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

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Abstract

This paper examines the impact of mass media and information and communications technologies (ICT) as knowledge-based infrastructures on economic development. The results suggest that both mass media and ICT penetration are negatively associated with corruption. This result holds across both the entire sample (of both developed and developing countries), and only for developing countries. The same result is also obtained for the effects of ICT and mass media on economic inequality,. However, ICT reveals itself inequality increasing for the developing country sample but inequality decreasing for the entire sample. Finally, lower poverty is robustly associated with higher media (newspaper circulation) penetration.

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

JEL Classification: D30 D80 O1 O57

Distributional Analysis Research Programme

The Distributional Analysis Research Programme was established in 1993 with funding from the Economic and Social Research Council. It is located within the Suntory and Toyota International Centres for Economics and Related Disciplines (STICERD) at the London School of Economics and Political Science.. The programme is directed by Frank Cowell. The Discussion Paper series is available free of charge. To subscribe to the DARP paper series, or for further information on the work of the Programme, please contact our Research Secretary, Leila Alberici on:

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. On the other hand, 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 role of Information Communications Technologies and mass media as instruments of access to information, and their effect on economic growth and development.

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 Information and Communications Technologies (hereafter ICT) comprise the two main vehicles of information in modern societies. While the spread and the nature of the information transfered to the citizens of a country are highly dependent upon the nature of ownership of the media (state or prviately owned), that 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.

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

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[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 though, the weightless economy with reference to developing countries, applies to mainly ICT penetration.

telephony 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. Likewise, high telephony and ICT penetration is a characteristic of developed economies.

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 the rich and poor countries. This paper empirically tests for the effects of both ICT/Telephony and media development on 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 the short run (and medium to long run) development and growth 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 individuals 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, cities, quick in adoption of the 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[2] 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, 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 positive impact of mass media penetration and ICT/mobile telephony. The paper discusses the impact of ICT and mass media on three development observables: corruption, inequality and poverty. The results provide strong evidence that higher mass media penetration (newspapers, radio and TV ownership) is associated with lower corruption. They are also robustly associated with lower inequality. The results for poverty suggest strong evidence for the impact of mass media (that it is associated with lower poverty), though ICT/telephony is not found to be robustly associated.

The rest of the paper is organised as follows. In Section 2, the current literature relating to media penetration and ICT/telephony penetration is discussed. Section 3 discusses the data and presents the empirical strategy and the results. Section 4 concludes.

2   Mass Media and ICT

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

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, through radios, televisions, and newspapers, 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. On the other hand, 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, 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. Besley and Prat (2001) study the determi-

nants 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) to print or broadcast stories which confirm readers' prior opinions than present 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, on the one hand, 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 over 1995 - 2000. Of course, cross-country variations exist. The US, for instance, has had a projected 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's studies (2002) reveal 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. Of 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, 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. On the one hand, 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 distinctly 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 geographical 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 the 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 it is yet to be empirically established. ICT's growth-inducing-inequality-increasing effect is characteristic 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. There have been no studies that investigate the effect of ICT on individual inequality. 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, inequality and poverty, discusses the specifications tested in the empirical analysis, and explains the 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. The principal data source has been the World Bank Indicators data base.

3.2 Measures of ICT and Mobile 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
    -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.
    Though there exists a large number of other ICT indicators, the country coverage dramatically drops, and are thus 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, which we will call INFRA) to be the general index of infrastructure, which takes an eigenvalue of over 5, results for which are omitted from the paper for brevity. 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). This explains the values of f1 and f2 taking negative values in the non-parametric plots in Figures 2 and 3, to be introduced later in the empirical analysis.

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. For robustness we will also use data from other organisations, namely Reporters Without Borders. Here again the data presented is in the form of a ranking of the countries in increasing order of freedom. The tests

performed in the empirical section below will test with both variables of press 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 entirely focuses on establishing the relationship between the existence of the knowledge-economy infrastructures (media and ICTs) and their correlations with a number of development outcomes - corruption, inequality and poverty. Connecting these outcomes to the multi-faceted aspects of the nature and 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. Of all country risk services ICRG covers by far the largest number of countries.

