



A sound basis for evidence based policy?
A critique of the ECTA regulatory scorecard
and SPC Network papers on investment
and broadband

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Executive Summary

Context for analysis

ECTA, the European Competitive Telecommunications Association, representing the interests of new entrant telecoms operators publish an annual regulatory scorecard prepared by Jones Day and SPC Network on “the relative effectiveness of the regulatory frameworks for electronic communications” in ten European countries. The third scorecard report was published on 1 December 2005 and updated on 27th April 2006 (to correct for errors in the scores assigned to countries and in the regression of the scorecard against telecommunications investment).

The scorecard includes analysis of the relationship between regulatory scores and telecommunications investment, and concludes that effective regulation has a “strong and positive impact” on the level of investment. The scorecard has also been utilised in analysis by SPC Network of the determinants of telecoms investment (29 March 2006), and separate analysis of the drivers of broadband market growth (27 February 2006).

The review of the European Framework for Electronic Communications during 2006 means that findings from empirical analysis are likely to be of particular interest for policy makers. We comment on the three studies, assess whether they provide a sound basis for policy formulation, and suggest lessons for any further empirical work.

Common issues to all three studies

Based on our analysis of the three studies we identify shortcomings regarding measurement, modelling and inference for policy makers. The studies suffer from a general lack of rigour, and make causal statements which are not consistent with the models used and the results. In particular all three include the following common problems:

- The assessment of regulatory effectiveness which forms the basis of the regulatory scorecard and SPC investment equation is subjective and involves a process whereby ECTA members are asked to assess regulation in each relevant market. This process is not reassuring in terms of objectivity.
- The ECTA regulatory scorecard does not provide a measure of “good regulation”, in particular it treats more regulation as good without taking account of the competitive conditions in each relevant national market.
- The investment and broadband equations estimated by SPC appear independent and have no common elements. In particular, the ECTA scorecard does not appear in the broadband equation and competition does not appear in the investment equation. The policy conclusion that would flow from this, if the models had any validity, is that competition is irrelevant to telecoms investment and regulation, as measured by the ECTA scorecard, is irrelevant to growth in broadband penetration. Such a result looks implausible, and we note that the authors of the two studies do not comment on the relationship between them.
- Correlation is presented as evidence of causation, in particular, the correlations between investment and the regulatory scorecard in the scorecard paper and the papers by SPC network that report estimated relationships for investment and broadband do not take account of a range of possible other explanatory factors identified in the wider literature.
- The estimated relationships treat different things as though they are the same, for example, broadband of different speeds is treated as homogenous, whilst different aspects of regulation and



competition (in particular, infrastructure competition versus competition based on regulated access products) are considered in terms of single aggregate variables.

- The selection of data and the relationships in the recent studies do not appear robust to changes in the set of countries in particular.

In view of these findings alone, we conclude that the studies do not provide a robust basis for policy analysis. Further analysis, explicitly considering regulation and competition together alongside other possible explanatory factors, would be necessary to see if robust relationships demonstrating causation can be estimated based on available data. Only then should possible policy inferences be considered.

Comments on the ECTA regulatory scorecard

Measurement and data

Measurement is a critical step that precedes inference or modelling. The measurement of the effectiveness of the regulatory framework in the ECTA scorecard suffers from two fundamental shortcomings.

- 1 The effectiveness of regulation is subjective since there are varying views on what constitutes effective regulation. Subjectivity also implies that it matters who makes the assessment. We note that for each country the authors of the scorecard report note that they requested “ECTA members to respond to detailed questions designed to assess the effectiveness of the regulatory framework.” ECTA Members are mainly alternative operators with particular interests in terms of regulation.
- 2 The scorecard does not provide a measure of effective regulation. Elements of the regulatory scorecard relate to the extent of regulation – the greater the extent of regulation the higher the score. Effective regulation, on the other hand, is widely acknowledged to depend on the extent of competition (as does the institutional design of the European Framework).

The relationship between competition and regulation is not taken into account in the regulatory scorecard. For example, there is no “bitstream access” product for the broadband mass market in the Netherlands because the regulator and the Commission have found that the market is effectively competitive. The ECTA regulatory scorecard assigns a score of zero on bitstream access, lowering the overall score for the Netherlands. Where competition is sufficient it is thought to be superior to regulation in ensuring good outcomes. A measure that scores more regulation more highly irrespective of the level of competition does not therefore provide a measure of “the relative effectiveness of the regulatory frameworks for electronic communications”. The most appropriate way to address this is to have a measure or measures of regulation and test for effectiveness controlling statistically for other factors such as competition.

Causation and robustness

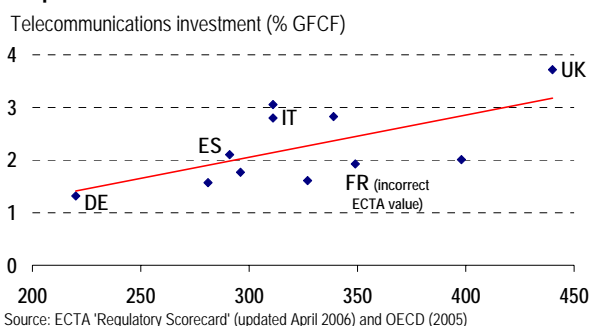
The scorecard report considers the relationship between investment and assigned regulatory scores. However, the analysis only serves to demonstrate a correlation rather than causation, since other factors such as the extent of different forms of competition are not considered in relation to investment.

The left hand figure on the following page replicates the figure in the ECTA scorecard, whilst the right hand figure corrects an error in the investment level assigned to France, and excludes Germany and

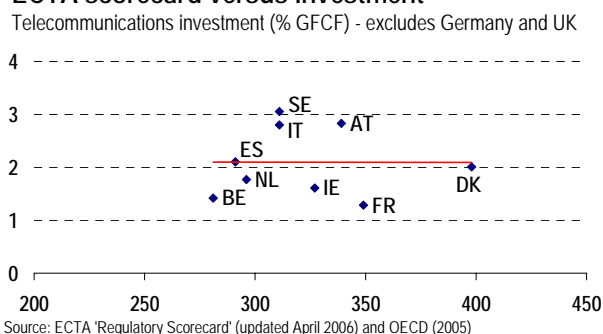


the UK to demonstrate the sensitivity of the apparent relationship to the set of countries included. No sound policy inferences can be drawn from such simple relationships.

Replication of ECTA scorecard versus investment



ECTA scorecard versus investment



Edwards and Waverman (2006) also concluded, in relation to the ECTA scorecards 2002 and 2004, that the reports “sample a subset of EU member states and provide cross-sectional data not easily comparable across time. These reports are therefore limited to 9 and 10 observations, respectively, precluding robust empirical analysis.”

Whilst data errors and the choice of data can influence an apparent relationship based on the scorecard, the deeper problem is that the scorecard does not provide a measure of the effectiveness of regulation. A test of whether more regulation produces more investment should, at the very least, consider whether the level of competition in each market influences the level of regulation and investment.

The fact that the scorecard does not provide a measure of effective regulation, and the lack of robustness and control for other factors in the relationship between the scorecard and investment, implies that the ECTA regulatory scorecard does not provide a basis for evidence based policy.

Comments on the SPC Network analysis of investment and broadband

SPC Networks conducted separate analysis of the determinants of telecoms investment (29 March 2006), and of the drivers of broadband market growth (27 February 2006). The purpose of the studies was to determine the factors, including competition and regulation, that drive investment and broadband growth.

As noted earlier, the two studies, despite their close timing and common authorship, do not integrate in any way. One would expect discussion of why factors which were found to be relevant in one study were not found to be relevant in the other. The two SPC Network equations considered together do not therefore, on the face of it, appear credible.

