Knowledge-Based Economic Development: Mass Media and the Weightless Economy*

Sanghamitra Bandyopadhyay†
STICERD, London School of Economics
and Oriel College, Oxford University

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The Toyota Centre
Suntory and Toyota International
Centres for Economics and Related
Disciplines
London School of Economics
Houghton Street
London WC2A 2A

(+44 020) 7955 6674

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† Correspondence: Department of Economics, London School of Economics, Houghton Street, London, WC2A 2AE. email: s.bandyopadhyay@lse.ac.uk

Abstract

We examine associations of mass media and information and communications technologies (ICT) as knowledge-based infrastructures on some economic development outcomes. We .nd that several mass media and ICT penetration variables are negatively associated with three development outcomes: corruption, inequality and poverty. Of the media variables, newspapers are observed to have a robust negative association with both corruption and inequality. Radios and TVs are also observed to have a robust negative association with inequality and poverty. ICTs and telephony infrastructures.association with corruption, inequality and poverty are mixed. There is some robust evidence of the negative association of ICT expenditures with corruption. An ICT index is constructed, which also has a negative association with corruption. ICTs association with inequality varies with the sample chosen - it is positively associated with inequality for the sample with both developed and developing countries, but negatively associated with inequality for the developing country sample. Finally, ICT expenditure is negatively associated with poverty.

Keywords: Information and Communications Technologies, Mass Media, Economic Growth and Development, Poverty, Corruption, Inequality.

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Telephone: UK+20 7955 6674
Fax: UK+20 7955 6951
Email: l.alberici@lse.ac.uk
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1 Introduction

The availability of information is crucial for efficient decision making by citizens and consumers (Stigler 1961, Stiglitz 2000). For the voter, information about government actions and political candidates is essential for accurate voting choices. Likewise, consumers and investors require information to purchase products and securities. Access to information is, however, circumscribed by the instruments that are made available to the citizen. Less developed economies particularly suffer from the lack of adequate communications technologies. While access to communications infrastructure, and thus information, is largely asserted to be a prerequisite for growth and productivity, and its absence a severe impediment, there is little empirical evidence which establishes this fact. This paper empirically investigates the association of Information Communications Technologies (hereafter ICT) and mass media as instruments of access to information, with three different aspects of economic development - corruption, inequality and poverty.

In most countries, citizens and consumers receive most of their information they need through the media, which comprise newspapers, television, and radio. The other recent technology which has revolutionised the transmission of information has been the incidence of mobile phones and the spread of the internet. Mass media and new technological revolutions in telephony and ICTs comprise the two main vehicles of information in modern societies. While the spread and the nature of the information transferred to the citizens of a country are highly dependent upon the nature of ownership of the media (state or privately owned), information made available to citizens via the ICT or the weightless economy[1] are less (or not at all) susceptible to any biases in the information provided[2].

Developing countries with underdeveloped and imperfect markets are more susceptible to the drawbacks of the lack of information availability. Typically poor in equipment investment and infrastructure and with underdeveloped media bodies, both consumers and citizens remain underinformed about economic activities and political markets. Higher levels of telephony

[1]The term "weightless economy", popularised by Quah (2001a, b) comprise knowledge based products: computer software, new media, electronic databases and libraries, and Internet delivery of goods and services. These elements of the weightless economy are knowledge-products, not necessarily because they are knowledge intensive in production, but because their physical properties resemble those of knowledge. The economy is knowledge intensive, not just because of the quantity of knowledge used in production, but because of the quantity of knowledge-products consumed. In this paper the weightless economy applies mainly to ICT penetration.

[2]There are some exceptions – one example is that of China, where Internet censorship is undertaken within a framework of laws and administrative regulations.

and ICT penetration, and media penetration and/or deregulation of the media are frequent policy levers discussed by both academics and policy makers alike. Studies have already identified strong links between media development and other development indicators, such income per capita and literacy.

What this seems to suggest is that there may be significant costs to having underdeveloped media and ICT in that it restricts information availability. That this may affect economic growth and development in LDCs is of concern, particularly in light of the increasing divide between rich and poor countries. This paper empirically tests for the associations of both ICT/Telephony and media development with various economic development outcomes.

There are long standing concerns about the nature of such technologies' impact on the economy; in particular, how they individually impact upon short run (and medium to long run) development outcomes. Of the two (i.e. media and ICT), the impact of ICT and telephony, like any other new technology, is a double edged innovation - one which results in both driving economic growth but also likely to result in increasing spatial and individual inequalities. While increasing returns and technological progress are conceptually distinct, both theory and evidence seem to suggest that they often come together and result in technological lock-in (David 1985), such that technologies that have an initial advantage tend to endure. Prominent theories on the sources of economic growth reinforce such concerns. The "weightless" properties of such technologies, with little regard for geographical barriers (Quah 2001a, b) enhance their rapid spread, thus on the one hand enhancing adoption, but on the other hand, due to unequal adoption rates, are predisposed to result in rapid increases in spatial and individual inequalities. Thus, in an LDC context, an urban growth/concentration in telephony and ICT penetration is highly likely to wedge the urban and the rural areas apart, as much as push the rich and the poor apart as well. The Indian economy is an apposite example where the introduction of (mobile) telephony and ICTs has adversely affected spatial and individual inequalities - regions and cities that are quick in adopting new technologies have experienced the development of local (albeit very scattered and small) clusters of productivity. Skill-biased technologies such as those engendered by development of ICT may also result in high wage inequalities - studies on the US increasing wage gap evince that skill-biased technological change (as a consequence of the increasing computerisation of the US work force) is an important driving force of US wage inequality (Autor and Katz 1999, Goldin and Katz 1996, DiNardo and Pischke 1994).

The impact of mass media however is less selective on its target audience and not likely to directly accentuate spatial or individual inequalities in the manner ICTs do. In its various forms - newspapers, radios and television -

mass media evens out asymmetries in information being available to citizens. However, its development and penetration is endogenous in a manner that ICT is not - the quality of news generated by the media industry is also strongly dependent of how the government treats the media indutry. Media penetration is dependent upon the nature of democracy, as well as if it exists at all. Data from Polity IV[3] suggests that countries which are rated more democratic have higher levels of media penetration as measured by newspaper circulation and television ownership. There is evidence of strong positive correlations between media penetration and measures of press freedom from Freedom House. Deeper media penetration, unlike ICT, has no unequal effects in its impact. On the other hand, the underdevelopment of media is often a consequence of governments attempting to evade scrutiny from mal-delivery or non-delivery of public goods, or government failure. Mass media functions to enhance citizens' abilities to scrutinise government actions.

Given these debates, there is still little evidence on the impact of ICT and media development in developing countries and their consequences. This paper aims to fill this gap by providing some robust evidence of the associations of mass media penetration and ICT/mobile telephony with three development outcomes - corruption, inequality and poverty. The paper discusses associations of ICT and mass media with three development observables: corruption, inequality and poverty. The results provide robust evidence that higher mass media penetration (newspapers) is significantly associated with lower corruption. There is also ample evidence that it is also robustly associated with lower inequality. The results also suggest for the association of higher incidence of mass media with lower poverty, though ICT/telephony is not found to be significantly associated. Radios are found to be robustly associated with lower poverty. We obtain mixed results with ICTs and telephony. We find some robust evidence of the association of ICT expenditures with corruption and inequality. We construct an ICT infrastructure index and find that it has a robust negative association with corruption. The ICT index's association with inequality varies with the sample chosen - it is positively associated with inequality for the sample with both developed and developing countries, but not robustly associated with inequality for the developing country sample. Some kernel regressions reveal a negative relationship for developing countries. Investigations for causality are not undertaken for any of these associations due to the inadequate availability of data to use as appropriate instruments.

The rest of the paper is organised as follows. In Section 2, the current literature relating to media penetration and ICT/telephony penetration is

[3] http://weber.ucsd.edu/~kgledits/Polity.html, also cited in Besley et al (2002b)

discussed. Section 3 discusses the data and presents the empirical strategy and Section 4 presents the results. Section 5 concludes.

2 Mass Media and ICT

2.1 Political Accountability

The rise of mass media as an indispensible accessory of modern society's access to information has been phenomenal. Mass media is the principal tool for the citizens to hold the governments accountable for their actions. Most importantly, it is the only vehicle which carries information about government actions. The rise of the popularity of the internet and cyberinformation has been the recent addition to the three main media instruments. In a democratic framework, it is essential that the citizens have access to information about the government to be able to select the appropriate government into power (in the presence of free elections) who will serve their needs, and vote out of power those who do not serve their needs. This is particularly important in less developed economies where the poor are particularly dependent on government actions.

