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DEMOGRAPHIC AND WELFARE RELATED COVARIATES OF MACROECONOMIC PERFORMANCE IN A DIGITAL AGE IN ASIA

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Abstract. Conventional growth models usually overlook the importance of demographic factors as a determinant of growth and their complementarities with other factors. This study develops a model to elucidate the role of demographics and human welfare in Asian countries in explaining the income determination by considering their complementarities with ICT. Sample of Asian countries have been used to analyze this model called as Demo-Tech Income Model. Considerable support is found for this hypothesis using data of selected Asian countries. Referring to Solow's Paradox, a possible explanation is found that emphasizes the importance of favourable demographic features and higher levels of welfare in explaining the 'fuzzy' ICT-income nexus. Demo-Tech income model is suitable for Asian countries that have favourable demographic features, such as higher concentration in urban areas and upright population pyramids. This model can have similar implications for other developing regions with similar demographic patterns and initial stage of ICT diffusion.

Keywords: Demography, Welfare, Macroeconomic performance, Asia

JEL classification: E60, I31, J11

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I. INTRODUCTION

From pre-historic times man has undertaken to store, recollect, and process information as a source of value. Starting from image carving in stone walls to today's digital technology, the information is handled in a number of ways.[1] During the last half of 20th century, the 'information revolution' was made possible through the digital Information and Communication Technology (ICT) (Drucker, 1998).[2] ICT has affected agriculture, industry and services sectors of economies world over like no other technology in past (Allen and Morton, 1995). Terms like information economy, digital economy, e-economy, weightless economy, paperless economy have been floated over the last 3 decades to term this readily evolving kind of economy. For instance, one of the pioneering works in this regard was a report by Porat (1977). Later, during mid-1990s term 'New Economy' was introduced to represent the marvelous growth in software industry in US. Besides technological, Moore's law has deep social and economic implications that goes a long way in affecting society and economy through improved ICT.[3] [4] Besides this law, a predictive hypothesis by George Gilder (1997) asserts the dynamic nature of ICT. According to him, bandwidth of network would triple each year for the span of 25 years. Increased processing ability (Moore's prediction) and extensive networking (Gilder's prediction) of electronic devices in economic and social fields of life.[5] As ADB (2001) list a few instances of ICT for development of UDCs in the fields of poverty reduction, governance, public health, education and management of environmental and natural resources.

Despite such promising potential of ICT, Nobel Prize winner Robert M. Solow's phrase, "You can see the computer age everywhere but in the

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[1]For more see, The Economic Implications of Moore's Law by G. D. Hutcheson Chapter 2 in *Into the Nano Era* by Howard Huff (2009).

[2]The ICT revolution is crucial insofar as it involves technologies geared to the production and dissemination of knowledge and information. These new technologies, that first emerged in the 1950s and then really took off with the advent of the Internet, have breathtaking potential.

[3]Moore's law purports an exponentially increasing 'information processing' capability in the field of microelectronics.

[4]The projections of growth rate of information processing might not be exact, but technological upgradation has always been unbridled.

[5]e-banking, e-billing, e-commerce, e-development, e-education, e-government, e-health, e-inclusion, e-participation, e-procurement, e-services, e-ticketing and e-transactions etc.

productivity statistics" has steered controversy in 1987.[6] This study tries to provide a plausible explanation for this paradox considering the case of Asian countries that have favourable demographic features.[7]

II. ICT IN ASIAN REGION

Asia as one of the densely populated regions of the world has shown high demand for ICT products after the falling prices of ICT equipment during the last quarter of 20th century. Policy reforms of deregulation and privatization in Asian countries like India, Pakistan, China and Indonesia have enabled the spread of ICT.[8]

TABLE 1

Descriptive Statistics of ICT Indicators

S. No.	Name	N	Mean	Maximum	Minimum	Standard Deviation
1.	FBBS	264	4.69	8.12	0.90	1.61
2.	FIS	264	5.68	8.37	1.84	1.30
3.	FTL	264	6.38	8.57	4.37	0.98
4.	ICTMI*	264	6.39	8.45	4.04	0.96
5.	INTU	264	16.38	81.60	0.05	20.68
6.	MBLC	264	6.81	8.94	3.06	1.06

*Components of ICT are diverse in nature and are evolving at the same time and are divided into basic components and advanced components. Basic components are of common use for a longer period of time while advanced components are more sophisticated and dynamic in nature. Data of basic components is used to estimate ICTMI due to data availability and common use at macro level and equal weights are used.