SPC Network investment equation

The SPC Network investment equation includes productivity growth, and regulatory quality as measured by the ECTA regulatory scorecard, as explanatory factors. As discussed in relation to the regulatory scorecard, the absence of any control for levels of competition and their relationship to regulation in the construction of the scorecard points to a need to test for different forms of competition as an explanatory factor for investment. SPC Network do not consider the level of competition in their report on investment.

Data for investment and the “regulatory efficiency” score moreover concerns different timeframes. The level of investment which the model seeks to explain lags the regulatory scorecard measure by 2



years – if both are changing then *current* regulation may not be a valid explanatory factor for *past* investment.

The SPC report presents correlation as evidence of causation. Investment is conventionally thought of as causing productivity growth via the substitution of capital for labour – indeed published econometric analysis has found evidence for such a relationship in relation to information and communications technology investment. Including labour productivity growth in an equation “explaining” investment therefore confounds cause and effect and simply demonstrates correlation, not causation.

The inclusion of productivity growth as an explanatory factor for investment, an apparent failure to consider competition as a driver of investment and reliance on the ECTA regulatory scorecard as a measure of effective regulation all imply that the SPC investment equation does not provide a basis for evidence based policy.

The SPC Network broadband equation

The SPC Network broadband equation shows a relationship between the rate of increase in broadband penetration and the rate of change of a composite measure of competition (giving equal weight to unbundled products which support intra-platform competition and true inter-platform competition). This relationship, in the absence of any other conditioning factors, does not provide a basis for evidence based policy.

If the SPC equation were valid it would imply a negative relationship between increases in the chosen measure of competition and the level of broadband penetration, since broadband growth and the level of penetration are negatively correlated, i.e. the higher broadband penetration is, the lower is typically broadband growth as markets approach saturation.

The SPC equation for broadband growth also implies that a more or less constant level of competition, regardless of the level of competition, would lead to no broadband growth. We do not consider an equation with these characteristics to provide a basis for evidence based policy.

Developing a sound evidence based approach to policy

The idea that econometric analysis should be applied to seek to better understand the relationship between various forms of competition, regulation and investment in communications and broadband is worthy of investigation. However, we conclude that the existing ECTA regulatory scorecard and the equations estimated by SPC Network do not provide a sound basis for evidence based policy. However, there are useful lessons to learn from an examination of these studies.

Policy makers are interested in what approach to regulatory policy, in which competitive environments, will serve to promote sustainable and efficient investment in broadband of differing speeds and in other telecommunications infrastructure.

- 1 First, neither the regulatory scorecard nor the SPC Network studies start from an assessment of the wider literature on the measurement of regulation and the factors contributing to investment and broadband uptake.
- 2 Second, there is no evidence of analysis to test and control for factors beyond those considered which are regarded in the literature as candidate explanatory factors, nor in particular to simultaneously control for the extent of regulation and competition in explaining observed outcomes.



- 3 Third, the estimated relationships treat broadband, competition and regulation as homogenous when one or more of these variables should be disaggregated (data permitting) to allow policy relevant propositions to be tested.
- 4 Fourth, evidence from outside as well as inside Europe should be considered. There may be lessons to learn from this wider experience, and consideration of longer time frames and a wider set of countries would enable the robustness of estimated relationships to be more fully explored.



1 Overview and main findings

1.1 Introduction

This paper comments on the following three papers:

- The ECTA Regulatory Scorecard (updated scorecard 27 April 2006).
- Strategy and Policy Consultants Network Ltd (SPC Network). European Telecom's Lost Investment: An analysis of the ECTA Scorecard. 29 March 2006.
- Strategy and Policy Consultants Network Ltd (SPC Network). Broadband Markets in the EU: the importance of dynamic competition Critique. 27 February 2006.

The European Framework for Electronic Communications is under review in 2006, giving greater policy relevance to any evidence that can be obtained from experience based on statistical analysis. We therefore comment on the three studies, and suggest a general framework for further work to advance evidence based policy in the communications sector.

We conclude that the specific measures and studies considered do not provide a sound basis for evidence based policy. However, by prompting a critique they do help in identifying what is wrong with these particular studies, and therefore how future work could be oriented.

1.2 Main findings

1.2.1 The ECTA regulatory scorecard does not provide a measure of effective regulation

The ECTA regulatory scorecard produced by Jones Day and SPC is reported in its own right, and is utilised in the investment relationship estimated by SPC. We therefore comment first on the scorecard.

Since the notion of effective regulation has no obvious metric, a score for each country is awarded on the basis of a subjective evaluation over a range of general functions identified by the regulator. The calculation of country scores on regulatory effectiveness is based on the *Areas of Assessment* laid out in Section III of the Report. These are: **I** Regulator General Functions; **II** Dispute Settlement; **III** General Market Access Conditions; **IV** Application of Regulation and Conditions of Competition in key access products. Each country receives a score based on regulatory effectiveness across these four areas.

The scoring should be independent of observed outcomes if the relationship between the scores and outcomes is to have any meaning. Given the subjective nature of a number of elements of the scorecard, and a lack of transparency over the procedures to ensure objectivity in assigning scores, it is unclear whether the scores are truly independent of outcomes. It may also matter as to who does the scoring, whilst this is unclear, ECTA note in the regulatory scorecard report that:

"For each country surveyed, the authors of the Report have requested ECTA members to respond to detailed questions designed to assess the effectiveness of the regulatory framework."

We also note that the scorecard has been found to contain errors in relation to calculations of scores, assignment of data from other sources and inconsistent use of weights.¹ We also found an error for the investment level for France in the updated scorecard.

¹ Specific errors were corrected in the ECTA update of 27 April 2006.



The subjectivity of both weights and scores is noted in relation to the ECTA scorecards of 2002 and 2004 in an academic paper by Edwards and Waverman (2006) which considered the ECTA scorecard approach:

“Apart from the small samples, a concern with these studies is the arbitrary assignment of weights to the various criteria in arriving at overall measures of regulatory independence and regulatory effectiveness. Another concern is the use, in some cases, of apparently subjective judgment when measuring criteria, for example, whether there is a likelihood of intervention from political authority other than through removal.”

The regulatory scorecard, to be useful, must also be in some sense a measure of good regulation. However, views about what constitutes good regulation differ. The scorecard, across a number of dimensions, is based on the presumption that *good* regulation corresponds to *more* regulation, for example, in relation to the provision of access products.

Whilst views about what constitutes good regulation differ, there is reasonably wide agreement that where competition is effective *ex ante* regulation is unnecessary (and quite possibly harmful). The European Framework itself enshrines this principle via the definition of relevant markets and assessment of significant market power (SMP).

The absence of a regulated access product would be considered “good” rather than “bad”, when competition is effective. For example, there is no “bitstream access” product for the broadband mass market in the Netherlands because the regulator and the Commission have found that the market is effectively competitive. The ECTA regulatory scorecard assigns a score of zero on bitstream access, lowering the overall score for the Netherlands. The scorecard does not, therefore, provide a measure of effective regulation.

This failure to condition scores for the availability of regulated access products on competitive conditions is therefore a major shortcoming of the ECTA scorecard, if it is to be a measure of effective regulation rather than simply a measure of the extent of regulation.

The scorecard also does not explicitly recognise considerations, such as regulatory commitment, which have been found in other empirical studies to be critical factors in explaining levels of infrastructure investment. For example, the scoring of disputes settlement assigns a lower weight to “due process” (10%) than “speed of process” (40%), when the former rather than the latter may be critical to achieving commitment.

Either ECTA should be clear that the scorecard as it stands is a measure of the extent of regulation rather than its effectiveness, and that in making inferences based on the scorecard due account should therefore be taken of the extent of competition in relevant national markets and of other factors such as the level of regulatory commitment.