3.5 Results

We will first present the results with corruption as the dependent variable, tabulated in Table 1. Table 2 presents the results with inequality (Ginis) and Table 3 with poverty as the dependent variable. Main specifications we are testing for are:

$$CORR_i = \beta_0 + \beta_1 MEDIA_i + \beta_3 ICTindex_i + \epsilon_i \tag{1}$$

We also then look at a much broader specification, where other determinants of corruption along with the two main explanatory variables are given as follows.

$$
\begin{aligned}
CORR_i \ = \ & \beta_0 + \beta_1 MEDIA_i + \beta_3 ICTindex_i + \beta_4 RULE_i + \beta_5 TRADE_i \\
& + \beta_6 BLACK_i + \beta_7 ETHNIC_i + \epsilon_i
\end{aligned}
\tag{2}
$$

A short discussion of the controls. Rule of law, in the tables as RULE, is a variable obtained from the ICRG, which measures the extent of the

citizens' capabilities to monitor the extent of corruption. It hence 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.

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). BLACK measures the black market premium on foreign exchange and is used in the literature as an indicator of the degree of government-created distortions in an economy. ETHNIC measures the degree of ethnolinguistic diversity which proxies for the cultural variation across the countries.

Other country specific controls are also included. GDP and Literacy measure the level of per capita GDP in 1990 (calculated at purchasing power parity), 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. Table 1 lists the sources of the variables.

OLS regressions in Table 2 highlight the relationship between corruption and the explanatory variables. The dependent variable is the corruption measure from ICRG. We use an average of this index (1994–1998) in order to match the timing with our main measures of mass media and the index of Tel/ICT. We use OLS for our estimations, as the dependent variable is a continuous variable. Various robustness tests are undertaken. We split the sample into developed and less developed countries to observe whether relationship is driven by LDCs, or othter outliers. We also use other measures of corruption and press freedom data for robustness. All t statistics are robust to heteroscedasticity in residuals. The controls used in this specification are those established in Brunetti and Weder (2003), in addition to the others which are relevant to the analysis.

Column 1 in Table 2 provides the base specification, as detailed above. We obtain a negative and significant coefficient for all newspapers, radio and televisions. Both controls are also positive and significant at the 1% level. This indicates that, as expected, corruption is lower in countries with a well-working bureaucracy and in countries with a well-established rule of law. The base specification explains 68% of the variation in the corruption levels between countries. The telephony/ICT index also shows up to be significantly

associated with lower levels of corruption. The following regression in Column 2 repeats the above specification, only with a sample of less developed countries (sample size now reduced to 93 countries). This is to confirm that the results of the relationship between mass media and corruption, and that of telephony/ICT with corruption respectively, are not being driven by differences in developed and developing countries alone - the coefficient is negative and significant still, though the explained variation has dropped signifcantly to 22%. While the control of BUREAU remains significant and of the same sign, RULE is no longer significant. To exclude the possibility that outliers may be driving the relationship, we restrict the sample to observations with residuals with plus minus twice the standard deviations - the results are again unchanged (a similar analysis is also undertaken in Brunetti et al (2003)). Column 3 presents the two stage least squares, with instruments for the mass media variable newspapers and telephony/ICT. We use press freedom measures as compiled by Freedom House, 2003. Other measures of press freedom compiled by other organisations have also been used, and the results are robust to the different specifications. Instruments for the Tel/ICT index are lagged values of the index by 3 years. Column 3 reveals that the results are robust - the results are the same as earlier, with slightly larger (and significant) co-efficients for the two explanatory variables. Non-linear specifications have not resulted in greater fit.

Column 4 presents the broader specification of the impact of other variables on corruption. We include other determinants of corruption along with our principal explanatory variables of media variables and Tel/ICT index. While both variables continue to have the same signs and are significant, the new explanatory variables' effects vary. The co-efficient of log of GDP per capita is negative and significant, while that of education is not so. The co-efficients of the two variables that proxy for distortions in the economy are both insignificant. Where TRADE has the expected positive sign, the positive coefficient of BLACK is unexpected. ETHNIC, the proxy for the degree of cultural fractionalization also has the expected negative sign but is insignificant. Column 5 presents the results for the sample size reduced to those of LDCs only (93), where the relationship between corruption and media variables, and Tel/ICT holds out with the correct signs and are significant, and the results for the controls remain the same as well. The controls' are no longer either of the expected signs or not significant.

We finally test for another specification to check for differences across continents. We include dummies for continents of Africa, OECD countries and Latin America - here we obtain the Latin American dummy to be significant. We run the instrumented regression, and Column 7 presents the results. The results are unchanged, though the significance of both media

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and tel/ICT variables drops considerably.

There are issues concerning endogeneity. While the endogenous effects of telephony and ICT on corruption can be ruled out, and the standard tests performed confirm this, that of press freedom and corruption cannot be so. A potential criticism is that press freedom may be endogenous since corrupt regimes may tend to limit press freedom. The latter is also addressed in Brunetti (2003). A word to note regarding causality. Due to the lack of perfect instruments and the short time series over which the study is conducted, it is difficult to establish robust causality. Several instruments as available has been used, and all time series variation in the variables available has been exploited to deal with the endogeneity.