A dataset of 24 countries is included in empirical analysis for the time span 2000-2010 depending on the availability of data. The chosen indicators are fixed broadband internet subscribers (FBBS), fixed internet subscribers per 100 inhabitants (FIS), internet users per 100 inhabitants (INTU), fixed

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[6]Written in review of a book 'Manufacturing Matters' by Stephen Cohen and John Zysman.

[7]ICT-Income nexus can be referred to as the causality between ICT and Economic Growth. Potential outcomes can be either: 1) no causality; 2) Uni-directional causality or 3) Bi-causality.

[8]For more on regulatory reforms and ICT infrastructure in Asia, see Samarjiva and Zainudeen (2008).

telephone lines per 100 inhabitants (FTL), information and communication technology maturation index (ICTMI), internet users per 100 inhabitants (INTU) and mobile cellular telephone subscriptions per 100 inhabitants (MBLC).[9]

III. DISCUSSION

At regional level, the ICT indicators show a mixed picture. For instance, the average FBBS in sample countries is 4.689 per 100 inhabitants which is quite low as compared to world average (17.0) and much lower as compared to that of DCs (49.3).[10] The average FIS, FTL, INTU and MBLC in sample countries is 5.678, 6.379, 18.383 and 6.812 per 100 inhabitants, respectively. Low average values for FIS, FTL and MBLC can be attributed to high concentration of the UDCs in this sample of Asian countries. Fixed broadband, fixed Internet and fixed telephone lines are being replaced by wireless technology (mobile and wireless broadband) due to the 'universal access' of the latter.[11] This clarifies the low average of FIS and FTL in sample countries while the low average of MBLC is due to later arrival of the mobile technology in sample countries.

It is evident that all other components of ICT show lower average level except for INTU. Internet users per 100 inhabitants give a promising picture and are likely to spearhead the overall scenario of ICT in sample countries. Its high average is due to its rapid adoption and since INTU includes approximately both kinds of internet users (fixed line and wireless). The maximum value of INTU is for Korea, which is one of the few countries out of the sample that have 'local IT players'. Local IT players allow the indigenous production of ICT (software and hardware). Arguably the biggest reason for UDCs being laggards in the field of ICT is not having indigenous development of ICT. This study hinges upon the data of fixed ICT components, since the wireless ICT is relatively new and therefore data is scarce for most countries while non-existent in a few cases.

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[9]ICTMI (Information and Communication Technology Maturation Index) is inspired from Information and Communication Development Index (IDI) in Teltscher *et al.* (2010) 'Measuring Information Society' published by International Telecommunication Union (ITU).

[10]Statistics for world average and DC average are estimated by author using ITU database for same number of years.

[11]Universal access implies the ability to have access (to a digital media) virtually everywhere, independent of wired network.

Further heedful observation of data over time reveals that China, INTU has seen a major spur and has become the flagship component of ICT in China. Indonesia, India, Iran and Pakistan show similar trends of rapid increase in INTU starting from an initial level of low diffusion. While Israel, Japan, Korea and Malaysia are the 'early adaptors' of INTU and are continuing their higher diffusion of INTU. Such all reveals a region wide trend in adopting Internet services. This is tabulated in Table 2.