That said, mass media are not neutral devices. Different mass-media technologies change the target group of who has access to political information. This is crucial for developing country citizens, where the incidence of different kinds of media varies tremendously. Ownership of the media body is a crucial determinant of the nature of the information provided - privately owned media bodies may well distort the information provided (or the contrary), or leave citizens underinformed of government actions. Under repressive political regimes, similar instances may happen with public media bodies. The effective publication and the credibility of the information, i.e., the publication of real information, will depend upon the nature of the media body - whether it is captured, regulated or repressed. Thus different bodies of mass media create different sets of informed and uninformed citizens.

2.1.1 Political Mechanism

Despite the obvious justifications that mass media creates a more educated and thus responsive citizen, and that it ensures governments are more accountable to citizens, it is only recently that the political economy literature has seriously begun to address these issues. There is a growing literature focusing on political agency problems. While most countries have media in some form of the other, it does not guarantee it as a successful vehicle of information - for that to be achieved, one requires the appropriate vehicles

of information, that will publish information on these issues. This is affected by a variety of government actions - ranging from policy decisions affecting the regulation and of entry and ownership of media on the one hand, to bribery and threats to the media bodies on the other. Besley and Prat (2001) study the determinants and the consequences of captured media, and looking at cross-country data on media ownership find that capture is more likely if there is more state ownership of newspapers and there is greater concentration in ownership of newspapers.

2.1.2 Corruption

The existence of an active mass media body is usually seen to be associated with an active democracy - citizens are free to have access to information about their politicians. A small but growing cross country literature connects the incidence of a free press and the political framework that accompanies it. There are countries which though democratic in structure have low press freedom - such is typically the case for developing countries. Brunetti (2003) and Ahrend (2002) finds robust correlations between press freedom and corruption. Djankov et al. (2003) also uncover robust cross-country evidence of state ownership of the media to be negatively correlated with a number of measures of good governance. Using a panel of 16 Indian states, 1958-1992, Besley and Burgess (2001) find that Indian state governments' provision of public food and calamity relief expenditure is more responsive to falls in food production and crop flood damage in states where newspaper circulation is high. The role of media in moderating business cycles is examined by Shi and Svensson (2002) - using a panel of 123 developed and developing countries over a 21-year period, Shi and Svensson indeed find larger political budget cycles in countries where few people have radios.

Greater media outlets on the other hand are found to be encouraging for the emergence of a free press (Besley, Burgess and Prat 2002). Competition, though, may result in two different effects. While Besley and Prat argue that more media outlets are an impediment to politicians trying bribe the media, Mullianathan and Shleifer (2003) argue that greater competition could result in newspapers (or other media forms) printing or broadcasting stories which confirm readers' prior opinions rather than presenting the real facts.

2.2 The Effect of ICT

The impact of ICT is of particular interest as an information carrier because of the nature of the technology it embodies. While it is a principal carrier of information, serving to even out asymmetries in information that may

exist in markets and society in general, its effect on economic development is more tangible than that of mass media - ICT carries with it technology that directly affects economic productivity and growth.

2.2.1 Growth

Increased investment in ICT has led to significant increases in economic growth - studies on investment in ICTs in industrialised countries (Haacker and Morsinck 2002) estimate an average increase in total factor productivity growth by just over one third percentage point per year between 1995 and 2000. Of course, cross-country variations exist. The US, for instance, had an increase in TFP by one half percentage point per year. Europe's experience with ICT's contribution to economic growth is relatively sporadic. Between 1995-2000, Daveri (2002) reveals that ICT contributions to growth were significant in only 10 countries out of 14. In only 6 of these, was ICT related capital-deepening associated with greater aggregate total factor productivity or growth in labour productivity. Among the newly industrialised economies in East Asia, the deepening of ICT has been of significant importance, particularly in production - 28% of their manufacturing exports are ICT products (Kenny 2003). The contribution of ICT related capital-deepening in Japan contributed to increasing growth by one half to three quarters. In some regions, however, estimation of the effects of ICT on growth are unavailable. In regions of South Asia (barring India), the Middle East and Africa, there is not enough data available for a growth accounting analysis. Likewise, in Latin America and Central and Eastern Europe, ICT investments are too small to measure their impact on economic growth (Piatkowski 2002), warranting greater research and data collection in this area.

2.2.2 Inequality

The factors determining the effects of ICT and mobile telephony penetration on prospects of economic development are multifaceted. Like various forms of mass media, it functions as an information carrier: carrying information related to both the market, and local and global society. This is particularly so for the case of the internet and cyberinformation. What prominently distinguishes the outcomes of ICT penetration as different from other forms of information carriers is that on the production front it is pervasively characterised by increasing returns. Arthur (1994) and Krugman (1991) emphasise that the predominance of increasing returns in a certain industry leads to spatial agglomeration, in a manner similar to how technological lock-in sets in. Thus, the greater the clustering, the greater spatial inequality. From this

point of view, ICT is no different from other industries - the concentration and the location of geographic clusters reflect simply the high skilled and fast-producing nature of the technology, like many other industries. ICT clustering is more pronounced in the EU than in the US (Koski et al 2000, Quah 2001a), though there are no studies which investigate the determinants of differential clustering across the two continents.

While this works at the level of the industry and results in spatial agglomeration, a similar process may function at the individual level - unequal access to ICT, and thus information, may exacerbate already exisiting individual inequalities. This depends upon individual access to ICT, cyberinformation and mobile telephony. Interestingly, ICT and telephony communications are experiencing faster growth-rates in low-income countries – more than twice as fast as in high-income countries in recent years (Coyle 2004). Coyle (2004) points out that the phenomenon of the rapid spread of mobile telephony cuts across many obvious characteristics such as GDP per capita, socio-demographic or geographic criteria - thus Finland and Uganda have a similar proportion of mobile-only users but are not sensibly comparable countries. Thus, while there are concerns of unequal adoption of ICT resulting in possible unequal access to information, this may be an effect which will quell in due course due to fast adoption in LDCs. Due to the recentness of the phenomenon and the lack of adequate data, this is yet to have been investigated empirically and will be attempted in the empirical section of this paper with data currently available.

Combining all these issues, one is prompted to ask whether ICT investment is just growth spurring or inequality increasing, or both. Some casual empiricism as discussed above suggests both, but its effects are yet to be empirically established. ICT's growth-inducing-inequality-increasing effect is a well known characteristic of the effects of new technology. While the phenomenon of spatial agglomeration (thus leading to spatial inequalities) is clearly understood in the literature, whether it is associated with increasing individual inequalities is not clear[4]. The empirical analysis that follows attempts to uncover any such correlations (and causality) between various development outcomes discussed above and ICT.

3 Data and Empirical Strategy

This section discusses the data on ICT, media, press freedom and corruption, discusses the specifications tested in the empirical analysis, and explains the

[4]Some work in this area has been done on the impact of ICTs on wage inequalities in the US, see Autor et al (1998).

Variable name	Abbreviation	Years	Source
Press Freedom	Press	1994-1997	ICRG
Average quality of the bureaucracy	Bureau	1992-1997	ICRG
Average Trade ((Export+Import) /GDP)	Trade	all years	WDI 2005
Average rule of law	Rule	all years	ICRG
Risk Premium	Risk	all years	ICRG
Natural Log of GDP, per capita	lgdppc	all years	WDI 2005
Education	lit	all years	WDI 2005
Latin America dummy	latin	all years	–
Africa dummy	africa	all years	–
OECD country dummy	oecd	all years	–
UNCTAD ICT diffusion index	unctad	1997	UNCTAD
Gini index	gini	all years	WIDER
Poverty, one dollar a day, head count ratio	pov1dd	all years	WDI 2005
Poverty, two dollars a day, head count ratio	pov2dd	all years	WDI 2005
Mobile phones (per 1,000 people)	mobile	all years	WDI 2005
Internet Users (per 1,000 people)	intusers	all years	WDI 2005
ICT expenditure as a percentage of GDP	ictexp	all years	WDI 2005
Fax machines (per 1,000 people)	fax	all years	WDI 2005
Telephone mainlines (per 1,000 people)	telmain	all years	WDI 2005
Telephone mainlines per employee	telmainemp	all years	WDI 2005
Telephone revenue (per 1,000 people)	telrev	all years	WDI 2005
Newspaper circulation (per 1,000 people)	news	all years	WDI 2005
Radios, (per 1,000 people)	radios	all years	WDI 2005
Televisions, (per 1,000 people)	tvs	all years	WDI 2005

Table 1: Variables used in the paper and their sources. All years refer to the period 1992-1997

econometric methodology used. The database has been put together from a variety of sources, each to be described in turn.

3.1 Measures of Mass Media Penetration

Mass media penetration is measured by using the number of newspapers in circulation, and the ownership of radios and televisions, per 1,000 people. The principal data source has been the World Bank Indicators data base.