The ideal way to measure effective regulation would be to test statistically, in a relationship that controls for other factors such as the extent of different forms of competition, whether more regulation across different dimensions of regulation produces better outcomes. A scorecard measure of regulation which served as an input to such analysis would then be described as a measure of the relative *extent* of regulation rather than the relative *effectiveness* of regulation.

The ECTA regulatory scorecard and the analysis based on it by SPC Network, do not do either of these. Taken together, therefore, they do not provide evidence in relation the extent and style of regulation which might be expected to support efficient and timely investment in broadband and other telecommunications infrastructure.



1.2.2 The investment and broadband equations do not include any common explanatory factors

Broadband is a form of communications investment, and increasingly a significant component of investment as companies and consumers seek higher speeds than standard DSL can readily offer. Moves to VDSL and fibre to the curb and home involve much greater investment since they require new civil works rather than a straightforward change of equipment at the local exchange to enable DSL. One would therefore tend to presume that drivers of investment generally would be increasingly relevant to understanding broadband take-up and moves to higher bandwidth.

However, the two estimated equations by SPC treat broadband and investment as entirely distinct, and have no common explanatory factors in common:

- The investment equation seeks to explain communications investment in terms of the ECTA regulatory scorecard and labour productivity growth
- The broadband equation seeks to explain changes in broadband penetration in terms of changes in a measure of competition

Table 1.1 summarises the position.

Table 1.1 Lack of relationship between the SPC equations for investment and broadband

	Change in composite “competition” measure	ECTA scorecard	Productivity growth
Investment		Yes	Yes
Broadband	Yes		

The relationships in Table 1.1 imply that regulation - as measured by the ECTA regulatory scorecard - is not relevant to the rate of broadband take-up; and competition – as measured by the SPC Network composite measure – is not relevant to communications investment. The two SPC Network equations considered together do not therefore appear credible as a basis for evidence based policy.

Further points in relation to the individual equations are considered below.

1.2.3 Correlation is presented as evidence of causation

It is very easy to find things that appear related, but correlation does not imply causation. In particular, any two things that have a time trend will appear to be related if one is plotted against the other. In order to interpret an observed relationship as evidence of causation, a number of conditions must be met. These include

- Having a relationship that has some meaningful interpretation or hypothesis as to why one would expect the explained and explanatory factors to be related
- Controlling for factors that might plausibly be involved in the relationship including time trends
- Ensuring that the measures of explanatory factors, such as regulation, are independent of the regulatory outcomes that regulation purports to explain.

The relationships in the ECTA regulatory scorecard and SPC reports on investment and broadband do not meet these criteria – as illustrated below and in more detail in the sections on each report.



1.2.4 SPC investment relationship demonstrates correlation not causation

The SPC investment relationship includes labour productivity growth as an explanatory factor. However, investment – namely the substitution of capital for labour – is the cause of productivity growth. A number of econometric studies such as OECD (2004) and Oultanand Srinivasan (2005) have shown that investment in ICT causes labour productivity growth.

Including productivity growth as an explanatory for investment might therefore be expected to show a strong correlation, but it does not necessarily tell us anything about what drives investment.

1.2.5 SPC broadband relationship has counterintuitive implications

The SPC broadband relationship shows a relationship between the change in broadband (discussed above) and the change in a measure of market concentration based on consideration of five different access methods which is used as a proxy for competition (the HHI or Herfindahl-Hirschmann Index used in the model).

Nearly all technologies follow an S-shaped uptake profile, slow at first, then accelerating and finally slowing down as the market saturates or reaches near universality. If a factor is positively related to growth it may therefore be negatively related to levels. The most recent OECD (2006) data for broadband demonstrates that this is indeed the case – those countries with high levels of broadband penetration typically have low levels of growth and vice-versa:

- In December 2005, four countries (Iceland, Korea, the Netherlands and Denmark) led the OECD in broadband penetration, each with more than 25 subscribers per 100 inhabitants.
- The strongest per-capita subscriber growth came from Iceland, Finland, Norway, the Netherlands and Australia. Each country added more than 6 subscribers per 100 inhabitants during 2005.

Figure 1.1 illustrates the inverse relationship between broadband growth and the level of broadband penetration using the set of countries SPC considered.

Figure 1.1

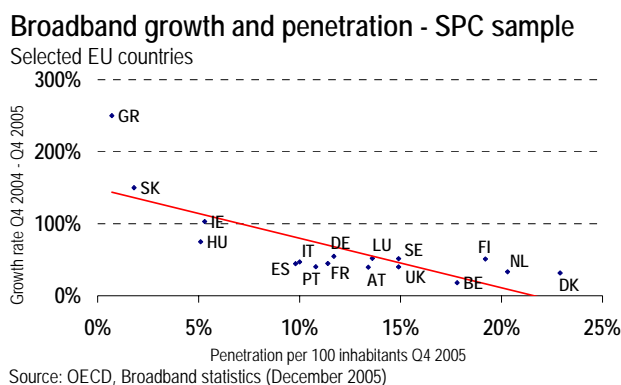


Figure 1.1 demonstrates that a regression of levels on a single explanatory factor will produce exactly the opposite conclusion in terms of “what is good” relative to a regression involving the rate of growth of broadband.

Since the *rate of increase* in broadband penetration is negatively correlated with the *level* of broadband penetration this relationship implies that increasing competition (as measured by SPC Network) would reduce broadband penetration.



The SPC equation for broadband growth also implies that a constant level of competition, regardless of the level of competition, would be expected to result in no broadband growth. This is not a plausible relationship.

1.2.6 The estimated relationships treat different things as though they are the same

In considering a relationship between two or more factors it is important not to treat as homogenous factors that may, in particular circumstances, have different relationships to one another. The ECTA regulatory scorecard, and estimated investment and broadband relationships all treat as common things that would be expected to have different relationships. This renders policy inferences based on these relationships potentially misleading.

1.2.7 Regulation that is good in some contexts may be harmful in others

The ECTA scorecard treats *more* regulation as more *effective* regulation regardless of the level of competition in the market. However, there are reasonable prior grounds for thinking that regulation of competitive markets might reduce, rather than increase, investment.

A relationship between investment and the scorecard is therefore not likely to be informative about the policy questions that matter, namely precisely what form of regulation in what circumstances is likely to be beneficial, unless we control for factors such as the level of competition in estimation.

The SPC HHI measure treats completely different forms of competition as though they are homogenous, in particular true infrastructure such as cable and competition based on regulated access products such as bitstream are treated as though they are the same. Clearly they are not, and they might reasonably be expected to have different impacts on investment or broadband penetration.

Further, the ECTA/Jones Day/SPC Network US Annex to the regulatory scorecard of June 2005 showed that the US had the third lowest score (215) of all the other (European) countries considered. The low level of availability of access products and slow disputes resolution procedures contributed to the low score.

However, the US FCC shift towards reduced regulation during 2004 and 2005 was designed to promote investment in new technologies and services. The FCC decisions were, in part, justified on grounds of existing and anticipated levels of platform competition. Regulatory withdrawal was followed by a sharp increase in investment in Fibre to the Home (FTTH) and Fibre to the Curb (FTTC). Without taking a view as to whether the US decision was the right one, it is clear that the ECTA scorecard would now give the US an even lower score, and that this might be at odds with observed outcomes in terms of investment.

It is plausible that a regulatory policy that promotes rapid diffusion of existing technologies such as DSL would prove counterproductive when it came to investment in a new technology such as VDSL or FTTH. The reason for this is that unbundled access at low prices may increase demand, whilst also reducing investment in the supply of more advanced broadband access technologies requiring substantial up-front investment and accompanied by greater demand uncertainty.

It is therefore important to understand what drives investment in high speed broadband, not simply broadband *per se*.

1.2.8 The relationships do not appear robust

A relationship that is useful for policy purposes needs to have a degree of robustness to variations in the data, and the specification of the model. If, for example, data for a different year, or exclusion or



inclusion of particular countries, results in significant changes in the estimated relationship then it may not be robust.