TABLE 2

Dynamics of ICT Indicators in Overall Sample Countries

YEAR	FBBS	FIS	FTL	INTU	MBLC	ICTMI
2000	3.39	5.01	5.67	18.97	6.25	5.74
2001	3.57	6.85	7.73	7.50	7.88	7.50
2002	3.91	6.71	7.16	10.32	7.33	7.04
2003	4.22	6.15	6.47	35.84	7.01	6.53
2004	4.49	5.05	6.21	17.51	6.30	6.02
2005	4.73	5.50	5.96	36.94	6.77	6.27
2006	5.05	4.78	5.45	15.26	6.05	5.53
2007	5.32	5.57	6.06	28.45	6.50	6.05
2008	5.53	6.39	6.90	7.72	7.56	7.05
2009	5.63	6.24	6.85	18.02	7.38	6.86
2010	5.73	4.21	5.70	5.68	5.90	5.65
						

Sparklines show that FBBS is the monotonously increasing component of ICT in sample countries. While FIS, FTL, INTU and MBLC are components of ICT that are rather erratic. Consequently the ICTMI (aggregate of ICT components) is also erratic as evident by sparklines.

The sparklines reveal no major trend except for that in the number of fixed broadband subscribers. Limited time span of approximately one decade can be one of the reasons for this. Nevertheless, the indicators have been stable on the whole and have a non-decreasing trend.

An innovative model is developed in this research that incorporates demographic factors along with ICT in a model that determines the national income in Asian economies. Such is justified since Asian economies are mostly labour surplus economies and have favourable demographic features.

IV. EXISTING LITERATURE

Solow's paradox was basically raised for macroeconomy and not otherwise (Lee, Gholami and Tong, 2005). Yet considerable amount of research is done for developed countries both at micro and macro level, including country case-studies, cross-country studies, industry level and firm level studies.[12] Most of research on productivity paradox has been furnished on developed countries, more specifically on OECD countries due to availability of suitable and ample data (see Howard and Mazaheri, 2009).

The 1970s and 1980s saw many economies making extensive use of existing technology to spur their economic growth seemingly following Robert Solow's model of economic growth which posits that the determinants of economic growth can be separated out into increases in inputs (labour and capital) and technical progress. Under this model, Solow calculated that about four-fifth of the growth in US output per worker was attributable to technical progress. Since this work, many advanced models of economic growth have been proposed, leading to varying conclusions about the causes of economic growth. During 1980s, however, there was growing belief that not only existing technology can spur growth rather technological change can also take place and contribute to growth (Romar, 1986). Later during 1990s, some researchers found evidence of ICT growth relationship. For a review of Solow's Paradox, see Schwartz (2010). During the last decade, empirical and theoretical literature has pointed out the possible contribution of factors that complement the ICT-Income relationship. Some of these factors are said to be political, economic and social.[13]

For micro level studies, Brynjolfsson and Hitt (2000) highlight the short-sightedness of looking at ICT capital only, since these investments enable other positive externalities which are complementary and usually overlooked in previous researches. Gargallo-Castel and Galve-Górriz (2007) conduct a micro level study to explore the ICT-productivity relationship in Spanish firms. Their innovation was to introduce a set of organizational variables (workers' qualifications, management attitude and process innovation) which would support the ICT to have its impact on organizational productivity. This is one example of exploring ICT paradox at micro-level along with

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[12] A micro-to-macro methodology based on a large-scale and cross-country firm level database on ICT and productivity has been conducted in Europe's Digital Competitiveness Report, Volume I.

[13] Gretton and Parham (2003) and Gargallo-Castel and Galve-Gorriz (2007). Also see Heeks and Kenny (2002).

complementary factors. Their findings affirm the role of (organizational) complementary factors in strengthening the ICT-productivity relationship.

A handful of studies conducted for Asian region disclosed the need for e-skills, e-readiness and e-competence of human resource. Traits like attitude towards and believes about ICT are also researched. These studies have tried to explain the ICT-growth nexus using this human capital related framework (Awang, 2004; Ahmed, 2006). But for Asian region, the complementary factors have not been incorporated in the empirical analysis.