3.2 Measures of ICT and Telephony

The data has been compiled from the World Bank indicators data set (2004). The variables for which we have obtained maximum coverage of countries are the following:

-Mobile phones (per 1,000 people)
-Internet Users (per 1,000 people)
-ICT expenditure as a percentage of GDP
-Fax machines (per 1,000 people)
-Telephone mainlines (per 1,000 people)
-Telephone mainlines per employee
-Telephone revenue (per 1,000 people)
-Number of personal computers per 100,000 people.

There exists a large number of other ICT indicators, but the country coverage dramatically drops, and are therefore not included in the analysis.

To identify the collective effect of the ICT variables, we construct an index of ICT using factor analysis. This technique is a method of data reduction and attempts to describe the indicators as linear combinations of a small number of latent variables. We accept the first factor (f1) to be the general index of ICT and telephony infrastructure (presented later in tables as $ICTindex$), which takes an eigenvalue of over 5. In performing the factor analysis, the data has been normalised for comparability of the numerical values (for example, comparing revenues in US dollars to number of personal computers per 1,000 people). Factors and factor loadings are presented in the Appendix. For our estimations we mainly use the first factor, and for robustness use the second factor f2. We also use the UNCTAD index of ICT diffusion as an alternate indicator of ICT penetration.

3.3 Measure of press freedom

Our main measure of press freedom is assembled by Freedom House, having published widely used indexes for political rights and civil liberties for the last 25 years. Here again the data presented is in the form of a ranking of the countries in increasing order of freedom.

There are a growing body of studies on the nature of media ownership, determinants of media capture (Djankov et al 2003, Petrova 2005). This paper explicitly focuses on the existence of the knowledge-economy infrastructures (media and ICTs) and their correlations with some development outcomes - corruption, inequality and poverty. Connecting these outcomes to the multi-faceted aspects of ownership of mass media entails a much broader research agenda, warranting a separate study altogether. These issues are thus not

addressed in this empirical study with the view of establishing the nature of the correlations, and if they exist at all.

3.4 Measure of corruption

Our main measure of corruption is an indicator collected by the International Country Risk Guide (ICRG). These are annual ratings of corruption levels by using surveys in the respective countries. The indicator ranges from 0 to 6 and is a rising index with falling levels of corruption. We would expect to obtain a positive association of this index with media and ICT variables in our empirical tests. Of all country risk services ICRG covers by far the largest number of countries. We have 114 countries in the full sample, and 83 countries in the developing country sample.

3.5 Measure of inequality

We use the Gini measure (of income inequality) from the WIID2b database published by UNU-WIDER, which documents annual measures of country Ginis, for the time period 1992-1997.

4 Associations of Corruption, Inequality and Poverty with ICT/media

In this section, we present estimates of the correlations of some development outcomes, namely corruption, inequality and poverty with ICT infrastructures and mass media. Given that the nature of their impact of any of these outcomes is unknown, we estimate our models using OLS.

In Tables 2 and 3 we present the models estimated with ICRG corruption index as as the dependent variable. Tables 4 and 5 presents the results with Ginis (inequality) as the dependent variable and Table 6 with poverty as the dependent variable.

The main specification we are testing for the model with the corruption is:

$$CORR_i = \beta_0 + \beta_1 NEWS_i + \beta_2 RADIO_i + \beta_3 TV_i + \beta_4 ICTindex_i + \beta_5 BUREAU_i + \beta_6 RULE_i + \epsilon_i \quad (1)$$

Table 1 lists the abbreviations and the sources of the variables in use. $NEWS_i, RADIO_i$ and TV_i represent the incidence of newspapers, TVs and radios in country i.The $ICTindex_i$ is the index (the first factor, in most

cases) that has been estimated using factor analysis in Section 3.2. For each of these variables, one would expect a negative relationship with rising corruption. With the ICRG corruption index, one would therefore expect a positive relationship.

We include a number of variables as controls. Rule of law, presented above as RULE, is a variable obtained from the ICRG, which measures the extent of the citizens' capabilities to monitor the extent of corruption. It represents the presence of sound political institutions, a functional legal system and "provisions for an orderly succession of power". BUREAU accounts for the quality of bureaucracy in the government, also provided by the ICRG based on evaluations from country experts. It indicates the degree of autonomy (of the bureaucracy) from political pressure. Both of these should be associated with lower values of corruption; we would therefore expect a positive relationship with the corruption index (i.e. a negative association with corruption).

In addition to these principal explanatory variables, we include a number of country-level characteristics which act as proxies of determinants of corruption. We augment equation 1 with other variables as follows:

$$\begin{aligned} CORR_i &= \beta_0 + \beta_1 NEWS_i + \beta_2 RADIO_i + \beta_3 TV_i + \beta_4 ICTindex_i + \beta_5 BUREAU_i \\ &\quad + \beta_6 RULE_i + \beta_7 TRADE_i + \beta_8 RISK_i + u_i \end{aligned} \tag{2}$$

TRADE and BLACK are proxies for distortions and restrictions of competition in an economy. TRADE measures the exposure of an economy to foreign trade and is defined as the sum of exports and imports as a percentage of GDP. It has been argued that open countries are subject to larger competitive pressure which reduces monopolistic rents and thus corruption (Ades and Di Tella 1999), therefore one would expect a negative relationship with corruption, and a positive association with the corruption index[5]. We also include a variable collected by the ICRG, an index of expropriation risk, named here as RISK, which is scaled such that high values of RISK indicates low risk of appropriation. We would therefore expect a positive relationship with the ICRG corruption index.

Given these factors, one can conjecture that higher incidence of media variables - such as newspapers, radios and televisions - and higher access

[5]A large number of cross country studies investigating differential development outcomes, have often included the extent of cultural diversification as a possible determinant of differential growth and development outcomes. It is purported to affect corruption in particular by impeding competitiveness. Ethnic fragmentation has been included in several specifications but has not shown up to be significant and hence is not presented.

to ICTs - such as higher internet usage, and deeper telecommunications' penetration - can be associated with lower levels of corruption. This may be due to the higher incidence of political awareness that results due to the greater availability of information about their government's activities and the general civic awareness that results. A better informed society can be expected to hold its government and politicians to better service delivery and evict malfunctioning or corrupt governments. It is in this light that we would expect both sets of media and ICT variables to be negatively associated with corruption, and positively associated with our corruption variable (a higher value of the variable corresponds to lower levels of corruption).

Other country specific controls are also included. ln GDP and Literacy measure the level of per capita GDP in 1995 (calculated at purchasing power parity US $), and the educational attainment. These both act as proxies for external controls - higher levels of GDP and education serve to act as a control on corruption by creating greater awareness.

In Table 2 we present the results with the full sample with all 114 countries. All standard errors are heteroscedasticity-consistent for all the models estimated. The first column presents the results with all ICT and media variables, and the two main controls, BUREAU and RULE. Of the different media and ICT variables, newspapers and percentage of GDP spent on ICT infrastructures are positive and significant. BUREAU and RULE are both positive and significant, confirming that these variables are associated with lower levels of corruption (note that the ICRG index of corruption increases for decreasing corruption). We include further controls to test for the stability of the observed associations - both newspapers and ICT expenditures continue to be significant and positive. Fax machines bears a negative and significant co–efficient - however, on having it independently with no other regressors, it has a strong positive coefficient ($b = 0.037, t = 12.56$). TVs are occasionally significant and positive (Col 2), and is strongly so when run independently ($b = 0.0037, t = 18.00$); likewise with internet users, though with a very small coefficient. Of the three land-based telecommunications variables used, percentage of households with mainline telephone lines is positive and significant, documented in Column 3. Literacy in several specifications, (in our case Cols 2-4) is significant and negative - this too, if regressed independently yields a positive and significant result ($b = 0.0172, t = 8.9$). Trade as a percentage of GDP is negative and significant in all cases, a result that does not conform to our expectations. Likewise, RISK is also observed to be negative and significant under some specifications, and is sensitive to whether an infrastructure index is used or the variables are included independently. Column 4 introduces country specific dummies - African, Latin American and OECD countries; we only obtain the Latin American dummy to be sig-

	1	2	3	4	5	6
	OLS	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*
news	0.0023*	0.0055*	0.0055*	0.0057*	0.0016*	0.0060*
radios	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
tvs	0.0009	0.0018†	0.0006	-0.0004	-0.0001	0.0016
fax	-0.0156*	-0.0500*	-0.0432†	-0.0857*		
ictexp	0.0942†	0.2943*	0.2823*	0.3346*		
intusers	0.0000	0.0000	0.0000†	0.0000		
mobiles	-0.0008	-0.0010	-0.0053	0.0037		
F1					0.0310	0.8411†
bur	0.3997*	0.3660*	0.2667*	0.2265†	0.3939*	0.2789*
rule	0.2226*	0.3917*	0.2919*	0.1547	0.2352*	0.3441*
lgdppc		0.0313	-0.0293	0.3752†		-0.2487
lit		-0.0398*	-0.0502*	-0.0293†		-0.0602*
tradegdp		-0.0032	-0.0018	-0.0084*		-0.0045
risk		-0.2272‡	-0.0343	-0.0366		-0.3356†
telmain			0.0024*			
africa				-0.2947		
latin				-1.1441*		
oecd				0.1972		
cons	0.5510†	4.5241†	4.5777†	1.6032	1.0853†	11.5833*
N	147	98	98	98	207	83
Adj R^{sq}	0.57	0.55	0.67	0.65	0.63	0.48
F	33.06	10.06*	13.19*	12.28	39.18	8.64*
Notes	*: Significant at 1% level of significance					
	† : Significant at 5% level of significance					
	‡: Significant at 10% level of significance					

Table 2: OLS Regressions of Corruption 1992-1997, all countries

nificant. To summarise, we find some significant and robust relationships between corruption and the ICT and media variables, though individually, one can see that they are sensitive to specification and the controls included in the regression[6].

