2.80)
SMP2	+	-0.071077	-0.036976	-0.069567	-0.035828	-0.066916	-0.042274
t		(1.45)	(2.30)	(1.50)	(2.32)	(2.02)	(2.77)
MMP	+	0.364502	0.358960	0.354034	0.444785	0.336543	0.291961
t		(1.60)	(0.38)	(1.55)	(0.54)	(1.19)	(0.13)
MMP2	+/-	-0.647034	0.397405	-0.635049	0.377629	-0.612516	0.504853
t		(2.86)	(0.45)	(2.82)	(0.43)	(1.80)	(0.30)
SMP×MMP	+	-0.178455	-0.293721	-0.167835	-0.371959	-0.170297	-0.292622
t		(0.95)	(0.38)	(0.91)	(0.61)	(0.80)	(0.17)
SMP×DISP	+	0.146688	0.009718	0.180247	0.020151	0.199073	0.020282
t		(1.23)	(0.24)	(1.61)	(0.66)	(1.85)	(0.80)
MMP×DISP	+	-0.739743	0.554684	-0.690329	0.618896	-0.560811	0.568471
t		(2.91)	(1.54)	(3.13)	(2.08)	(1.42)	(0.65)
INC	-	na	na	0.105618	0.045608	0.081707	0.086737
t				(1.79)	(2.41)	(2.03)	(2.44)
IDMM	+	na	na	0.047753	0.017329	0.056749	0.056900
t				(1.00)	(3.58)	(0.90)	(1.34)
MMNET	+	-0.015162	0.008130	-0.015166	0.007757	-0.013997	0.008961
t		(1.88)	(0.76)	(1.89)	(0.74)	(2.19)	(0.63)
MMNET2	+	0.000435	-0.001672	0.000435	-0.001563	0.000349	-0.001627
t		(0.62)	(1.06)	(0.63)	(1.03)	(0.73)	(0.65)
REG	-	0.017165	0.010726	0.023585	0.012127	0.044049	0.012654
t		(0.29)	(0.70)	(0.43)	(0.85)	(1.83)	(0.92)
CORR	+	0.045931	0.033935	0.050099	0.035352	0.058339	0.034571
t		(1.78)	(1.85)	(2.04)	(2.21)	(2.54)	(2.45)
RUR	+	-0.124217	-0.180583	-0.006414	-0.144401	-0.004225	-0.055287
t		(0.36)	(1.35)	(0.03)	(1.65)	(0.03)	(0.71)
Constant	+	na	na	-0.669571	-0.423167	-0.407141	-0.841155
t				(1.37)	(4.94)	(2.00)	(5.16)
Hausman test (prob)				χ^2 (52)	18.189(1.00)		
Hansen J test (prob)						χ^2 (22)	26.85 (0.22)

Notes

SSA: sub-Saharan Africa; RoW: Rest of World