In effort of spiraling down to main debate, this study suggests a newer set of complementary factors including demographic factors and welfare related factors. In this study, complementary factors are divided into two major categories and are explained below:

V. DEMOGRAPHIC FEATURES

From demographic point of view, a few factors are listed and explained in the light of existing empirical literature.

ECONOMICALLY PRODUCTIVE YOUTH

Youth, here, refers to age group that is capable of contributing to production in an economy. The salient trait of Asian region (especially the developing countries) is the young population which implies potential human resource as revealed by population pyramids and their forecasts. Asian Miracle is considered an outcome of the young population in East Asian countries (Bloom and Williamson, 1998; Bloom and Finlay, 2009). Such population combined with ICT can increase income via improved productivity. Younger people adopt the Internet more as compared to older people (Goldfarb and Prince, 2008). Abdelfattah *et al.* (2010) also found similar results for youth.

In relatively advanced countries like those in Europe young population that uses the advanced ICT for recreational and economically productive purposes is termed as 'digital natives' (European Commission, 2010). Age and gender are previous related with ICT by Ono and Zavodny (2007). Authors examine the patterns of IT in five countries, considering the deviations in IT usage across gender, education, age and income groups.[14]

[14]Some studies relate dependence of ICT usage and its consequences (digital divide) with level of education, income, household type, race, age, gender, experience with digital technologies, individual capabilities and language are Primo Braga *et al.* (2000); Nurmela and Viherä (2000); van Dijk and Hacker (2003); Stanley (2003); Welling and Kubicek (2000).

This study hypothesizes a certain age cohort to be relatively more productive that is termed as ‘digitally productive’ group of population.

URBAN POPULATION

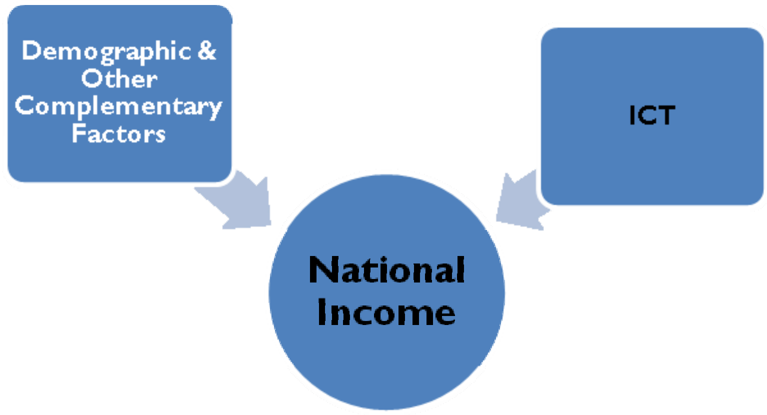
Furuholt and Kristiansen (2007) inquire the difference between access to ICT in rural and urban areas of Tanzania and find no significant difference. This opens the debate for inquiring the impact of urban-rural population in a country in relation with ICT adoption. Under the theory of agglomeration economies, greater urban area and population is considered to be an advantage to a country. Therefore, the population/labour in urban areas is relatively more productive than population in non-urban areas. Increased usage of ICT by such ‘more productive’ population can become a cause of increased income.

WELFARE RELATED FACTOR: HUMAN DEVELOPMENT INDEX

A population with higher HDI (higher education, better health and good standard of living) is hypothesized to be more productive user of ICT. Empirical literature in this direction is very limited. Ngwenyama *et al.* (2006) find similar results for West African countries. While Abdelfattah *et al.* (2010) in their exploratory study find that countries with low HDI rank have citizens who are less connected.

FIGURE 1

Converging Radial Diagram for Demo-Tech Income Model
ICT and Complementary Factors (Demographic
and Welfare) Affect National Income



Source: Authors’ own formulation.

VI. HYPOTHESIS

For inquiring ICT-income nexus with complementary factors (henceforth Demo-Tech Income Model), the following hypothesis is developed:

H_A: ICT will contribute more to national income when coalesced with complementary factors (favourable demographic features and greater human development).