In Table 3, we now discuss the results of the impact of media and Tel/ICT variables on inequality. The dependent variable is the Gini coefficient, obtained from the Deninger and Squire (1996) database over the years 1994-1996, and is updated with data from the new release of Ginis in the World Income Inequality Database (2005). Robustness tests similar to the earlier specifications with corruption are undertaken. We split the sample into developed and less developed countries to observe whether the relationship is driven by LDCs, or other outliers. We also use other measures of corruption and press freedom data for robustness. All t statistics are robust to heteroscedasticity in residuals.

The basic specification that we are testing is as follows:

$$GINI_i = \beta_0 + \beta_1 MEDIA_i + \beta_2 TEL/ICT index_i + \beta_3 X_{it} + \epsilon_i \qquad (3)$$

As for controls, to avoid any ambiguity we choose two sets of 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[3]. The Perotti specification excludes most

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[3]The list of variables included in both specifications are as follows: Perotti:

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 coefficients in two regressions is therefore slightly different. The results presented in Table 2 allow for both sets of controls. We choose the set of the same 128 countries for which media and tel/ICT index data is available i.e. the same set of countries as for the corruption data set.

Column 1 presents the basic specification - newspapers, radios and TVs are significantly associated with lower inequality. The Tel/ICT index is also significantly associated with inequality - increasing values of Tel/ICT are associated with lower inequality. Column 2 presents the same specifications with only the set of developing countries (having excluded the same countries as in the earlier "corruption" regressions. Here one finds an interesting change in results. While the results for the media variables are unchanged, one finds that the sign of the tel/ICT variable has switched. This has important implications for the effects of telecommunications and ICTs for developing countries, a result to be discussed in greater detail later. Column 3 presents the two stage least squares results using the same set of instruments for the media variables and the Tel/ICT variables over the entire sample - the results remain largely unchanged. Columns 4 and 5 introduce the two sets of controls, the Perotti and Barro specifications respectively. The results are largely unchanged, and the mass media variable and Tel/ICT variables are still negatively and significantly associated with the Ginis, though their effects are less stronger as is in the case without the controls. Fit improves with the inclusion of the controls, however at the expense of the explanatory power of the main explanatory variable we are interested in. To confirm that there are no regional effects driving the results, we incorporate the continent dummies for our last set of specifications. None of the continent dummies shows up as significant.

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)

Instruments:

Barro Log(GDP(1990)), log(GDP(1990)) squared, government consumption(1990), secondary education(1990), higher education(1990), fertility(1990), 1/30*(term of trade(1995)-terms of trade(1990)), rule of law, democ(1990), democ(1990) squared, Spanish or Portuguese colony.

The final relationship that we will be investigating is for the impact of these variables on poverty. The specification in main use is identical to that above

$$POVERTY_i = \beta_0 + \beta_1 MEDIA_i + \beta_2 TEL/ICTindex_i + \beta_3 X_{it} + \epsilon_i \quad (4)$$

where X_{it} are the set of controls, which we will specify shortly. Poverty is measured using the dollar a day definition of the World Bank. Data is obtained from the World Bank indicators' database over the years 1994 - 2002. For this particular specification we only consider the sample of LDCs that have been used in earlier specifications in Tables 1 and 2. Here again we use the same set of controls as determinants of poverty. For robustness we will extract outliers using the same rule as earlier in Table 1, by excluding those with residuals with plus minus twice the standard deviations.

In Table 4, Column 1 presents the basic specification with newspapers, radios, and TVs as the main media variables, and the tel/ICT index as the telephony variable. We find that the newspapers variable shows up just about significant, with the correct sign (i.e. negatively correlated) with radios and TVs not showing up as significant. The fit of the regression is also quite poor. As a confirmatory test we run a second set with the entire sample of countries (both developed and developing countries). The results show up as similar to those obtained in the earlier specifications - newspapers show up as being negatively associated with poverty - the results for radios and TVs is again insignificant, in Column 2. Column 3 presents the two stage least squares results using the same instruments for newspapers and for the tel/ICT index. Fit remains almost the same, though the significance of the newspapers variable improves. Tel/ICT index remains just significant. Columns 4 and 5 present the specifcations with the two sets of controls - both Perotti and Barro sets. Fit significantly improves, and the size of the coefficient of newspapers is slightly larger than the earlier specifications. Columns 6 and 7 includes continent dummies for the earlier specifications in Columns 3 and 4 with the Perotti and Barro controls. In both specifications, the dummies are, however, not significant.