1.2.9 Lack of robustness to changes in set of countries or time period in investment relationship

The selection of data and the relationship in the ECTA scorecard do not appear robust in particular to changes in the set of countries. Figure 1.2 replicates the figure in the ECTA scorecard, whilst Figure 1.3 corrects an error in the investment level assigned to France, and excludes Germany and the UK

Figure 1.2

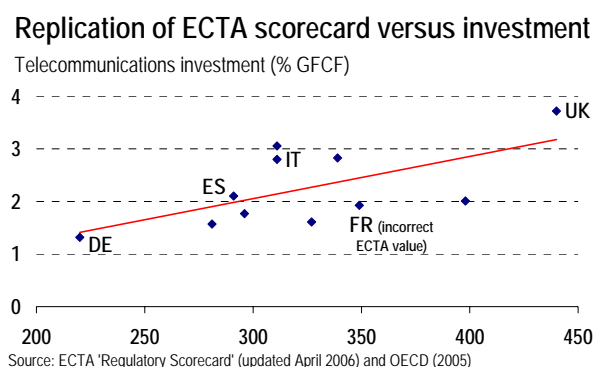
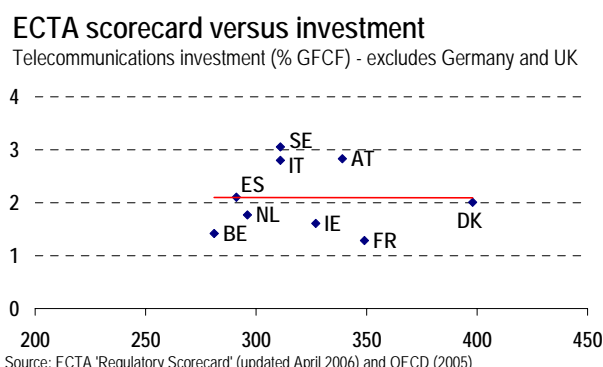


Figure 1.3



This serves to demonstrate the sensitivity of the apparent relationship to the choice of sample countries (and to an error in the original figure). The key point is that no particular inference can be based on either figure and no sound policy conclusions can be drawn from such simple relationships.

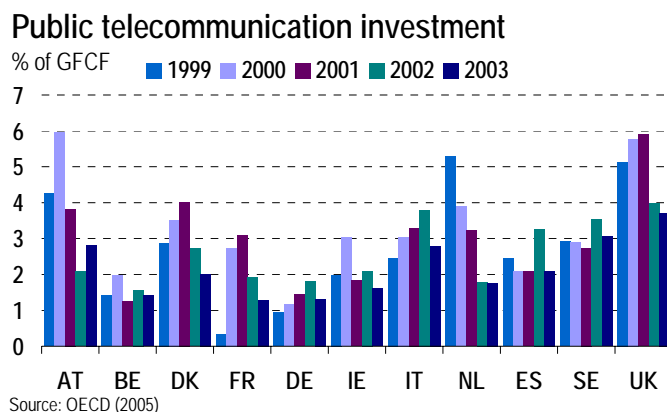
In considering alternative measures of regulation, Edwards and Waverman (2006) concluded that:

“For the EU, in two separate reports commissioned by the European Competitive Telecommunications Association (ECTA), Jones Day (2002, 2004) has attempted to measure elements of regulatory governance in the telecommunications industry and relate these to industry performance. Each of these reports sample a subset of EU member states and provide cross-sectional data not easily comparable across time. These reports are therefore limited to 9 and 10 observations, respectively, precluding robust empirical analysis.”

Figure 1.4 shows variability in investment over time. The figure simply illustrates that the choice of time period could matter in terms of any inference based on the data.



Figure 1.4

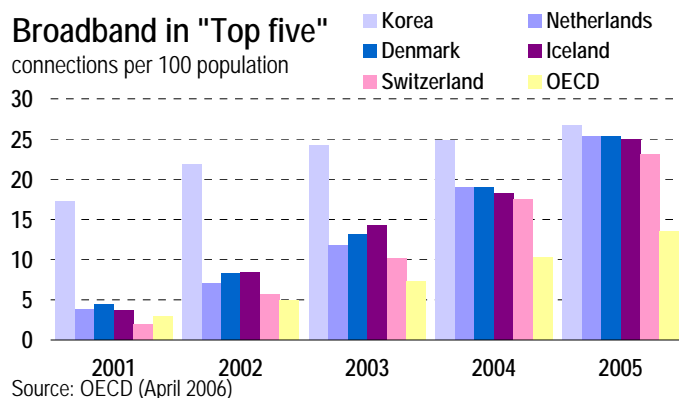


However, the level of investment which the model seeks to explain also lags the regulatory scorecard measure by 2 years – if both are changing then *current* regulation may not be a valid explanatory factor for *past* investment.

1.2.10 Lack of robustness to consideration of wider set of countries in terms of broadband relationship

Korea provides an example of a country that achieved high levels of broadband penetration early on, but which now has a slow rate of growth in broadband, as illustrated in Figure 1.5.

Figure 1.5



Korea also had very limited access regulation or unbundling during the period of strongest growth in broadband penetration. The explanatory factor identified by SPC, namely the rate of change in competition, would have been low in Korea during the period of rapid broadband growth. The SPC single variable model is therefore at variance with experience in Korea. This may reflect the fact that the maintained assumption in the SPC Network study is that the only driver of variation in the rate of growth in broadband penetration is competition.

1.3 Developing a sound approach to evidence based policy

The idea that statistical econometric analysis should be applied to seek to better understand the relationship between various forms of competition, regulation and investment in communications and broadband in particular is sound. Policy makers are interested in what approach to regulatory policy,



in which competitive environments, will serve to promote sustainable and efficient investment in broadband of differing speeds and in other telecommunications infrastructure.

However, to inform policy, an observed relationship must provide evidence of causation. A number of conditions must be met for this to be the case, including:

- Having a relationship that has some meaningful interpretation or hypothesis as to why one would expect the explained and explanatory factors to be related
- Controlling for factors that might plausibly be involved in the relationship including time trends
- Ensuring that the measures of explanatory factors, such as regulation, are independent of the regulatory outcomes that regulation purports to explain.

In terms of the approach adopted in the ECTA/SPC regulatory scorecard and SPC studies, we draw the following lessons:

- 1 First, neither the regulatory scorecard nor the SPC Network studies start from an assessment of the wider literature on the measurement of regulation and the factors contributing to investment and broadband uptake.
- 2 Second, there is no evidence of analysis to test and control for factors beyond those considered which are regarded in the literature as candidate explanatory factors, nor in particular to simultaneously control for the extent of regulation and competition in explaining observed outcomes.
- 3 Third, the estimated relationships treat broadband, competition and regulation as homogenous when one or more of these variables should be disaggregated (data permitting) to allow policy relevant propositions to be tested.
- 4 Fourth, evidence from outside as well as inside Europe should be considered. There may be lessons to learn from this wider experience, and consideration of longer time frames and a wider set of countries would enable the robustness of estimated relationships to be more fully explored.



2 Comment on the ECTA regulatory scorecard

2.1 Overview and policy inference

The third ECTA Regulatory Scorecard Report (2005; updated 2006 carried out by Jones Day and SPC Network) focuses on the measurement and quantification of 'effective regulation' in the telecommunications sector. There are two primary components of this report: i) the measurement of effective regulation and ii) estimation of the impact of regulation on investment.

The ECTA regulatory scorecard claims to measure the degree of effective regulation for EU countries, and to estimate the impact of regulation on key outcomes, such as the level of investment in the telecommunications sector and the rate of broadband penetration. The scorecard does not, as it claims, provide a measure of effective regulation. The underlying premise of the scorecard is therefore potentially misleading for policy makers. The scorecard provides a partial measure of the extent of regulation, which in isolation is uninformative.