In the following two columns, we repeat the earlier specifications, this time replacing the ICT variables with the first factor obtained from the factor analysis exercise. In our base specification, in Col 5, it is not significant, though on including further controls and country specific factors and country dummies, it is significant. Newspapers is robust to all these specifications - it remains positive and significant, as is BUREAU and RULE. In summary - of the different media and ICT variables that we use, newspapers and percentage of GDP spent on ICT infrastructures have proven to be robust under several specifications. TVs and telephone mainlines are occasionally positive and significant. The collective ICT index derived using factor analysis is also significant under several specifications.

In order to isolate these associations only in developing countries, we repeat this analysis with only developing countries, results presented in Table 3. Many of the observed associations continue to hold for the developing countries' sample. Newspapers and percentage of GDP for ICT expenditures are significant and positive for all cases (except for Col 3 when the country dummies are introduced). While faxes are no longer significant, telephone mainlines are still significant at 1% (Column 3). The ICT infrastructure indicator, f1 is significant under some specifications (Column 6). The number of internet users is significant in the first specification (Column 1), though not with the inclusion of controls in later specifications. Mobile phones are significant and negative for some specifications - the negative association could be proxying an omitted variable in the model, or simply be subject to endogeneity. BUREAU and RULE continue to remain significant and positive, though one observes that the relationship is less robust as was in the case with the full sample of countries. Literacy is again negative and significant, as was the case with the full sample, (while is positive and significant if regressed independently). Trade as a percentage of GDP is significant and negative for the specification (Column 6) and is found to be sensitive to specification. Risk is also observed to be negative and significant for some specifications (Column 6), when all controls for country specific characteristics are included, with a significant Latin American dummy. Overall, one observes the highest ex-

[6]In light of the major technological advances in China, a China dummy was included to test for its significance. The dummy was insignificant in all specifications tested, and was dropped from the model. I am grateful to a referee for this suggestion.

	1	2	3	4	5	6
	OLS	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*
news	0.0093*	0.0074†	0.0036	0.0024	0.0090*	0.0093†
radios	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
tvs	-0.0051	-0.0007	-0.0020	0.0021	-0.0045†	0.0005
fax	-0.0330	-0.0170	0.0975	0.1846		
ictexp	0.2513*	0.3446*	0.1012	0.2416‡		
intusers	0.0000*	0.0000	0.0000	0.0000		
mobiles	-0.0180†	-0.0155	-0.0276‡	-0.0228		
f1					0.3482	1.1593†
bur	0.3389	0.2851†	0.0248	0.0848	0.3988*	0.3102†
rule	0.1690*	0.2740	0.2666‡	0.2314	-0.0160	0.1691
lgdppc		-0.2328	0.1461	0.1640		-0.4798‡
lit		-0.0301*	-0.0426*	-0.0137		-0.0540*
tradegdp		-0.0009	0.0016	-0.0024		-0.0053‡
risk		-0.2436	-0.2470	-0.2860		-0.3186‡
telmain			0.0039*			
africa				0.4780‡		
latin				-0.8080		
cons	1.0285	6.5558*	6.1018*	3.6937	2.3735*	13.3677*
N	60	59	49	59	49	48
Adj Rsq	0.41	0.50	0.63	0.56	0.28	0.44
F	5.60	5.44	6.92	5.85	4.07	4.63
Notes	*: Significant at 1% level of significance					
	† : Significant at 5% level of significance					
	‡: Significant at 10% level of significance					

Table 3: OLS Regressions of Corruption 1992-1997, developing countries only

planatory power when the individual ICT variables are in use instead of the ICT infrastructure variable.

4.1 Robustness checks

With the purpose of re-affirming the significant associations observed above, we estimate some instrumental regressions, results in the Appendix. For the ICT index, we use lagged values of the index by 3 years. For mass media, we use a measure of press freedom for newspapers: we use press freedom measures as compiled by Freedom House for years 1994 to 1997; there are no rankings available prior to 1994. Both instruments are simplistic in their approach - the lagged value of ICT may affect current values of corruption via its effect on current values on ICT - in which case, one is also testing for the persistence of the effects of ICT. Likewise, higher press freedom can be deemed to be associated with higher incidence of the media - both in terms of intensity, quality and quantity of media covered, and that of the proliferation of new print media. We use press freedom as an instrument for newspaper circulation. There are however several potential criticisms for using press freedom as an instrument for newspapers - one is that press freedom may itself be endogenous since corrupt regimes may tend to limit press freedom. Likewise, for many developing countries investment in ICT and mass media may not be persistent enough for lagged estimates of ICT to be strongly correlated with current values.

We present the results of the 2SLS estimates using lagged ICT by 3 years as an instrument for the ICT index (f1) in Table 12, in the Appendix. The ICT index is not significant. The co-efficient of newspapers is still positive and significant for the full sample. Non-linear specifications have not resulted in greater fit. The Latin American dummy continues to be significant. The Hausman statistic also does not suggest significant endogeneity of ICT for the developing country sample.

We have repeated the above specifications using the UNCTAD ICT diffusion index for year 1997. This is the only year for which we obtain an overlap in the years in use for our analysis. The index is composed of the same variables as ours, and also uses a few more to account for their variation[7]. The results with the UNCTAD ICT diffusion index are tabulated in

[7]The UNCTAD Report and data is available at http://www.unctad.org/en/docs/iteipc20065_en.pdf. The UNCTAD index of ICT infrastructure is based on similar sets of communications infrastructure, with a greater focus on access, therefore including macroeconomic aggregates such as literacy and GDP per capita in their index. It includes the following variables for each country: internet hosts per capita, personal computers per capita, telephone mainlines per capita, mobile

the Appendix. We test with both the levels of the index and also a squared term. For the full sample we observe a positive and significant association of the UNCTAD ICT squared term, with the corruption index, a result which conforms with the findings using the ICT index estimated in this paper. For the levels we obtain a negative and significant co-efficient.

We also estimate 2SLS estimates using press freedom as an instrument for newspapers, results presented in the Appendix. For both full sample and developing country samples we do not obtain a significant association.

We can now summarise our findings:

- The corruption index is positively and significantly associated with newspapers, i.e., corruption is significantly and negatively associated with newspapers. This relationship is particularly robust for the full sample. For the developing country sample, newspapers are sensitive to the inclusion of country characteristic controls and is not significant for all models. TVs are occasionally observed to be significant, positive for the full sample, but negative for the developing country sample. It's association with corruption is therefore less clear. Radios are not observed to be significantly associated with corruption.

- The ICT infrastructure index is observed to be significant and positive under some specifications, i.e., it is negatively associated with corruption. For some specifications, a significant association is observed with higher order terms of the ICT index.

- Many of the individual ICT and telephony variables are also significantly associated with the corruption index. ICT expenditure is positively and significantly associated with the corruption index under all models for the full sample, and all but one for the developing country sample. This is the only ICT/telephony variable which is significantly associated with corruption. Landline telephone density is also occasionally positively and significantly associated with the corruption index (i.e., negatively associated with corruption) for both developing and full samples.

subscribers per capita, number of internet users, literacy, cost of a local call (telephone charges and internet access charges), GDP per capita. Methodology used to obtain the index is that of indicator scoring, rather than aggregating normalised values of the variables using factor analysis used in this paper.

4.2 Inequality, and ICTs and Media

In Tables 4 and 5 we present the results of the associations of media and Telephony/ICT variables with levels of inequality. The dependent variable is the Gini coefficient, obtained from the UNU-WIDER (2005) database (WIID2b) for years 1992-1997. We estimate both for the full sample of countries, and the developing countries' sample, to observe whether the relationship only holds for LDCs.