4 The non-linear relationship between inequality and ICT index

The results in Table 3, tabulating the regressions of inequality on mass media and ICT indicators established two sets of relationships. For developing countries, ICT is found to be inequality increasing, while for developed

countries it is inequality decreasing. To affirm this non-linear relationship between inequality and the ICT index, I plot local average smoothers for the ICT indices as a simple non-parametric tool which will allow us to specify the particular non-linear nature of the relationship. Local average smoothers of the ICT index are plotted for the three years 1992 to 1994, for both f1 and f2 (the first two factors retained to act as indexes of ICT) in Figures 1 and 2. The plots reveal that increasing levels of ICT index are associated with lower levels of inequality - this is clearly observed in all 3 plots. The plots also shows signs of the formation of two "peaks" of which the peak at low values of ICT is clearer and corresponds to lower levels of ICT and high levels of inequality. This agrees with the earlier finding, that developing countries (which typically have lower levels of investment in ICT relative to richer countries) are associated with higher levels of inequality. This pattern is again repeated for our second set of plots using the second factor f2 - figures 2. Here too, the inverse relationship between levels of ICT and inequality is clearly revealed. For greater specification of the functional relationship, one can undertake more detailed non-parametric methods, or investigate further non-linear specifications in the regressions earlier. The small data set, however, in this case, does not allow one to undertake further non-parametric analyses in specifying the functional form. While a causal relationship is difficult to establish because of the lack of data, and requires a further set of analyses beyond the current purview of the paper, it is clear that higher levels of ICTs is associated with lower inequality.

5   Conclusion

There is an increasing dependence on the knowledge-based economy for economic development and growth. Mass media and ICTs are two important vehicles of information in developing countries. In this paper we present evidence of some robust associations between some development outcomes (namely corruption, inequality and poverty) and ICT and mass media. The results strongly suggest that both mass media and ICT penetration are negatively associated with corruption. This result holds across both the entire sample (of both developed and developing countries), and only for developing countries. Of the 3 media penetration variables, newspaper circulation holds out most robustly under all specifications The same result is also obtained for the effects of ICT and mass media on economic inequality, measured by the Gini. However, ICT reveals itself inequality increasing for the developing country sample (robustness checks confirmed), but inequality decreasing for the entire sample. Robustness checks are again performed for developing

countries only, and for any outliers driving the results. Non-parametric plots confirm this result. The final set of tests uncover robust associations between media (newspaper circulation) penetration and poverty.

The empirics derived in this paper are still associations and causality remains difficult to identify. This is due to the lack of appropriate data and a short time series of ICT data in particular. However, with the empirical literature still at its early stages, the evidence obtained is convincing that there exists a clear and significant association between media and communications infrastructures, and corruption, inequality and poverty in developing economies.

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Variable name	Abbreviation	Years	Source
Press Freedom	Press	1994-2002	ICRG
Average quality of the bureaucracy	Bureau	1982-1995	ICRG
Average Trade ((Export+Import) /GDP)	Trade	all years	World Bank
Ethnolinguistic Fractionalisation	Ethnic	all years	Easterly-Levine (1997)
Black market premium on foreign exchange	Black	1974-1989	Pick's Currency Yearbook
Average rule of law	Rule	1982-1995	ICRG
Natural Log of GDP	ln GDP	all years	World Bank
Education	Literacy	all years	World Bank
Latin America dummy	Latin America	all years	–
Africa dummy	Africa	all years	–
OECD dummy	OECD	all years	–