Analogous to the role of institutions for economic growth, regulatory effectiveness is a critical component for the diffusion and adoption of many telecommunications, but given both its qualitative and multidimensional characteristics is notoriously hard to measure. Given that the ECTA scorecard represents one of a large number of approaches to the measurement of regulation in the telecommunications industry, it is important to consider the relative characteristics of this particular index (something neither ECTA nor SPC do).

Since the notion of effective regulation has no obvious metric, a score for each country is awarded on the basis of a subjective evaluation over a range of general functions of the regulator. Subsequently there are issues to consider as to whether a specific type of measurement, such as subjective assessment, might compromise inference.

In undertaking this critique we make a deliberate distinction between the following components

- 1 measurement and data as the basis of any empirical analysis
- 2 econometric analysis, i.e. modelling and robustness.

The ECTA scorecard represents an opportunity to consider how these related issues combine to affect the quality of inference. Specifically, our discussion will consider the need for careful design of the appropriate measures, the need for careful collection and use of data and a recognition that in order to make statements that to some degree may be considered as causal, it is necessary to construct a model which has good statistical properties.

We highlight a number of characteristics of the ECTA scorecard measure of regulatory effectiveness that, in conjunction with a modelling approach which is open to criticism and a number of data inconsistencies, cast considerable doubt on the validity and robustness of any subsequent inference.

We wish to emphasise that the issues relating to modelling are to some degree independent of the measurement issues. Namely, even if the ECTA measure of regulatory effectiveness did not suffer from a number of specific problems, as outlined below, the modelling approach employed in examining the relationship between regulatory effectiveness and investment is independently flawed.

2.2 Problems of measurement and data

A significant component of the regulatory scorecard is the design and utilisation of an approach to provide measures of regulatory effectiveness. In this respect the notion of measurement is central. It is instructive to note that in considering the ECTA scorecard approach to *measuring* regulation, we are



focussing on measurement in an *unconditional* sense. Namely, how is knowledge and data collected and used to construct a measure of regulatory effectiveness.

2.2.1 Lack of appropriate measures

The ECTA regulatory scorecard is based on the recognition that regulatory effectiveness is intrinsically unobservable, but there exist a number a number of imperfect indicators of regulation. The calculation of country scores on regulatory effectiveness is based on the *Areas of Assessment* laid out in Section III of the Report. These are: **I** Regulator General Functions; **II** Dispute Settlement; **III** General Market Access Conditions; **IV** Application of Regulation and Conditions of Competition in key access products. Each country receives a score based on regulatory effectiveness across these four areas. Scores for each of these areas is then combined to form an aggregate weighted mean score. Weights reflect the subjective relative importance in delivering the objectives set out in paragraph 12 of Section 1.

Below we consider a number of characteristics of the scorecard. These are: the use of subjective measures of regulation, the use of weighted scores, and inconsistencies with the data.

2.2.1.1 Objective versus subjective measures

The ECTA scorecard has a significant component of subjective assessment. The extent to which a given index includes subjective components will determine the likelihood of introducing measurement error which may introduce bias into the estimates of the impact of regulatory regulation on regulatory outcomes. This happens given that those undertaking subjective assessments are likely to be aware and influenced by the regulatory outcomes in the given country.

As an example, *Effectiveness of the appeal procedure* constitutes one of the seven criteria which determine any given country's score under *General Functions*. As the scorecard notes, one component of the effectiveness of a regulatory regime concerns the possibility of appealing a decision. If this information is not available the report states that *answers are based on the authors' general estimates and perception of the incumbent's tendency to generally challenge NRA decisions*. As the language reveals, such an approach is highly subjective and may introduce possible biases. One way to account for the coexistence of objective and subjective components in any index of regulatory effectiveness would be to apply a weighting scheme which differentially weighted objective and subjective assessments. The report does not consider implementing such an approach.

In reviewing a number of alternative databases which measure various dimensions of regulation in the telecommunications sector, Edwards and Waverman (2004) note that the European Union Regulatory Institutions (EURI) Database is *objective* in so far as the measure on each of the twelve dummy variables is observable and not dependent on subjective assessment.

2.2.1.2 Weighted versus unweighted measures

A fundamental problem which characterises the ECTA scorecard approach to measurement is the arbitrary weighting of the various factors, again based on subjective evaluation. Subsequently any inference which is based on these scores, especially those at the most aggregate level, may be highly dependent on the specific set of weights – both across and within the four key components of effective regulation?

The ECTA scorecard approach utilises a weighting scheme to combine multiple pieces of information of regulatory effectiveness. This occurs at a number of levels. First, as noted above, the four *Areas of Assessment* are allocated a priori weights, and the score for each specific area is a weighted average of sub-criteria. For example, the General Functions of the regulator are assigned a weight, and the



seven criteria that comprise these functions, with relative weight, are: speed of process (5%), transparency and consultation (15%), powers and sanctions (10%), scale of resources (10%), independence (15%), and market analysis procedure and imposition of remedies (25%). Focussing on one criterion, independence of the regulator, this is then assessed by assigning scores to criteria which include: the potential and actual extent of political intervention, the duration of office of the NRA management, and grounds for removal. In addition, once the scores are assigned, a further set of weights are applied to reflect the perceived importance of the criteria which determine independence. As the above demonstrates, the construction of an aggregate score on regulatory effectiveness is characterised by the assignment of both subjective scores and arbitrary weights

One solution to the use of arbitrary weights would be the use of a factor model which extracts common factors over the elements of an index, and in doing so assigns model-based weights. We note that Edwards and Waverman (2006) explicitly recognise this key dimension of uncertainty and conduct robustness tests to consider the impact of variations in the construction of the index, and in addition conduct a factor analysis on the 12 elements. One relatively simple test of robustness, and carried out by these authors, is to construct multiple indexes where each index is equivalent except for dropping one of the 12 dummy variables. Such an approach is adopted in order to demonstrate the robustness (or lack of) of any findings, and ensure that one particular element of the index is not exerting a disproportionate effect.

2.2.2 Data Quality and Inconsistencies

2.2.2.1 Lack of data quality

The ECTA scorecard report for 2005 contains inference conducted on the basis of 16 observations (countries); the 2004 included only 11 observations.

There are a number of obvious errors in the tabulation and use of data. A non exhaustive list includes:

- a the regulatory score presented in Section III is bounded between 0 and 400. However, in Figure 1 a score of 430 for the UK exceeds this bound. It is obviously necessary to check whether the impact of these errors compromise the inference in a significant way.
- b in table 3 positive coefficients are accompanied by negative t-statistics. Since this cannot occur this represents an example of poor presentation and error checking.

In examining the impact of regulation on investment a number of competing measures of investment are considered: investment as a percentage of GDP, investment per capita, and investment as % of Gross Fixed Capital Formation (GFCF). We believe that this is an example of good practice in the sense that the report explicitly recognises some degree of uncertainty over the appropriate measure of investment. Subsequently the analysis is not presented in terms of the robustness of any estimated effects to these different measures.

2.2.2.2 Comparison of databases

One noteworthy example of an alternative database is the EURI database, described in Edwards and Waverman (2006). In contrast to the ECTA scorecard, the EURI database focuses on one key component of regulation, namely the independence of the industry regulator from the government. The database measures for each EU founder member state the absence or presence of 12 elements of the institutional environment related to independence, for the period 1997-2003.

Edwards and Waverman (2006) provide a useful overview of a number of existing measures of regulatory governance in telecommunications, characterising each measure according to whether it is based on a single binary indicator, (see Gutierrez and Berg (2000), 19 Latin American countries over



three years); or an index, see, for example Bauer (2003), calculated over eight criteria for a cross-section of 15 EU countries in 2000.