SAMPLE ISSUES AND DATA SOURCES

A dataset of mixed sample of countries of Asian region (few DCs and mostly UDCs) is gleaned depending on availability of data for relevant variables. A maximum of 24 countries are selected while the number of years is 11. T = 11 and N = 24, since t > n, there is a panel data set.[15] Collection of data is done from World Development Indicators (WDI) and International Telecommunication Union (ITU) for selected Asian countries.

VII. DEVELOPMENT OF DEMO-TECH INCOME HYPOTHESIS

The model developed in this study is named as **Demo-Tech Income Model**. Based on the factors included in it, *i.e.* demographic features and information and communication technology, the term Demo-Tech Model is devised. Emphasis is kept on demographic factors and ICT, since they are likely to have strong complementarities. Among other variable is human development index. Human Development Index is expected to have a significant influence on the ability of the ICT users to be more productive and capable of contributing to national income.

ESTIMABLE MODEL

Demo-Tech model is estimated for assessing the role of ICT, along with complementary factors, in explaining national income:

$$YCD_{i,t} = \omega\,(ICTMI_{i,t}, ICTSERT_{i,t}, p1564_{i,t}, URBNP_{i,t}, TRD_{i,t}, ELTKW_{i,t}) \quad (1)$$

$$YCD_{i,t} = \alpha_{i,t} + \alpha^{1}_{i,t}\,(YCD_{i,t-1}) + \beta_{i,t}\,(ICTMI_{i,t}) + \gamma_{i,t}\,(ICTSERT_{i,t}) + \delta_{i,t}\,(p1564_{i,t}) + \kappa_{i,t}\,(URBNP_{i,t}) + \lambda_{i,t}\,(TRD_{i,t}) + \zeta_{i,t}\,(ELTKWi,t) + \eta i + \varepsilon i,t \quad (1\text{-e})$$

[15]Bangladesh, Bru Nei Darul Islam, China, Indonesia, India, Iran, Israel, Jordan, Japan, Kazakstan, Kryzgystan, Cambodia, Korea, Kowait, Lao PDR, Malaysia, Oman, Pakistan, Philippines, Russia, Saudi Arabia, Thailand, Tajikstan, Yemen.

Where, *YCD* is *GDI* in constant dollars. All reappearing notations stand for variables as above.[16] *ELTKW* is the technology related complementarity by using the variable 'electric power consumption in kWh' and *TRD* shows the trade openness as a percentage of GDP. η_i are the country specific effects and $\varepsilon_{i,t}$ is the error term. *i* shows countries and *t* years.

A COUPLE OF TESTS FOR ENDOGENEITY

Test for endogeneity are estimated:

TABLE 3

Tests for Endogeneity in Instrumental Variables (IVs) – Durbin-Wu-Hausman

Null Hypothesis (H_0): Regressor is Exogenous			
Test	Notation	Statistic	p-value
Wu-Hausman F test	F (1, 207)	30.571	0.0000
Durbin-Wu-Hausman χ^2 test	χ^2 (1)	31.853	0.0000

Source: Author's calculations using Stata (Special Edition) 12.0 user defined command ivendog.

DECISION ON USING IV REGRESSION OR GMM – IV-HETEROSKEDASTICITY TESTS

As per Baum *et al.* (2003), GMM gives more efficient estimates as compared to simple Instrumental Variables regression when heteroskedasticity exists. In presence of heteroskedasticity, GMM estimator is a better estimator. The results of these tests are given in Table 4.

Results of the two tests are in favour of presence of heteroskedasticity. Breusch-Pagan/Godfrey/Cook-Weisberg and White/Koenker $n^{R_c^2}$ test statistics are statistically significant at 1% level of significance. Pagan-Hall General test and Pagan-Hall Test w/assumed Normality statistics show reveal homoskedasticity. Since half of tests reveal the presence of heteroskedasticity, it is safer to assume heteroskedasticity and GMM should be preferred.