Table 1: Variables and sources

	1	2	3	4	5	6	7
	OLS	OLS (LDCs)	IV	OLS	OLS(LDCs)	OLS	IV
Constant	1.97	2.4	1.68	2.05	2.65	1.4	1.2
	(3.2)	(4.2)	(6.4)	(6.2)	(4.1)	(3.67)	(4.7)
Press	-0.009	-0.012	-0.018	-0.021	-0.022	-0.014	-0.012
	(-5.23)	(-4.34)	(-4.44)	(-5.1)	(-3.2)	(-2.34)	(-3.12)
Bureau	0.17	0.16	0.21	0.2	0.16	0.034	0.032
	(-3.1)	(-3)	(-2.3)	(-3.2)	(-2.4)	(-0.34)	(-0.73)
Rule	0.23	0.19	0.15	0.23	0.014	0.14	0.2
	(3.1)	(2.7)	(3.4)	(4.2)	(0.34)	(0.2)	(0.4)
Newspapers	-0.02	-0.025	-0.028	-0.017	-0.02	-0.019	-0.023
	(-2.34)	(-3.3)	(-3.2)	(-2.5)	(-2.2)	(-1.9)	-4.3
Radios	-0.07	-0.06	-0.04	-0.02	-0.003	-0.06	-0.057
	(-2.23)	(-4.1)	(-5.2)	(-2.23)	(-0.302)	(-3.1)	(-3)
TVs	-0.008	-0.009	-0.002	-0.003	-0.004	-0.001	-0.001
	(-1.56)	(-1.2)	(-1.4)	(-1.3)	(-2.06)	(-0.78)	(-0.64)
Tel/ICTIndex	-0.005	-0.004	-0.005	-0.003	-0.002	-0.001	-0.003
	(-2.02)	(-4.1)	(-3.1)	(-2.2)	(-2.1)	(-3.2)	(-1.2)
ln GDP				0.096	0.152	0.094	0.089
				(0.42)	(0.53)	(0.43)	(0.62)
Literacy				-0.062	-0.076	-0.054	-0.06
				(-1.43)	(-1.56)	(-1.78)	(-1.3)
Black				0.0009	0.0009	0.0009	0.0009
				(1.2)	(1.6)	(1.3)	(1.5)
Ethnic				-0.2	-0.13	-0.45	-0.42
				-1.4	1.2	-1.8	-0.67
Latin America						-0.43	-0.52
						(-2.34)	(-2.77)
Africa						-0.05	-0.05
						(-0.13)	(-0.67)
OECD						0.23	0.3
						(1.2)	(1.04)
N	120	93	98	64	42	64	64
R$^{\text{sq}}$	0.69	0.41	0.69	0.63	0.31	0.67	0.65

Table 2: OLS Regressions of Averaged Corruption 1994-1998

Estimation Method			2SLS	OLS	2SLS	OLS	2SLS
Control Variables				Perotti	Barro	Perotti	Barro
Press	-0.003	-0.009	-0.016	-0.034	-0.019	-0.009	-0.006
	(-2.37)	(-1.25)	(-2.58)	(-3.5)	(-3.7)	(-1.34)	(-2.64)
Bureau	0.09	0.07	0.08	0.07	0.07	0.029	0.019
	(-2.71)	(-2.9)	-2.7	-1.2	-2.7	-2.98	-1.33
Rule	0.11	0.11	0.09	0.09	0.021	0.048	0.015
	(-3.9)	(-1.9)	(-3.7)	(-2.9)	(-1.22)	(-1.7)	(-0.32)
Newspapers	-0.014	-0.018	-0.012	-0.029	-0.025	-0.027	-0.021
	(-3.14)	(-3.1)	(-2.4)	(-4.1)	(-2.8)	(-2.1)	(-3.7)
Radios	-0.01	-0.01	-0.016	-0.013	-0.009	-0.02	-0.012
	(-2.59)	(-3.4)	(-4.7)	(-3.27)	(-1.32)	(-2.1)	(-1.2)
TVs	-0.0008	-0.0008	-0.002	-0.001	-0.00018	-0.001	-0.0006
	(-2.23)	(-2.2)	(-1.9)	(-4.3)	(-3.06)	(-1.24)	(-0.67)
Tel/ICTIndex	-0.004	0.002	0.003	-0.003	-0.001	-0.002	-0.001
	(-4.05)	(4.5)	(2.1)	(-1.8)	(-0.2)	(-1.2)	(-2.2)
ln GDP				0.18	0.132	-0.043	0.21
				(0.432)	(0.83)	(-0.93)	(0.93)
Literacy				-0.047	-0.17	-0.154	-0.06
				(-1.23)	(-0.72)	(-1.10)	(-.53)
Black				0.0002	0.0002	0.0001	0.0001
				(1.05)	(0.87)	(0.32)	(1.5)
Ethnic				-0.36	0.19	-0.52	-0.24
				(-1.4)	(0.67)	(-1)	(-0.67)
Latin America						-0.23	-0.32
						(-1.06)	-0.87
Africa						-0.02	-0.03
						(-0.61)	(-0.27)
OECD						-0.23	-0.3
						(-1.02)	(-0.9)
N	120	93	98	64	42	64	64
R^{sq}	0.63	0.34	0.58	0.61	0.28	0.59	0.62

Table 3: OLS Regressions of Gini Index 1994-1998, for both developed and developing countries