In considering alternative measures of regulation, Edwards and Waverman (2006) concluded that:

“For the EU, in two separate reports commissioned by the European Competitive Telecommunications Association (ECTA), Jones Day (2002, 2004) has attempted to measure elements of regulatory governance in the telecommunications industry and relate these to industry performance. Each of these reports sample a subset of EU member states and provide cross-sectional data not easily comparable across time. These reports are therefore limited to 9 and 10 observations, respectively, precluding robust empirical analysis.”

2.3 Problems of the econometric analysis

Section V of the 2005 ECTA scorecard finds a *clear and positive* relationship between regulation and telecoms investment. This finding exhibits *some* degree of robustness – across different measures of investment and for high and low income countries. However, there are a number of possible problems with the analysis, which we outline below.

2.3.1 Maintained Assumptions

- a A calculated aggregate regulatory score is reasonably homogenous in the various components.
- b All variation in regulation effectiveness is exogenous to investment. This implies that any omitted factors are independent of regulation, and that there is no measurement error in the regulation index.

The above assumptions are unlikely to hold since other academic evidence suggests some elements of regulation may retard broadband penetration, and the extent of inter-platform and intra-platform competition – which are both omitted – are most unlikely to be independent of regulation.

2.3.1.1 Model specification

When we consider the problems in the use of regulation scores in an econometric model, then in order to isolate *an effect of measurement* on a specific regulatory outcome, our analysis is *conditional* in the sense that we need to control for other factors which jointly influence regulation and the regulatory outcome we are examining. Critical here is the need to separate the effects of regulation and competition. A well specified econometric model can do this.

In examining the simple econometric model presented in the ECTA scorecard we highlight the need to consider the following issues:

- a The need to expand the existing model by including additional factors that also determine investment levels
- b Endogeneity of regulation through the influence of omitted factors
- c Endogeneity due to measurement error induced by subjective scores
- d Fixed effects panel to circumvent endogeneity due to time invariant factors.

2.3.1.2 Lack of robustness

Although there are a number of obvious extensions to the model based on the inclusion of additional controls, there are obvious problems in seeking to conduct reliable inference with such a small sample. The results of simple models examining the relationship between regulatory effectiveness



and investment are based on small samples (16 or sometimes 11 countries). Subsequently any model is likely to produce imprecise parameter estimates, and small changes in specification may result in large changes in estimated parameters. For example, Figure 2 of the updated ECTA scorecard (April 2006, p. 44) we observe that by removing Germany and the UK from the sample generates a switch in sign, revealing a significant negative correlation between regulatory scoring and investment (see Figure 1.3 of overview). This serves to demonstrate the sensitivity of the apparent relationship to the choice of sample countries. No particular inference should be based on such relationships.

There exists considerable uncertainty in terms of what constitutes a good and reliable measure of regulation. Issues such as objective versus subjective assessments, weighted versus unweighted indices, and the potential for endogeneity biases to confound inference on the impact of regulation on regulatory outcomes have been discussed. As a result, in order that any policy statements are credible it is at the very least necessary to explore and represent this uncertainty, by demonstrating robustness of results to changes in the number of countries, and additional controls. The report does not do this.



3 Comment on the SPC Network investment analysis

3.1 Overview and policy inference

The second report examines the relationship between regulatory effectiveness and investment. Investment is measured as telecoms investment as a percent of total industry value added. Regulatory effectiveness is measured using data provide by the ECTA regulatory scorecard. The unit of analysis is a country, with the sample restricted to 9 EU countries, and covers the years 2002, 2004, and 2005.

The principle findings of the report may be summarised as:

- For every 1% increase in regulatory effectiveness there is a 0.47% increase in investment
- If all countries achieved 100% regulatory effectiveness, as measured by the Scorecard, annual investment would increase by 14.3 billion Euros
- If all countries achieved regulatory effectiveness as achieved by the leading country, the UK, annual investment would increase by 8.5 billion Euros

Policy recommendations: Achieving regulatory effectiveness is critical to generating investment in the electronics communications sector. EU and national policy makers need to determine how to improve the regulatory environment.

As in the last section, in undertaking our analysis we differentiate between aspects relating to measurement and data and issues concerning the econometric analysis, i.e. modelling and robustness.

We inter alia find that the use of an aggregate measure of regulation in the investment equation is problematic and find a misinterpretation of correlation versus causation between investment und labour productivity

Based on our analysis we conclude that the approach adopted in this report, namely utilising an aggregate measure of regulatory effectiveness is not informative with regards the debate as to how EU and national policy makers might improve the regulatory environment.

3.2 Problems of measurement and data

3.2.1 The use of an aggregate measure of regulation

The report states that a 'holistic' approach is adopted when measuring regulation. The authors make this statement in order to justify the use of an aggregate measure of a regulation score, computed as a weighted sum of a large number of individual measures. Such an approach therefore embodies a maintained assumption that the individual components exert a reasonably constant effect on investment if they were to be considered independently. This approach precludes an analysis of whether different types of regulation have differential effects on investment.

The authors allude to a study by Chang et al (2003) who conduct a disaggregate analysis by examining the relationship between levels of investment and individual regulatory measures. However, there is no discussion of how an aggregate approach might result in problems for inference.

Following the discussion in Section 3, it should be apparent that there is a more general issue of whether the use of the ECTA Scorecard measure of regulatory effectiveness (and the attendant approach to measurement) is at all appropriate. This naturally leads to a discussion of the exogeneity of regulation.



3.2.2 Exogeneity of Regulation

The assumption of exogeneity of regulatory effectiveness is pivotal in terms of the validity of any subsequent inference on the effects of regulation on investment. To elaborate on the importance of this point we first reproduce a statement from the executive summary:

“The ECTA regulator Scorecard 2005 shows significant differences in levels of regulatory effectiveness across the European Union”

The report utilises this variation, along with variation in labour productivity, to explain variation in investment. However, the extent to which one or more excluded variables are partial determinants of regulatory effectiveness and investment, may confound any subsequent inference. In view of the parsimonious nature of the existing model, endogeneity is likely to be a problem. Given the likelihood that such a problem exists, the current inference in terms of the magnitudes of the reported elasticities, and the *estimate* of the *Missing Investment* can be called into question.

If there is measurement error in the variable regulatory effectiveness this will also introduce endogeneity bias. This was discussed in more detail in Section 2. In a study seeking to evaluate the effect of regulatory independence on interconnect rates in EU telecommunications, Edwards and Waverman (2006) recognise the nature of these problems and following earlier work by Evans and Kessides (1993), adopt an instrumental variables approach to account for endogeneity.

The question of how robust are the findings of this report is obviously an empirical issue. However, it is noticeable that the authors do not allude to any of the potential problems that might compromise their results.

3.2.3 Correlation versus Causation

The SPC investment relationship includes labour productivity growth as an explanatory factor. However, investment – namely the substitution of capital for labour – is the cause of productivity growth. A number of econometric studies have shown a relationship between investment in ICT and labour productivity growth (OECD 2004 and Oultan and Srinivasan 2005).

Including productivity growth as an explanatory for investment might therefore be expected to show a strong correlation (and R^2), but it does not necessarily tell us anything about what drives investment.

Furthermore, investment data are not contemporaneous with regulatory effectiveness measures. The reason provided for this is that the OECD publishes investment data with a two year lag. The model specification then utilises cross-sectional variation in regulatory effectiveness in period t to explain variation in investment in period $t-2$.

3.3 Problems of the econometric analysis

3.3.1 Maintained Assumptions

- The relationship between investment and regulatory effectiveness is linear (in logs).
- The percentage increase in investment subsequent to a 1% increase in regulatory effectiveness is constant for all levels of regulation.
- The percentage increase in investment subsequent to a 1% increase in regulatory effectiveness is constant over the estimation period and for the nine countries.
- All variation in regulation effectiveness is exogenous to investment.