The basic specification that we are testing is as follows:

$$\begin{aligned} GINI_i &= \beta_0 + \beta_1 NEWS_i + \beta_2 RADIO_i + \beta_3 TV_i + \beta_4 ICTindex_i + \beta_5 BUREAU_i \quad (3) \\ &\quad + \beta_6 RULE_i + \beta_7 TRADE_i + \beta_8 RISK + \epsilon_i \quad (4) \end{aligned}$$

We continue to use the same controls (BUREAU, RULE, TRADE and RISK) as used in the corruption model. We envisage the association of any of the media or ICT variables with inequality to tbe due to media and ICTs equalising access to technology, and also via political economy linkages. Societies with higher rule of law indicate the existence of high quality institutions and legal bodies, which can positively affect the impact of ICT and mass media infrastructure on citizen's education or awareness in general. This over time, could translate into higher skills and thereby higher incomes. This impact, if partial across the distribution - that is, positively affects one section of the distribution more than others - may wedge the sections apart, resulting in a rise in inequality. This is often the case in developing countries when access to the knowledge-based technology involved is expensive, and infrastructure-intensive. The reverse may also happen; the knowledge it engenders, may "equalise" society on some development outcomes (for example, awareness about birth control amongst men and women, brought about by national health programmes, brings down household size and thereby raises household per capita income in poor countries). ICTs and media can therefore serve to work eitherway on the extent of inequality.

Higher international exposure via TRADE makes the economy competitive, and enhances the quicker spread of information and associated technologies, by bringing down the prices of many of these technologies. As discussed earlier with relation to RULE, its effect may be either positive or negative[8].

[8]Two other controls were used, have been dropped from the analyses due to their insignificance - black market premium and ethnic fragmentation. Black market premium on foreign exchange is used in the literature as an indicator of the degree of government-created distortions in an economy. Higher black market premium, and higher ethnic fragmentation are more likely to be inequality-increasing, due to the distortions they encourage in the economy.

In addition, we choose two sets of country-specific controls used by Perotti (1996) and Barro (1999) as has been popularly used in the inequality and growth literature (Banerjee et al 2002). This is because a central concern for the empirical literature is that any of the right hand side variables used as controls could proxy for omitted variables. The choice of the variables entails judgements about causality that are hard to substantiate. Therefore, we use an already established set of controls: those used in Perotti (1996) and those used in Barro (1999). Specifications empirically tested for thus are repeated with two sets of controls. These specifications are useful benchmarks for two reasons. First, the Perotti specification has been used by most subsequent studies. Second, they represent two extremes, the Perotti specification using the smallest number of control variables and the Barro specification the largest[9]. The Perotti specification excludes most variables (in particular, investment and government spending) through which inequality could be affected. The variables included are male and female education and the purchasing power parity of investment goods, a measure of distortions. Barro, on the other hand, includes a much larger set of variables through which inequality could be affected - investment share of GDP, fertility, education and government spending. The interpretation of the co-efficients in two regressions is therefore slightly different. The results presented in Tables 4 and 5 allow for both sets of controls. To separate out the associations for developing countries only, we estimate the model for both the full sample of countries and the developing country sample separately, presented in Tables 4 and 5 respectively.

Table 4 presents the estimates for the full sample - Column 1 estimates the basic model, with the individual media and ICT and telephony variables included individually, and the country-level controls BUREAU, RULE, Ln GDP, literacy, TRADE and RISK. We observe that newspapers, TVs and faxes are negatively and significantly associated with inequality. Telephone mainlines are also negatively and significantly associated with inequality. Of the ICT variables, only number of internet users is observed to be significant and positively associated with inequality. Inclusion of continent dummies

[9]The list of variables included in both specifications are as follows: Perotti: Log(GDP(1990),PPP I (1990), male education (1990), female education (1990).

Barro: Log(GDP(1990)), log(GDP(1990)) squared, government consumption(1990-1995), secondary and higher education(1990), fertility(1990), 1/30*(term of trade(1995)-terms of trade(1990)), rule of law, democ(1990), democ(1990) squared, inflation(1990-1995), investsment share (1990-1995).

	1	2	3	4	5	6	7
	OLS	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*	*IV*
			Perotti	*Barro*	*Perotti*	*Barro*	*Barro*
news	-0.0578*	-0.0505*	-0.062*	-0.061*	-0.088*	-0.065*	-1.23*
radios	0.0000	-0.0003	-0.001	0.000	-0.001	-0.001	-0.0004
tvs	-0.0404*	-0.0390*	-0.024*	-0.043*	-0.035*	-0.0301*	-0.016*
fax	-0.3643†	-0.3131‡	-0.001				
ictexp	0.1726	-0.0797	-0.880				
intusers	0.0000‡	0.0000†	0.000†				
mobiles	0.0186	0.0554	-0.0211				
f1				-0.178			
f1*sq*					10.56*		
f2						6.162‡	4.15‡
bur	0.2631	0.5521	1.264	-0.190	1.449‡	0.583	-0.283
rule	-3.6385*	-2.5837*	-1.412	-3.257*	-0.993	-1.078	-1.09
lgdppc	3.1356†	2.4951‡	0.578	1.301	3.69*	-0.411	0.387
lit	0.0715	0.1036	0.1334	0.123	0.383*	0.176	0.176
tradegdp	0.0290	0.0035	0.107*	0.023	0.131*	0.084*	0.085*
risk	-0.6271	-1.7575	-2.14‡	-0.697	-1.321	-2.491†	-1.128†
telmain		-0.0126‡					
africa			10.8*		12.47*	10.73*	9.23*
latin			13.0*		13.38†*	11.9*	10.92*
cons	49.5*	61.1*	55.3*	62.4*	-6.27	66.7*	52.04*
N	97	84	97	83	83	83	83
Adj Rsq	0.70	0.71	0.78	0.67	0.74	0.75	0.73
F	19.0600	15.9800	23.7900	17.66	20.79	22.12	21.3
Notes	*: Significant at 1% level of significance						
	† : Significant at 5% level of significance						
	‡: Significant at 10% level of significance						

Table 4: OLS Regressions of Gini Index 1992-1997, for full sample

	1	2	3	4	5
	OLS	*OLS*	*OLS*	*OLS*	*IV*
	Barro	*Perotti*	*Barro*	*Perotti*	*Perotti*
news	-0.0678†	-0.0654‡	-0.083†	-0.081†	-1.080†
radios	-0.0010	-0.0006	-0.001	0.000	0.000
tvs	0.0024	-0.0113	0.007	-0.005	-0.005
fax	0.4239	0.0261			
ictexp	0.3214	-1.3864			
intusers	0.0000	0.0000			
mobiles	0.0131	0.0192			
ICT index			1.004	-2.614	-2.64
bur	2.0215‡	2.7760†	2.246†	2.773†	-2.110‡
rule	-1.2533	-0.5364	-1.321	-0.142	-0.121
lgdppc	4.4332†	-0.6182	3.788‡	0.076	0.023
lit	-0.0615	0.1997	0.029	0.184	0.110
tradegdp	0.0121	0.1242†	0.036	0.107†	0.090‡
risk	-0.083	-0.73	0.149	-0.212	-0.212
telmain					
africa		14.4‡		9.6	7.6
latin		15.2†		11.5†	10.5†
$_{c}ons$	24.1	33.8	19.6	20.9	19.9
N	58	58	48	48	0
Adj Rsq	0.44	0.49	0.47	0.51	0.46
F stat	4.4600	4.7000	5.19	5.04	5.23
Notes	*: Significant at 1% level of significance				
	† : Significant at 5% level of significance				
	‡: Significant at 10% level of significance				

Table 5: OLS Regressions of Gini Index 1992-1997, for developing country sample

in Column 3, and the Perotti controls, reveals both the Africa and Latin America continent dummies to be significant. We obtain the same results with the Barro controls (results not presented in Table).

For the estimates in Columns 4 to 7, we replace the individual variables with the ICT/telphony index - Columns 4 and 5 present the results using the first factor obtained from the factor analysis exercise, with the Barro and Perotti controls; the ICT/telephony index is not significant when included as levels, but is positive and significant when included as f1 squared. Other media variables - newspapers and TVs continue to be negative and significant. Fit drops on inclusion of the ICT index, particularly so for the model including the Barro controls. We replace the first factor by the second factor obtained from the factor analysis as the ICT index in Column 6 (using Barro controls) - here we obtain a significant and positive co-efficient for the ICT index. In all the specifications, the continent dummies are significant.