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[16]ICTM is used as an 'external instrument' as suggested in Roodman (2009).

TABLE 4

Testing Heteroskedasticity in Presence of Instrumental Variables (Levels of IVs)

Null Hypothesis (H_0): Disturbance is Homoskedastic		
Test	χ^2 (6)	p-values
Pagan-Hall General Test Statistic	1.184	0.9913
Pagan-Hall Test w/assumed Normality	1.424	0.9848
White/Koenker $n^{R_c^2}$ Test Statistic	57.319	0.0000
Breusch-Pagan/Godfrey/Cook-Weisberg	73.369	0.0000

Source: Author's calculations using Stata (Special Edition) 12.0 user defined command ivhettest, all.

GMM ESTIMATION RESULTS

System GMM is considered for estimation of the panel dataset for Demo-Tech model, justification of which is given in Table 5.

TABLE 5

SYSTEM GMM Estimates (Augmented ICT-Income Nexus)

Dependent Variable: Gross National Income ($YCD_{i,t}$)

	Coefficients	Standard Errors	t-statistics	p-values
$YCD_{i,t-1}$	0.9552	0.0614	15.55	0.000
$ICTMI_{i,t}$	0.0224	0.0081	2.77	0.006
$ICTSERT_{i,t}$	0.0035	0.0016	2.23	0.027
$P1564_{i,t}$	0.2878	0.1668	1.73	0.086
$URBNP_{i,t}$	0.0162	0.0069	2.36	0.019
$TRD_{i,}t$	–0.0324	0.0371	–0.87	0.383
$ELTKW_{i,t}$	1.0082	0.1732	5.82	0.000
C	–0.6707	0.2896	–2.32	0.022

	Coefficients	Standard Errors	t-statistics	p-values
Time Dummies				
yrtd_02	–0.0298	0.0151	–1.97	0.050
yrtd_03	–0.0208	0.0104	–1.99	0.047
yrtd_04	–0.0140	0.0089	–1.57	0.118
yrtd_05	–0.0070	0.0119	–0.59	0.556
yrtd_06	–0.0109	0.0056	–1.94	0.054
yrtd_07	–0.0070	0.0055	–1.29	0.200
yrtd_08	–0.0053	0.0043	–1.24	0.217
yrtd_09	–0.0026	0.0022	–1.16	0.247
Other Tests and Parameters				
Observations = 135	Countries = 15	Instruments = 135	F (15, 23) = 7162 [p = 0.000]	
p-value: Hansen J-Test = 0.222		M1: p = 0.198 & M2: p = 0.304		
Difference in Hansen tests / C-tests: [p = 0.730, p = 0.644, p = 0.626 and p = 0.794]				

Source: Author's calculations using Stata (Special Edition) 12.0 user defined command xtabond2.

NOTE: Following Roodman (2006) and Mileva (2007), SGMM is applied on model with arguments **small, twostep** and **robust**.

VIII. INTERPRETATION

The growth model estimations reveal the existence of relationship between ICT and national income based upon demographic complementary factors. Lagged value of national income is found to be positively related with its previous values, showing the dynamic behaviour of the variable yielding a dynamic panel model. It is statistically significant at all levels. The pivotal variable ICTMI comes with a positive sign showing favourable effect of ICT on national income. Similar to demo-tech productivity models, ICTSERT is also used in the regression capturing the interaction effect of ICT and school enrollment rate at tertiary level. This coefficient is both positive and significant (at 10% level of significance). This entails that highly educated ICT users contribute to national income.

ICT using young (physically and mentally capable) population is also found to contribute to national income. Statistically significance is both at 5% and 10%. Substantial portion of this segment of population is expected to be ICT-savvy and proficient user.

Urban population is hypothesized to be more economically productive than rural population. Population in urban areas gets better education and job opportunities due to urbanization economies. Impact of ICT on national income becomes richer if urban population is included in the regression. Its coefficient is statistical significant. Such positive contribution can be attributed to urbanization economies.