- The percentage increase in investment subsequent to a 1% increase in the individual components of regulatory effectiveness is reasonably homogenous.

Estimation and inference is based on data on a sample of ten EU countries, observed for the years 2002, 2004, and 2005.

3.3.2 Model Specification

In this section we consider a number of issues related to model specification. These include the appropriate set of controls, the assumption of exogeneity, and the pooling of cross-section data

- a An appropriate set of controls. The model assumes that all systematic variation in investment can be captured by regulatory effectiveness and labour productivity. This is unlikely to be the case, and suggests the need to expand the existing model by including additional factors that also determine investment as a percentage of total value added.
- b The assumption of exogeneity of regulatory effectiveness is unlikely to hold and should be tested.
- c A number of dummy variables are included in the model specification. Time dummies are included to control for excluded variables which are time varying but country invariant. Dummy variables are also included for high, medium and low Investment as a percentage of value added. Parameter estimates are not reported. An investigation of whether there is any significant variation in the effects of regulation according to low, medium, and high investment regimes, would proceed by interacting these dummies with regulatory effectiveness.
- d A pooled panel data model is used as a basis for parameter estimation. We note that the authors circumvent the lack of precision that would follow from the use of a single cross-section of ten countries, by pooling observations over three years. However, such a approach is based on the assumption that pooling of data (over time periods) is valid. This means that you can estimate pooled data only if the relationship is reasonably homogenous over time. To the extent the effect of regulation on investment varies significantly over time this would call into questions this maintained assumption.
- e In general the selection of a double-log model over a linear specification is not possible using standard measures of fit i.e. percent of explained variation (R^2).

3.3.3 Estimation and Robustness

The parameters of the pooled cross-section/time-series model are estimated using iterative Generalised Least Squares (GLS). It is presumed that a GLS procedure was used with cross-section weights², to achieve robustness to heteroscedasticity. The authors claim that the results of the model are robust, suggesting a strong and stable relationship between regulatory effectiveness (as measured by the Scorecard) and investment. However, the nature of this robustness is not stated, and corroborative evidence of this claim is not provided.

² The specific format of these weights is not provided.



4 Comment on the SPC Network broadband analysis

4.1 Overview and policy inference

The third report presents the results of an econometric model which examines the relationship between the rate of change of market concentration and the rate of change in broadband subscribers for two sample of EU economies over the period 2002-2005. Based on the estimation of a fixed effects log-linear panel data model, the principle findings of the report may be summarised as:

- a In the case of the EU 13 sample of Member States for every 1% decrease in market concentration there is a commensurate 2.86% increase in broadband take-up. In the expanded sample of 16 countries the figure is 1.66%.
- b If all countries moved to the (lower) level of market concentration achieved by Sweden, we would find an additional 20m subscribers.

Policy recommendations: Remove barriers to efficient market entry, promote infrastructure competition, reduce barriers to switching, and monitor collusion.

We analyse aspects relating to measurement and data and issues concerning the econometric analysis, i.e. modelling and robustness.

One of the principle decisions to be made before undertaking analysis of this sort is the question as to the most appropriate relationship to examine. Here we highlight related issues, such as the most appropriate units of measurement, whether the relationship is represented as static or dynamic and whether an aggregate measure of market concentration is appropriate.

We conclude that the broadband equation does not provide a plausible relationship to inform evidence based policy.

4.2 Problems of measurement and data

4.2.1 Appropriate units of measurement

In terms of the most appropriate units of measurement, the authors refer to one of their previous papers³ in which the relationship between the *level* of market concentration and broadband penetration was examined. In the paper commented on here the focus is on the relationship between the *rate of change* of the two variables. Although a justification for moving from a model specified in levels to a rate of change is often provided based upon the likely better properties of the latter, the report does not provide any discussion why a relationship cast in terms of rate of change would be of interest.⁴

Decisions as to the most appropriate units of measurement should be taken on fundamental grounds related to both economic and econometric criteria and not simply a comparison of simple correlations which may be misleading in the absence of other controls. From a policy perspective we are primarily interested in the level of broadband penetration and use, not the rate of increase. We would also not

³ A precise reference to this study is not provided.

⁴ In an earlier report *Broadband and i2010: The importance of dynamic competition Critique* (21 February, 2005) the same authors motivate a preference for modelling the relationship between the rate of change in broadband penetration and the rate of change of market concentration based on the observation that a simple correlation between a measure of the rate of change in the two variables over the period was significantly higher (-0.72) than the same correlation calculated between the levels of the variables. (-0.4).



expect the rate of change of competition to be an explanatory factor, rather it is conventional to consider the level of competition as a possible driver.

4.2.2 Static versus dynamic relationship

The approach adopted by the authors tends to imply that the best way to introduce dynamics into a model of the relationship between broadband penetration and market concentration is to represent the variables as rates of change. It is indeed the case that a log-linear model cast in levels and using measures of market concentration and broadband penetration for the same period, is static and further implies a constant elasticity between broadband penetration and market concentration. Such a model is not consistent with the generally accepted fact that the growth of broadband penetration may be represented by a logistic curve.

If this is the case then one would observe an inverse relationship between the level and the growth rate of broadband penetration, as Figure 4.1 for broadband penetration in OECD countries and Figure 4.2 for the set of countries taken into account in the study illustrate.

Figure 4.1

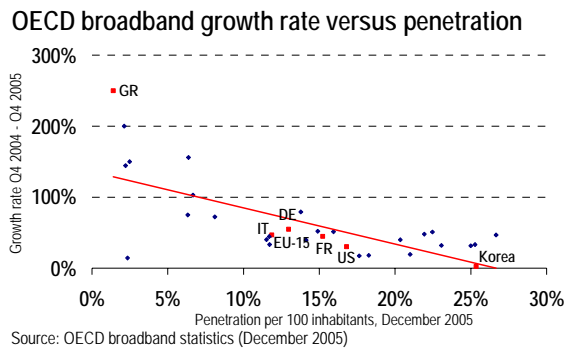
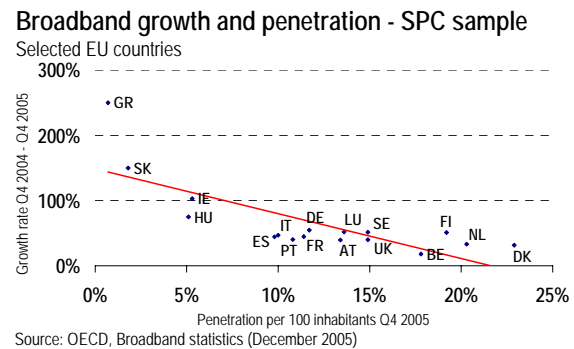


Figure 4.2



The main conclusion is that since the *rate of increase* in broadband penetration is negatively correlated with the *level* of broadband penetration the estimated SPC Network relationship implies that increasing competition (as measured by SPC Network HHI measure) would reduce broadband penetration.

The SPC equation for broadband growth also implies that a constant level of competition, regardless of the level of competition, would be expected to result in no broadband growth. This is not a plausible relationship which would inform evidence based policy.

A further intuitive test of the robustness of the relationship is to see how well it performs for countries outside the sample, though we note that other explanatory factors could be relevant to an out of sample country that do not differ across the within sample group. South Korea had high rates of growth in broadband penetration early on when inter-platform competition was high, but when regulated access was not mandated. Competition was therefore high but relatively constant, precisely the circumstances in which the SPC model would predict little if any broadband growth – at predication completely at odds with the outcome in Korea.

In this respect a reasonable extension of a simple model of the relationship between broadband take-up and market concentration would be to represent part of the dynamic relationship by considering the effect of start-up time. This is consistent with the diffusion of many technologies characterised by a progression from slow, fast, to slow rates of diffusion.