Dependent variable				Poverty			
Estimation Method			2SLS	OLS	2SLS	OLS	2SLS
Control Variables				Perotti	Barro	Perotti	Barro
	1	2	3	4	5	6	7
Press	-0.004	-0.007	-0.011	-0.012	-0.017	-0.009	-0.005
	(-3.29)	(-3.65)	(-2.02)	(-5.55)	(-4.6)	(-2.03)	(-2.04)
Bureau	0.07	0.12	0.11	0.13	0.08	0.03	0.08
	(-3.9)	(-4)	-2.67	-5.2	-2.4	-0.94	-0.88
Rule	0.12	0.11	0.11	0.21	0.019	0.15	0.14
	(-4.1)	(-4.7)	(-3.9)	(-2.2)	(-1.34)	(-2.2)	(-1.4)
Newspapers	-0.02	-0.015	-0.019	-0.011	-0.017	-0.009	-0.012
	(-3.39)	(-2.3)	(-4.9)	(-3.2)	(-3.6)	(-2.9)	(-4.1)
Radios	-0.04	-0.04	-0.02	-0.02	-0.012	-0.034	-0.014
	(-1.03)	(-1.1)	(-2.2)	(-2.37)	(-1.31)	(-2.2)	(-3.1)
TVs	-0.002	-0.002	-0.001	-0.003	-0.001	-0.001	-0.002
	(-0.29)	(-0.2)	(-1.9)	(-1.1)	(-1.76)	(-1.03)	(-1.6)
Tel/ICTIndex	-0.003	-0.003	-0.004	-0.002	-0.002	-0.002	-0.003
	(-2.19)	(-2.1)	(-3.5)	(-3.76)	(-2.89)	(-3.9)	(-1.9)
ln GDP				0.087	0.234	0.124	0.145
				(0.72)	(0.67)	(0.36)	(0.72)
Literacy				-0.012	-0.046	-0.024	-0.036
				(-0.47)	(-0.96)	(-0.88)	(-0.73)
Black				0.0002	0.0009	0.0007	0.0004
				(0.89)	(0.78)	(1.1)	(1.2)
Ethnic				-0.2	-0.13	-0.45	-0.42
				(-1.8)	(-1.5)	(-0.88)	(-0.77)
Latin America						-0.25	-0.72
						(-1.24)	(-1.22)
Africa						-0.23	-0.24
						(-0.26)	(-0.67)
OECD						0.29	0.3
						1.4	0.89
N	93	120	98	64	42	64	64
R^sq	0.4	0.54	0.51	0.49	0.31	0.38	0.44
		23					

Table 4: OLS Regressions of Poverty, for only developing countries

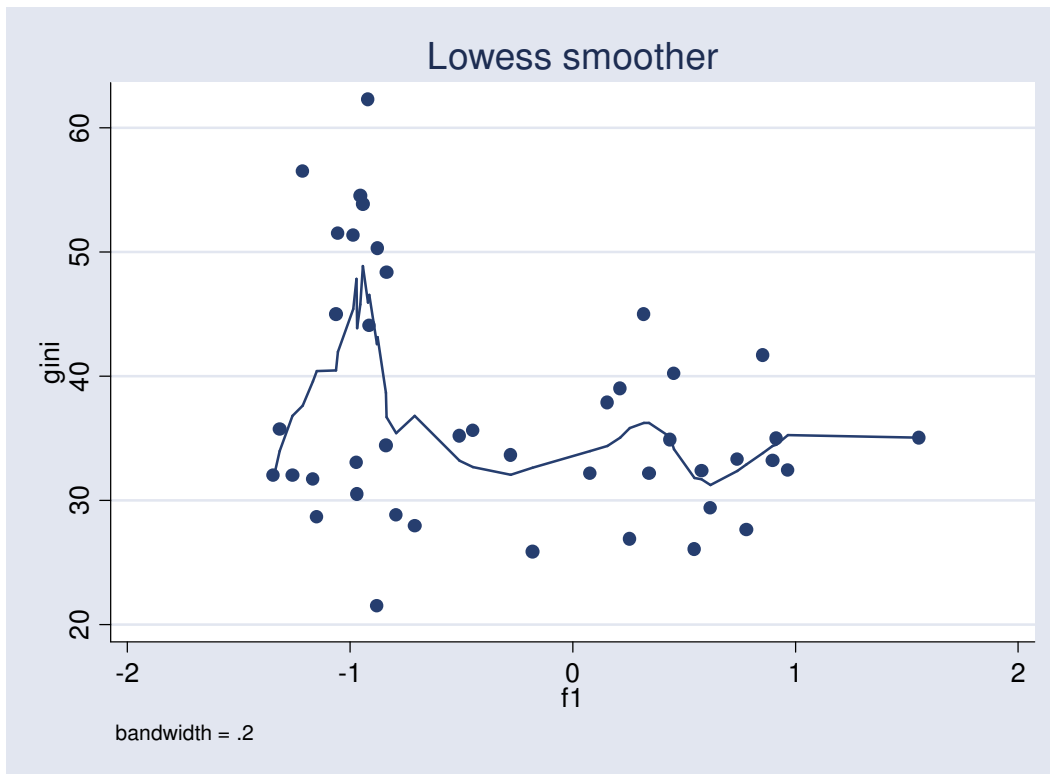**Fig. 1a Non-parametric plot of relationship between gini and ICT index (f1) for 1992**