In Column 7, for robustness, we report results with the 2SLS regression for the ICT index (f2) lagged by 3 years as the instrument for f2. The ICTindex is again significant, as are newspapers and TVs. The instrumental regressions estimated using f1, and with lagged values of f1 as the instrument are presented in the Appendix. We do not obtain a significant co-efficient for both full and developing country samples. The UNCTAD ICT diffusion index is not significant either (results in Appendix). Two stage least squares regressions were also run instrumenting newspapers by press freedom, results in Appendix. It does not appear to function as a successful instrument for newspapers in this case.

Table 5 presents the estimates for the developing countries' sample - Columns 1 and 2 present the results for inclusion of the individual media and ICT/telephony variables, with the Barro and Perotti controls respectively. Newspapers are negatively and significantly associated with inequality, but TVs are no longer significant. Continent dummies are significant for both specifications. We replace the individual media and ICT variables with the ICTindex in Columns 3 and 4 - we obtain a negative co-efficient for the model including the Perotti controls, but it is not significant. We include squared f1 and f2 as well, and obtain no significance. The same models were tested using the UNCTAD ICT diffusion index as well, and no significant results were obtained, results tabulated in the Appendix. Newspapers are also instrumented using press freedom as the instrument, results in Appendix. We obtain the wrong sign of the coefficient.

In both sets of models for full sample and developing country sample, there have been mixed outcomes for the country level controls - RULE for the full sample has been negative and significant throughout, likewise mostly for RISK, but not so for the developing country sample. BUREAU has also

been positive and significant under some specifications for the developing country sample, while TRADE and literacy even rarely so. Ln GDP for several specifications is positive and significant under both the full sample and developing country sample, supporting a common observation made in the empirical literature that higher levels of inequality is a common characteristic of developed economies.

To summarise our results obtained:

- Inequality (as measured by Ginis) is found to be negatively and significantly associated with several media variables, most notably with newspapers. Newspapers is negative and significant under all specifications: OLS, IV, for the full sample and developing country sample, and under the different models including Perotti and Barro controls. TVs are also found to be negatively associated with inequality, though the levels of significance varies with the model and controls included.

- Inequality is also found to be significantly associated with the ICT index under several specifications for the full sample. For the full sample models, it is positive and significant, particularly for the models where it is included as with higher orders, but for the developing country sample it is not significant. The relationship is sensitive to specification, and could be due to non-linearities in the relationship, to be investigated in the following section.

4.3 Non-linearities in the ICT-inequality relationship

The results tabulating the regressions of inequality on mass media and ICT indicators in Tables 4 and 5, established two sets of relationships. For the full sample of countries, ICT is found to be positively associated with inequality, while for the developing country sample, it is either not sigificantly associated, or weakly negatively associated with inequality. To affirm this non-linear relationship between inequality and the ICT index, we plot some kernel regressions of inequality (Ginis) on the ICT index to ascertain the non-linear nature of this relationship. The non-linear relationship between growth and development indicators and inequality is well documented - starting from Kuznets's inverted U-curve hypothesis, to recent studies on inequality and growth (Banerjee and Duflo 2002, Quah 2002), and it is possible that a similar "stage of development" -specific relationship exists for inequality and the ICT infrastructure index.

Kernel regressions of the Gini on the ICT index are plotted for both f1 and f2 (the first two factors from the factor analysis exercise retained as

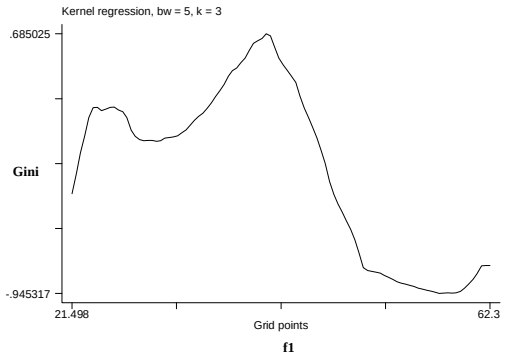

Figure 1: Kernel Regression of ICT index (first factor, f1) on Inequality, Epanechnikov kernel, years 1992 to 1995

indices of ICT) in Figures 1 to 4. We use two types of kernel estimators, the Epanechnikov estimator, and a quartic estimator - both reveal similar non-linearities in the relationship between ICT indices and the Gini. For the regression of the Gini on the first factor, f1, in Figures 1 and 2, we observe that for lower values of f1, the relationship is positive, and for higher values of f1, it is negative. For the regression of the Gini on the second factor, f2 in Figures 3 and 4 we observe a clearer negative relationship, though this negative relationship often switches to a positive relationship for rising levels of ICT index f2.

To summarise: We find that kernel regressions clearly reveal the non-linear relationship of the ICT index with Ginis - this non-linearity is also reflected in our OLS estimates in the previous section

To summarise the association of inequality with mass media and ICT variables:

- Inequality has a robust relationship with media variables - it is negatively and significantly associated with newspapers under all models estimated and with tvs and radios under several specifications.
- The ICT variable has a non-linear relationship with inequality - it is negatively associated for the full sample, and positively associated for the developing country sample. It's association, though, is not robust

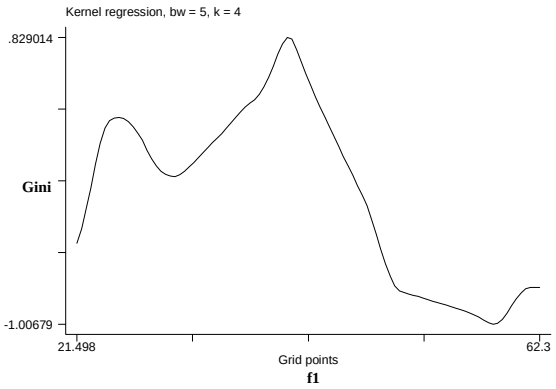

Figure 2: Kernel Regression of ICT index (first factor, f1) on Inequality, Quartic kernel, years 1992 to 1995

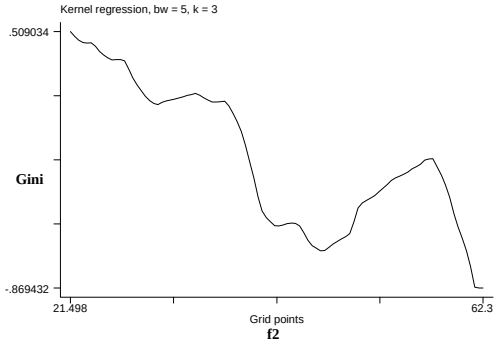

Figure 3: Kernel Regression of ICT index (second factor, f2) on Inequality, Epanechnikov kernel, years 1992 to 1995

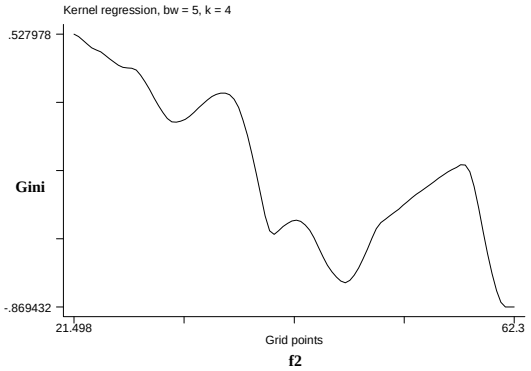

Figure 4: Kernel Regression of ICT index (first factor, f2) on Inequality, Quartic kernel, years 1992 to 1995

to different specifications and inclusion of the several controls. Kernel regressions confirm that the relationship between inequality and the ICT index varies with the level of the ICT index.

4.4 Poverty, ICTs and Media

The final relationship that we will be investigating is the association of the media variables and the ICT index with poverty. The main model estimated is

$$\begin{aligned} POVERTY_i &= \beta_0 + \beta_1 NEWS_i + \beta_2 RADIO_i + \beta_3 TV_i + \beta_4 ICTindex_i + \beta_5 BUREAU \quad (5) \\ &\quad + \beta_6 RULE_i + \beta_7 TRADE_i + \beta_8 RISK + \epsilon_i \quad (6) \end{aligned}$$

Poverty is measured using two definitions of poverty - the one dollar a day definition (poverty headcount ratio at $1 a day (PPP) (% of population)) , and the two dollar a day definition (poverty headcount ratio at $2 a day (PPP) (% of population)) of the World Bank. Data is obtained from the World Bank indicators' database over the years 1992 - 1997[10]. For this analysis we only consider the sample of LDCs (83 countries). Data availability for all the years are sparse, hence the number of observations in the regressions

[10]We also estimated the models with the poverty headcount ratio at national poverty line (% of population), but due to the number of observations being very low, most specifications did not run.

that ran are small. Here again we use the same set of controls as determinants of poverty as before, via the same political economy routes. Controls of BUREAU and RULE account for good governance, and provide the institutional set up for growth and economic development. TRADE and RISK ensure the competitiveness required for economic growth and development, thereby lowering levels of poverty. We would expect a negative association of poverty with all of these four controls. Country level characteristics of Ln GDP and literacy are also included, and are expected to be negatively associated with poverty.