ICT's role in national income is favourably complemented by higher levels of trade openness as represented by coefficient of TRD. Empirical evidence on trade-income relationship is inconclusive and can vary from sample to sample. In this growth regression, however, trade openness has a negative impact on national income.

Electricity consumption in this regression justifies its inclusion via positive sign of its coefficient and significance at 1% (5% and 10% as well). In terms of magnitude the coefficient is the highest, because the role of electricity consumption is not limited only to complementing the ICT. Rather electricity consumption complements other non-ICT sectors, *e.g.* industry, as well and contributes to national income via other channels. Consequently, it is safely stated that electricity consumption has strong complementarity with ICT.

Time dummies have been included and they improve the statistical diagnostics of the model as per Sarafidis *et al.* (2006). The overall significance of the model is satisfactory (at 1%, 5% and 10% levels of significance) as per F-test of joint significance. Condition that number of observations > number of instruments also holds in this case, *i.e.* (240 > 30). Hansen test of correct specification and over-identifying restrictions has a p-value of greater than 0.05, *i.e.* (p-value = 0.222 > 0.05) implying that all over-identified instruments are exogenous. The Arellano and Bond test for first order 'M_1' and second order 'M_2' correlation, *i.e.* AR(1) and AR(2) show p-value of greater than 0.000,. *i.e.* $(M_1)_{p\text{-value}} = 0.198 > 0.05$ and $(M_2)_{p\text{-value}} = 0.304 > 0.05$. Hence, there is no second order serial correlation in residuals.

C-test (Baum, 2006; Roodman, 2006) for the validity of subsets of instruments for level and difference equations are also satisfactory. These tests are four in number and have same criteria, i.e. the p-value should be greater than 0.05:

$(\text{C-test})_{\text{Ho: GMM-differenced instruments are exogenous}} = 0.730 > 0.05$

$(\text{C-test})_{\text{Ho: System GMM instruments are exogenous \& they increase Hansen J-test}} = 0.644 > 0.05$

$(\text{C-test})_{\text{Ho: GMM instruments excluding IV-instruments are exogenous}} = 0.126 > 0.05$

$(\text{C-test})_{\text{Ho: Standard IV-instruments are exogenous \& they increase Hansen J-test}} = 0.794 > 0.05$

There is not enough evidence to reject the null hypotheses set in these four tests of difference-in-Hansen/C-tests.

IX. CONCLUSION AND RECOMMENDATIONS

Empirical results confirm the existence of complementarities between demographic and welfare related factors and the ICT. These factors include population in large urban areas that is found to reinforce the ICT-income relationship. Urban population in likely to be digitally literate and hence economically more productive. Similar implications are found for ICT using age cohort of population that use ICT for economically productive purposes. More specifically, it is affirmed that populations with higher level of HDI (education, health and living standards) are better able to use ICT for productive purposes contributing to national income. The strongest complementarity is convincingly with electricity consumption.

Outcome of this research related to HDI shows that merely throwing ICT at the disadvantaged populations/regions shall not bring the desired result of increased income. For that the funding agencies have to embed these ICT development programmes with awareness campaigns so as to enable the target population for the economically productive usage of ICT equipment. For instance programme of ICT4D (Information and Communication Technology for Development) faces issue of poor infrastructure, low illiteracy and poor health in implementing the ICT-based development projects in disadvantaged regions like Africa (For more details see Heeks, 2002). As highlighted in the empirical analysis of this study youth, combined with ICT diffusion, can contribute to level of productivity and hence national output. Most of sample countries have shown greater proportion of youth in total population. Need is to channelize this youth but making them digitally literate so they contribute to national income. In brief this finding of the study suggests a form of man-power planning which focuses the ICT skills to channelize the benefits of favourable demographic features. Moreover, the supply of electricity for proper operation of ICT is inviolable for ICT to show a significant impact on national income. Policy makers should lay down plans and projects for uninterrupted electricity supply for the functioning of today's digitally advanced economies.

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