Lowess smoother

bandwidth = .2

Fig. 1b Non-parametric plot of relationship between gini and ICT index (f1) for 1993
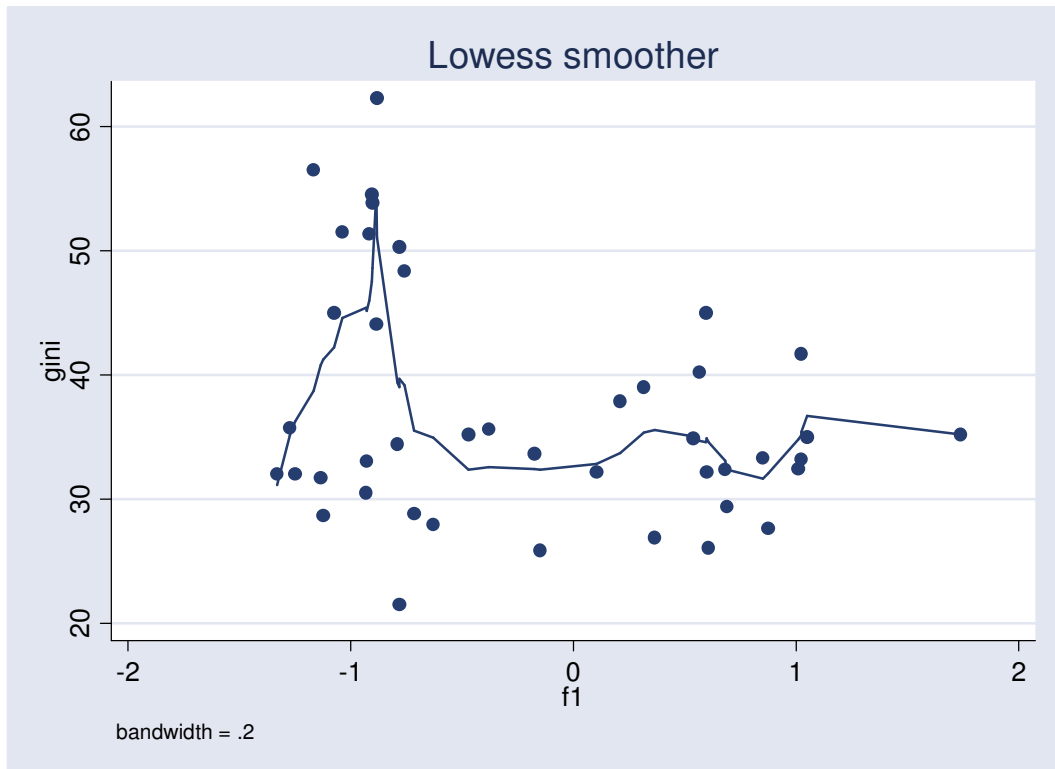
Lowess smoother

bandwidth = .2

Fig 1c. Non-parametric plot of relationship between gini and ICT index (f1) for 1994

Lowess smoother

bandwidth = .2

Fig 2a. Non-parametric plot of relationship between gini and ICT index (f2) for 1992