In Table 6, Column 1 presents the results of the basic specification with newspapers, radios, and TVs as the media variables, and the ICT and telephony individual variables, using the one dollar a day definition of the poverty measure. Due to the small sample size we only include the Perotti controls, and the country-specific characteristics. Newspapers are not significantly associated with poverty - this result holds for all specifications, barring Column 2 where it is positively associated with poverty. This result is not observed elsewhere. Radios are however, significant and negative for all models tested. This is observed for all the models presented, and also for any other model that has been tested. TVs are not significant, and this holds for most specifications using the one dollar a day measure of poverty. None of the individual ICT variables are significantly associated with poverty, but telephone revenues is significant. In Column 2, we also observe mobile telephony to be negative and significant as well. TVs and newspapers are significant and positive - this result is sensitive to the specification, and does not hold for the rest of the results presented.

In the following two columns, we replace the individual ICT variables with the ICT index - we have tested with both f1 and f2 factors, and higher order terms (squared terms), and it has not been significant in any of the specifications. Radios continue to be negatively and significantly associated with poverty. The continent dummies included in Column 4 are not significant - this is observed for all specifications estimated.

Columns 5 to 7 present the results using the two dollars a day measure of poverty. We again observe the negative and significant association of radios with poverty, but also observe that TVs is also negative and significant. This result holds for all specifications tested with the two dollar a day measure of poverty. Of the ICT variables tested, we observe that ICT expenditure as a percentage of GDP to be negative and significant. Internet users is also observed to be negative and significant - this result holds for all specifications.

	1	2	3	4	5	6	7
Dep variable	pov1dd	pov1dd	pov1dd	pov1dd	pov2dd	pov2dd	pov2dd
news	0.0310	0.1270†	0.029	0.0360	-0.0600	0.007	0.008
radios	-0.0180‡	-0.0290†	-0.016‡	-0.0150‡	-0.0340†	-0.045*	-0.046*
tvs	0.0590	0.1160†	-0.008	-0.0260	-0.1270†	-0.087†	-0.087‡
fax	3.7530	-3.6840			7.4260		
ictexp	-0.0340	3.6790			-4.5070‡		
intusers	0.0000	0.0000†			0.0000‡		
mobiles	-0.0760	0.7550‡			-0.5900		
f1			-1.791	4.7910		-9.562	9.612
bur	0.4320	-0.7660	-2.138†	-1.6280	-1.3650	-2.707	-2.93
rule	-0.6910	-5.3340†	-0.058	0.3120	5.5690	1.857	1.17
lgdppc	-9.7920‡	-13.5420*	-2.697	-2.2100	-2.6430	-3.699	-2.468
lit	-0.3340	-1.2410*	-0.567†	-0.6290†	0.0060	-0.875†	-0.951†
tradegdp	-0.1050†	-0.2380*	-0.089†	-0.0920†	-0.1090	-0.159*	-0.226*
risk	-2.2560	4.6710	-0.749	-1.0910	-3.9390	0.658	-0.876
telmainrev	0.0280†	0.0260†					
telmainemp		-0.0170					
africa				-0.6480			-8.405
latin				1.2940			-7.46
$_{c}ons$	111.4300†	178.7760	105.657†	110.5790†	123.9190†	168.349†	201.208*
N	25	21	21	21	25	25	21
R^{sq} adj	0.5600	0.8990	0.635	0.6000	0.8630	0.869	0.87
F	3.1800	12.1700	4.48	3.5000	12.6000	11.65	12.18

Notes
*: Significant at 1% level of significance
† : Significant at 5% level of significance
‡: Significant at 10% level of significance

Table 6: OLS Regressions of Poverty 1992-1997, for developing country sample

None of the telephony variable are significant. On replacing the individual ICT variables with the ICT index, we do not observe a significant co-efficient. It is possible that the ICT variables that are individually significant are proxying for the level of development.

Due to the small sample, it was not possible to run the instrumental regressions for the poverty model.

To summarise our results:

- We find that newspapers and radios as media variables, are significantly and negatively associated with poverty. This result holds for all the models that have been estimated.
- The ICT index is not significantly associated with poverty. We find this to hold for most of the specifications. Of the individual ICT variables, ICT expenditures is significantly associated with poverty under some specifications.

5 Conclusion

There is an increasing dependence on the knowledge-based economy for economic development. Mass media and ICTs are two important vehicles of information in developing and developed countries alike. Is there any evidence that these vehicles of information are associated with positive development outcomes? In this paper we present some robust evidence of some associations of ICTs and mass media with some development outcomes - namely corruption, inequality and poverty. We obtain some robust evidence that both mass media and ICT infrastructures are negatively associated with corruption. Of the media variables, newspaper penetration is negatively associated with corruption, a result that holds out robustly for all models tested with the full sample. Of the ICT and telephony variables, we observe a robust association of ICT expenditure (as a percentage of GDP) and corruption, as is also the case with telephone landlines. The ICT index is also significantly correlated with corruption under some specifications. This result holds across both the full sample and the developing countries' sample.

We observe similar results for associations of inequality (measured with the Gini index) - it is negatively associated with newspaper penetration, and is one of the most robust observations of all the estimates. ICT and telephony variables, and the ICT index has mixed outcomes with their associations with inequality - for the full sample there exists a positive association, and a weak association (mostly negative) for the developing country sample. ICT expenditures as a percentage of GDP are found to have a negative association

with inequality. For poverty, the most prominent result observed was the negative association with the incidence of radios and TVs - this result has been robust to all specifications tested, particularly for radios.

We do not test for causality between ICT and media variables and the development outcomes in this paper. Due to the short times series of much of the variables, and the lack of suitable instruments, it was not attempted in this paper and remains open for future research. With the empirical literature still at its early stages, the evidence obtained however, is convincing that there exists a clear and significant association between media and communications infrastructures, and corruption, inequality and poverty. Country-specific micro-studies will take this literature further.

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Appendices

A Countries used in the analyses.

The full sample consists of the following 128 countries.

Algeria	El Salvador	Korea, Republic	Poland	Uruguay
Angola	Ethiopia	Kuwait	Portugal	Venezuela
Argentina	Finland	Lebanon	Qatar	Vietnam
Australia	France	Liberia	Romania	Yemen, Rep.
Austria	Gabon	Libya	Russian Federation	Yugoslavia
Bahamas	Gambia	Luxembourg	Saudi Arabia	Zaire
Bahrain	Germany, FR	Madagascar	Senegal	Zambia
Bangladesh	Ghana	Malawi	Sierra Leone	Zimbabwe
Belgium	Greece	Malaysia	Singapore	
Bolivia	Guatemala	Mali	Slovakia	
Botswana	Guinea	Malta	Somalia	
Brazil	Guinea-Bissau	Mexico	South Africa	
Brunei	Guyana	Mongolia	Spain	
Bulgaria	Haiti	Morocco	Sri Lanka	
Burkina Faso	Honduras	Mozambique	Sudan	
Cameroon	Hong Kong	Myanmar	Suriname	
Canada	Hungary	Namibia	Sweden	
Chile	Iceland	Netherlands	Switzerland	
China	India	New Zealand	Syria	
Colombia	Indonesia	Nicaragua	Taiwan	
Congo	Iran	Niger	Tanzania	
Costa Rica	Iraq	Nigeria	Thailand	
Cote d'Ivoire	Ireland	Norway	Togo	
Cuba	Israel	Oman	Trinidad and Tobago	
Cyprus	Italy	Pakistan	Tunisia	
Czech Republic	Jamaica	Panama	Turkey	
Denmark	Japan	Papua New Guinea	UAE	
Dominican Republic	Jordan	Paraguay	Uganda	
Ecuador	Kenya	Peru	United Kingdom	
Egypt	Korea, DPR	Philippines	United States	

Table 7: Countries included in the full sample

The developing country sample consists of the following countries:

Algeria	Gambia	Morocco	Yemen, Re.
Angola	Ghana	Mozambique	Zaire
Argentina	Guatemala	Myanmar	Zambia
Bahamas	Guinea	Namibia	Zimbabwe
Bahrain	Guinea-Bissau	Nicaragua	
Bangladesh	Guyana	Niger	
Bolivia	Haiti	Nigeria	
Botswana	Honduras	Oman	
Brazil	India	Pakistan	
Brunei	Indonesia	Panama	
Burkina Faso	Iran	Papua New Guinea	
Cameroon	Iraq	Paraguay	
Chile	Jamaica	Peru	
China	Jordan	Philippines	
Colombia	Kenya	Qatar	
Congo	Kuwait	Saudi Arabia	
Costa Rica	Lebanon	Senegal	
Cote d'Ivoire	Liberia	South Africa	
Cuba	Libya	Sri Lanka	
Dominican Republic	Madagascar	Surinam	
Ecuador	Malawi	Syria	
Egypt	Malaysia	Thailand	
El Salvador	Mali	Trinidad and Tobago	
Ethiopia	Malta	UAE	
Gabon	Mexico	Venezuela	