4.2.3 Aggregated Measure of Market Concentration

The report represents market concentration as a single measure aggregated over 5 different access models. It is therefore not possible to isolate the effects of changes in market structure in terms of changes in the distribution of access modes (incumbent, OLO, LLU, cable and other) on broadband penetration. Subsequently it is not possible to determine whether there are any differential effects on intra versus inter-platform competition on growth. As documented in Table 2 of the report, cable and other are true inter-platform forms of competition to the incumbent. OLO and LLU may then be interpreted as representing intra-platform competition as these are to a larger or lesser extent based on the incumbent's infrastructure.

The use of an aggregated measure for market concentration, including access products mandated by regulation alongside genuine infrastructure competition, is insufficiently granular to inform evidence based policy.

4.2.4 Existing Literature

The authors pay scant reference to the existing literature on the diffusion of telecommunications in general and broadband in particular. A number of studies are of particular note.

Wallsten (2005) utilizes variation at the State and Federal level to examine the impact of various policies on broadband penetration in the US. One notable characteristic of this study is a careful attempt to control for a wide range of factors, including population, income, urbanization, venture capital, the political party of the governor, and year fixed effects, prior to isolating any effects of particular policies. These controls are included in an attempt account for factors that determine the demand and costs of supplying broadband across states. Such an approach is standard in academic empirical work, and is designed to increase the robustness of any inference, in mitigating the effects of omitted factors.

One of the principle findings in Wallsten further highlights the need to consider the potential differential effects of two forms of competition on broadband penetration. Specifically, the share of telephone lines provided under UNE-P regulations was found to be negatively correlated with penetration, whereas resold lines are positively correlated. The aggregation of components into a composite variable when the direction of the effects of the constituent parts vary may be flawed.

Another study by Wallsten (2006) considered broadband and unbundling regulations in OECD countries and also found that different aspects of regulation had different impacts. The study also considered the impact of policy and other variables on the penetration of broadband of different speeds. Wallsten found that controlling for country and fixed year effects, local loop unbundling had no robustly significant impact on broadband penetration.

Denni and Gruber (2005) consider the role of competition in determining the diffusion of broadband telecommunications, and focus on the relative impact of intra and inter-platform competition. Two HHI indices, one for each type of competition, are constructed. In looking at diffusion across U.S Federal states inter-platform competition is found to be significantly more important than intra-platform competition. The authors also explicitly consider the non-linear nature of diffusion and base their model around a logistic take-up curve. This naturally leads to the consideration of a dynamic model in order to capture the positive externalities which result from the nature of diffusion process. Namely, in any given period the increase in take-up will depend inter alia on the number of existing users that effectively spread further adoption.

Estache, Manacorda, and Valletti (2002) examine the stylized facts on regulatory reform and its effects on internet penetration in Latin America. Again the dynamic nature of the diffusion process is



captured by the use of a logistic take up curve in conjunction with the use of a lagged dependent variable. The authors also include a number of additional controls including per capita GDP, a measure of internet costs and a variable capturing access to basic infrastructure, which will also partially reflect the cost of internet adoption.

4.3 Problems of the econometric analysis

4.3.1 Maintained Assumptions

- 1 The relationship between broadband penetration and competition is linear (in logs)
- 2 The percentage increase in broadband penetration subsequent to a 1% increase in competition is independent of the level of competition.
- 3 The percentage increase in broadband penetration subsequent to a 1% increase in competition is constant over the estimation period and the EU 13 and EU 21 sample of countries.
- 4 All variation in competition is exogenous to penetration.
- 5 The percentage increase in investment broadband penetration commensurate with a 1% increase in the different components of competition (access markets) is reasonably homogenous.

Analysis is performed for two samples. EU 13 comprising pre May 2004 EU members states; and EU 21, a larger sample comprising 21 of the 25 EU members states⁵. In both cases the time period spanned quarter 1 2002 to quarter 3 2005.

4.3.2 Model Specification

- a Shortcoming of chosen functional form. The maintained assumption that the relationship between broadband penetration and competition is log-linear, imposes the constraint that the estimated elasticity is constant over the range of competition. Such an assumption is unlikely to be consistent with the existence of a logistic uptake curve. For example, countries such as Ireland that have high rates of broadband growth are arguably on a steep early phase of a logistic uptake curve. Subsequently it might be argued that the starting point is a key explanatory factor for the rate of growth in uptake, such that the exclusion of this variable is likely to bias the estimated elasticity. Note that if starting points are aligned with individual countries then the fixed effects model would partially account for this factor.
- i The authors fail to consider the stationarity properties of the two main variables. For example, a model cast in levels will often generate invalid inference if both variables are integrated of order 1 (i.e. have a unit root). Regression performed on two such variables can generate the well known spurious regression problem. One solution to this problem is to estimate the model in first difference of the two variables and specify the model in terms of rates of change. In most cases one would observe higher correlation (and R-squared) when representing a model in levels relative to differences, or rates of change. The fact that the authors note that the correlation between the two variables expressed as rates of change is higher than that for levels, suggests that the two variables share different stationarity properties. Subsequently, one would question the validity of both the level and rates of change specification. In any subsequent analysis we would recommend that prior to estimating any regression equations that the stationarity properties of the two variables be considered.

⁵ Cyprus, Czech Republic, Latvia and Poland were excluded due to data problems.



ii Maintained assumption 5. supports the use of an aggregate measure of competition. Specifically, the construction of an HHI index which aggregates the various access methods, incumbent, OLO, LLU, cable and other, assumes that the competitive impact on penetration levels are homogenous in terms of the levels. Given that these different access methods involve more or less infrastructure, then such an assumption might not be supported by the data.

b Heterogeneity of the broadband product and heterogeneity of the impact of competition on penetration levels. Such heterogeneity may also be present in terms of significant differences across countries in elasticities. This point may be partially addressed by expanding the set of controls.

c An appropriate set of controls

The estimated model, representing the relationship between competition and broadband penetration, excludes the effects of all other potential explanatory factors. The critical issue in this context relates to the maintained assumption 4: *All variation in competition is exogenous to penetration*. If this holds then, ceteris paribus, any omitted variables will not generate bias in the estimated elasticity. It is also the case that this assumption precludes any bias originating from measurement error in the competition variable.

In a number of places throughout the report, the authors emphasise the fact that *broadband access market varies in each of the EU countries*, and also note that there are many factors that might explain the varying rates of broadband penetration. The potential role of price, the launch date of commercial broadband and government policy are mentioned. However, none of these factors are included in the model, and no mention is made of the potential effect of such exclusion.

The extent to which one or more omitted factors are also partial determinants of competition, and therefore that the exogeneity assumption is violated, is a critical issue. For example, if more infrastructure competition is correlated with less regulation and more broadband penetration, then the problem of endogeneity needs to be addressed.

We suspect that in view of the parsimonious nature of all reports, that endogeneity is likely to be a problem. If such a problem exists then the current inference in terms of both the signs and magnitudes of the reported elasticities may be called into question. Specifically, under this scenario the effects of competition and regulation are confounded, and the estimated elasticity of broadband penetration with respect to competition would be biased.

d Country Specific Fixed Effects

The impact of country specific (time invariant) factors are accounted for by the inclusion of country dummy variables. This controls for the effect of any omitted variables which do not vary over time such as a number of institutional characteristics and start-up time.

e Pooling of Data

Despite alluding to the fact that the new member states are obviously different on a number of dimensions potentially related to the provision of broadband services, the chosen methodology pools observations over older and new member states, without testing if this is valid.



4.3.3 Estimation and Robustness

The paper refers to a pooled cross-section/time-series estimator, but at the same time points to allowing for country-specific intercept. This is not a pooled model, rather it is a fixed effects estimator. The paper refers to the model as robust but is not clear as to how this robustness is measured.



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