Lowess smoother
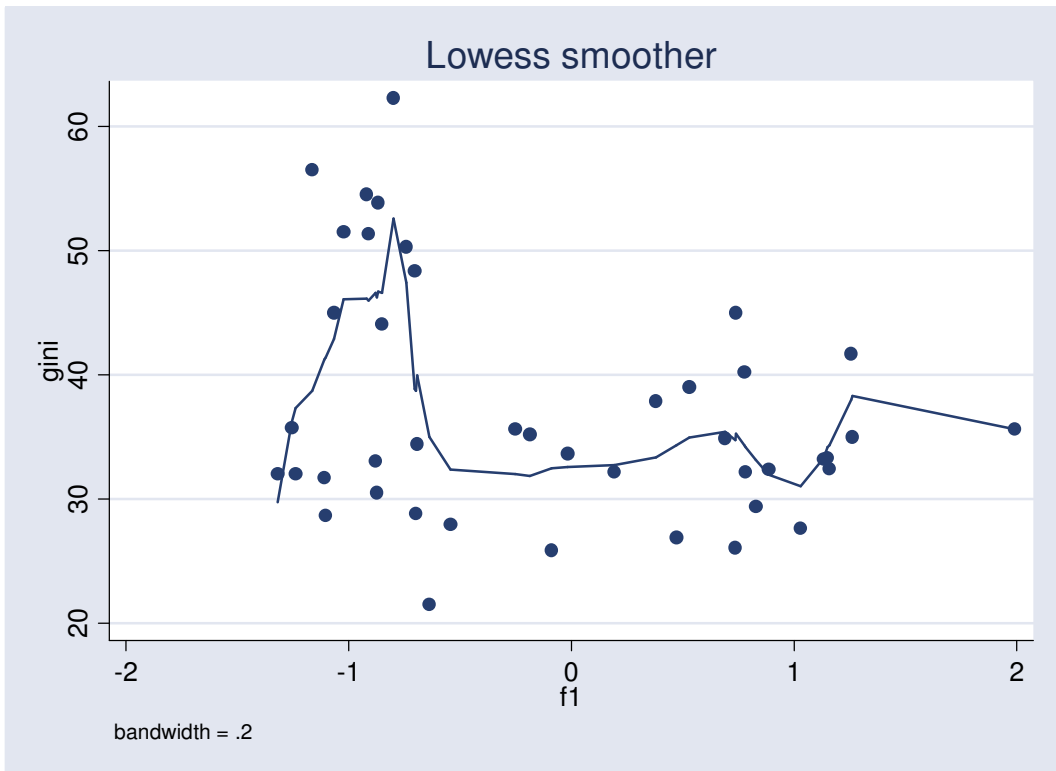
bandwidth = .2

Fig 2b. Non-parametric plot of relationship between gini and ICT index (f2) for 1993
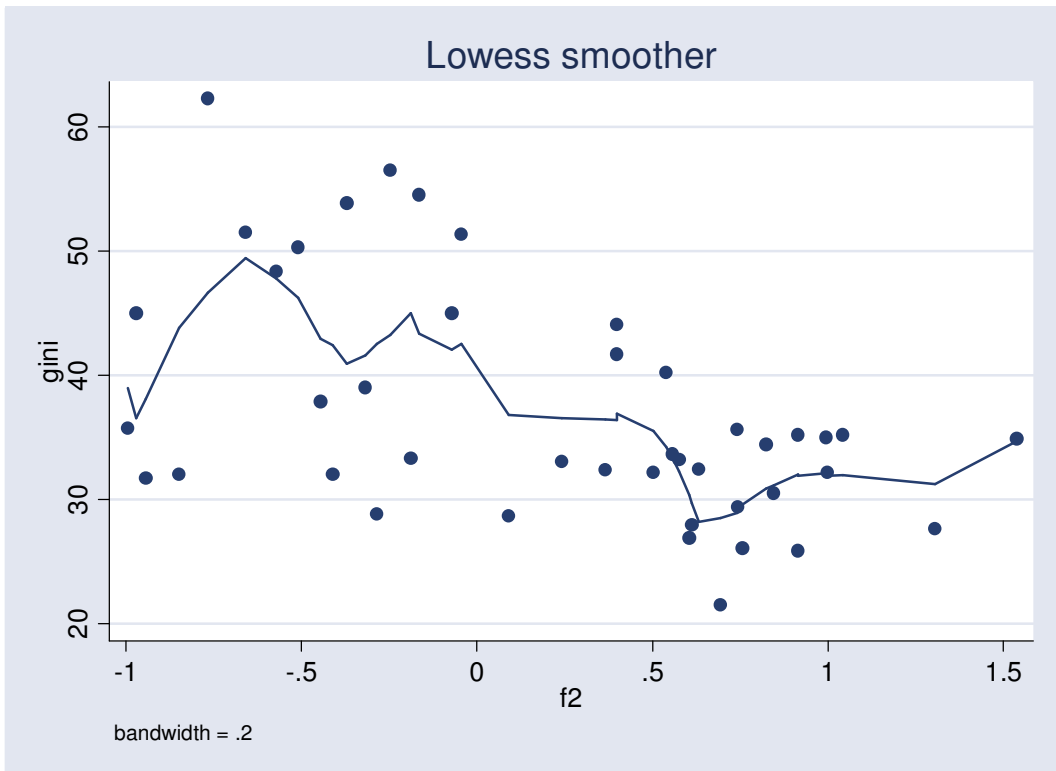

Lowess smoother

bandwidth = .2

Fig 2c. Non-parametric plot of relationship between gini and ICT index (f2) for 1994

Lowess smoother

bandwidth = .2