Table 8: Countries included in the developing countries sample

B Factor Analysis of ICT variables

Here we present the results for the factor analysis that was undertaken. Table 9 presents the factor loadings and the eigenvalues associated with each factor is presented in Table 10.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5
Mobile phones per 1000 people	0.7215	0.2403	-0.1753	0.0261	-0.1341
Internet users per 1000 people	0.4245	0.3596	0.2983	-0.0372	0.083
ICT expenditures as % of GDP	0.7758	-0.118	-0.1489	-0.0757	0.1383
Fax per 1000 people	0.8488	0.1245	0.1797	0.1241	-0.0257
Computers (per 1000)	0.9316	0.1062	-0.0883	-0.1442	-0.0044
Mainline telephones (per 1000)	0.8882	-0.2715	0.0924	-0.1192	-0.0698
Telephone revenue (per 1000)	0.7422	-0.016	-0.2122	0.188	0.0665
Mainline telephones per employee	0.5501	-0.3381	0.2191	0.0926	-0.0132
Notes	Average interim Cronbach's alpha (standardised) = 0.527				
	Scale reliability coefficient: 0.8995				

Table 9: Factor loadings of the ICT variables obtained using Factor Analysis

Factor	Eigenvalue
Factor1	4.5335
Factor2	0.4161
Factor3	0.2835
Factor4	0.1021
Factor5	0.0541
Factor6	-0.0531
Factor7	-0.1095
Factor8	-0.1669

Table 10: Eigenvalues of the factors of ICT variables obtained using Factor Analysis

C Regressions using the UNCTAD Diffusion Index

In this section, we present the results for the corruption and inequality models, replacing the estimated ICT index by the UNCTAD ICT diffusion index. The correlation co-efficient of the UNCTAD index with our ICT index is very low - 0.17. Due to the very small sample size, the regressions did not run with the poverty measure. We observe here that the UNCTAD ICT diffusion index is negative and significantly associated with the corruption index - a result which is exactly the opposite of what we expect. However, on including it squared, *unctad*2, we obtain a positive and significant effect, only for the full sample.

For the inequality regressions, we obtain no association for the full or developing country sample. This does not agree with our findings in the paper using our own estimated ICT index, where we obtain a positive and significant coefficient for the full sample.

D Instrumental variable regressions

In this section we present the results of the instrumental regressions instrumenting the ICT index with the lagged value of the ICT index by 3 years. The estimates use robust estimates of the standard errors. The F statistic tests for the significant improvement in the explained variation of the IV model over the OLS model. The Hausman statistic tests for signficant endogeneity of the variable being instrumented (i.e. the ICT index).

For the corruption model, the ICT index is revealed to be endogenous (Hausman statistic significant) for the full sample but not the developing country sample. The instrumented ICT index is not significant for either samples. Other variables continue to have the same signs as in the OLS model presented in Tables 2 and 3.

For the inequality model, we again observe that the ICT index is endogenous in the full sample, but not in the developing country sample. Once again, it is not significant for either samples.

For both corruption and inequality, the F statistics do not suggest any improvement of the explained variation with the IV models estimated.

Dep var	Corruption				Gini			
	full	full	dev	dev	full	full	dev	dev
news	0.001	0.002‡	0.000	0.001	0.002	0.003‡	-0.144‡	-0.140‡
radios	0.000	0.000	-0.001	-0.001	0.002	0.003	0.012	0.012
tvs	-0.002‡	-0.002‡	-0.002‡	-0.002	-0.038‡	-0.044	0.026	0.023
unctad	-0.011†		-0.013†		-0.029		-0.067	
unctad2		0.000‡		0.000		0.000		0.000
bur	0.336*	0.383*	0.200	0.192	0.401	0.270	3.178	3.032
rule	0.369*	0.382*	0.343†	0.341	0.203	0.145	1.881	1.896
tradegdp	-0.002	-0.002	0.000	0.001	-0.025	-0.035	0.071	0.067
risk	-0.080	-0.093	-0.086	-0.112	1.060	0.593	-0.307	-0.460
africa	0.110	0.091	0.080	0.099	5.310	5.769	4.994	4.968
latin	0.197	0.181	0.185	0.136	12.939*	11.589	6.373	5.982
$_{c}ons$	2.960†	2.093‡	3.801†	3.311	40.838‡	49.051‡	36.277	36.118‡
N	94	94	64	64	42	42	42	42
R^{sq} adj	0.5077	0.4900	0.1611	0.17	0.1513	0.1617	0.1513	0.1617
F	10.59	10.1400	2.21	2.32	1.7300	1.79	1.73	1.79
Notes	*: Significant at 1% level of significance							
	†: Significant at 5% level of significance							
	‡: Significant at 10% level of significance							

Table 11: OLS Regressions of Corruption and Gini Index 1997, for full and developing country samples, using the UNCTAD ICT Diffusion Index

	corruption		Inequality (Gini)	
	full	developing	full	developing
f1	-1.140	-0.496	11.134	1.4407
news	0.008*	-0.018	-0.064*	-0.0699*
radios	-0.002	0.017*	-0.007	-0.0046
tvs	0.015*	-0.013†	-0.088*	-0.0156†
bur	0.510*	1.764*	-2.083*	1.6763*
rule	-0.148	3.082*	-0.980	-2.6026*
lgdppc	0.279	-6.003*	-4.721	-2.8077†
lit	-0.026	-0.208*	0.030	0.3201*
tradegdp	0.025	0.028‡	-0.120	0.0565*
risk	0.151	2.181†	-1.114	2.7147*
africa	5.448†	2.726	-21.578†	1.6533
latin	1.591*	5.881*	-5.871†	4.7037*
oecd	-1.514†		0.404	
cons	-6.153	21.947	159.692‡	33.0488*
N	30	16	30	16
R^{sq}	0.821	0.95	0.960	0.99
F	2.8	1.23	2.8	1.23
Hausman	17.510†	9.82	23.260*	1.64
	*: Significant at 1% level of significance			
	† : Significant at 5% level of significance			
	‡: Significant at 10% level of significance			

Table 12: IV Regressions of Corruption and Gini Index 1992-1997, for full and developing country samples, using lagged ICT index by 3 years

	corruption		Inequality (Gini)	
	full	dev	full	dev
news	-0.0218	-0.032‡	-0.200†	-0.370*
radios	0.0003	0.000†	0.000	0.001†
tvs	0.0155‡	0.025†	0.037	0.189*
fl	0.0035	0.339	-11.048‡	-8.518†
bur	-0.0098	-0.428	-1.310	-4.361†
rule	-0.0884	0.902*	-4.281†	3.008†
lgdppc	0.1404	-1.711*	8.652†	-3.069
lit	0.0686	0.029	0.805†	0.640*
tradegdp	0.0280	0.037†	0.210†	0.347*
risk	0.5369	-1.489†	-1.848	-14.233*
africa	2.8540‡	5.712*	21.898*	44.495*
latin	-1.1763	3.117*	1.773	25.970*
cons	-3.0569	19.326†	-19.480†	106.000*
N	55	34	55	34
R^{sq}	0.51	0.3	0.7	0.7
F	2.32	4.57†	2.32	4.57†
Hausman	35.97*	19.8†	21.48*	15.24
Notes	*: Significant at 1% level of significance			
	† : Significant at 5% level of significance			
	‡: Significant at 10% level of significance			

Table 13: IV Regressions of Corruption and Gini Index 1994-1997, for full and developing country samples, using press freedom as an istrument for newspaper circulation

In Table 13 we present the results of the instrumental regressions for newspapers, using press freedom as an instrument. The data was obtained from Freedom House for the years 1994 to 1997 (rankings are not available for years 1992 and 1993). The rankings are on a scale of 1 to 100 on a decreasing scale (free to not free). While this is a widely used variable in the empirical literature, the correlation between the newspapers variable and press freedom was 0.17. We would therefore expect a negative co-efficient for corruption.

The F statistics for IV regressions for the corruption model do not suggest improvement with the application of the instrument. However, the co-efficeint is negative and significant for developing countries.

For the inequality model, we would expect a positive relationship - for rising values of press freedom index (i.e. progressing towards lower amounts of press freedom), should imply unequal access to information and therefore rise in inequality. For both full and developing country sample, we obtain a negative co-efficient.