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Standardisation in ICT: Current Economic Perspectives

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Standards and ICT

Standards can be defined as technical specifications that may be adhered to by a producer, either tacitly or as a result of a formal agreement. Standards may be developed by national standards bodies, regional bodies such as ETSI and global partnerships such as 3GPP (which includes ETSI as a member). Standards bodies are not the only source of standards, with market processes creating *de facto* standards and proprietary standards. Standards may also compete, for example the initial competition between Blue-ray and HD DVD. Finally, there may be a complementary relationship between formal and consortia standardisation [1].

Standards play a key role in the diffusion and use of ICT, for example, standards underpin the Internet (and increasingly Internet applications), wireless systems including WiFi and 3G and next-generation fixed core and access technologies including GPON. In relation to wireless technology, harmonisation of services in specific frequency bands may also apply in addition to standards.

The contribution of ICT and standards to economic outcomes

Until comparatively recently, the contribution of ICT to improved productivity at the macro-economic level was unproven. As Nobel Winner Robert Solow observed in 1987: 'You can see the computer age everywhere but in the productivity statistics.'

This paradox has now been replaced by a new one; you can see a dramatic impact of ICT in some countries but not others. Even though ICT should be almost universally available globally it has contributed to economic divergence rather than economic convergence. As Jorgenson and Vu observe [2]: 'Although the surge in investment in IT equipment and software is a global phenomenon, the variation in the contribution of the investment has increased considerable since 1995.'

This divergence is also apparent between the US and Europe, as Figures 14.1 and 14.2 illustrate [3].

Figure 14.1 for the US shows the estimated contribution of ICT production (the first two grey bars) and use (the top bar) to overall labour productivity growth per hour worked (the line). A rising absolute contribution is apparent from the mid-1990s, accompanied by rising aggregate productivity growth. In contrast Figure 14.2 shows that in the EU-15 the contribution of ICT to productivity growth increased up to the mid-1990s, but has been static since then and accompanied by declining aggregate productivity growth.

Differences in policy, and potentially in the cultural environment, are thought to be responsible for much of this divergence (also apparent across individual states within Europe) [4].

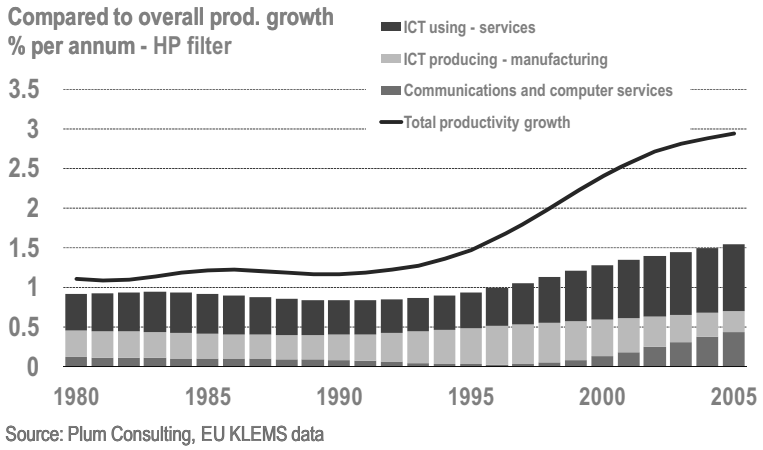

Figure 14.1 ICT contribution to productivity growth, US.

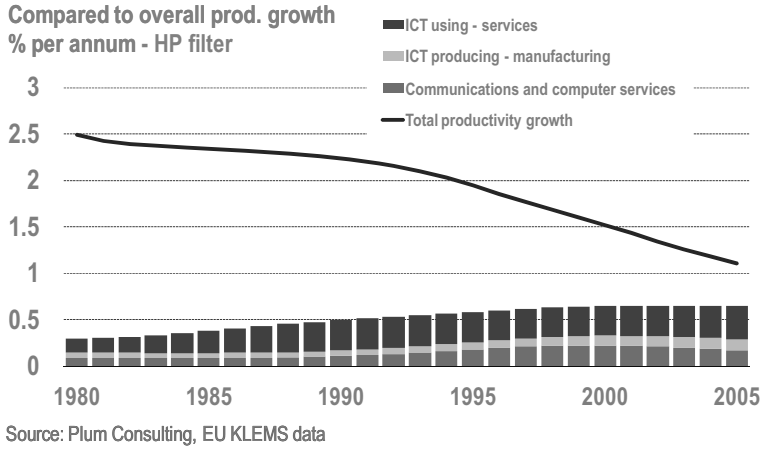

Figure 14.2 ICT contribution to productivity growth, EU-15.

Differences in labour and product market flexibility are one factor thought to be important in determining the productivity impact of ICT since restructuring of economic activity is required to realise the full benefits of ICT. Differences in skills levels also impact on the adoption and economic impact of ICT [5,6]. Evidence points to the particular importance of higher education in countries close to the technological frontier [7].

The approach to standards might also be expected to explain divergence given the role of standards in technological diffusion, adoption and ease of communication along supply chains. However, within Europe many national standards are now pooled at the European level, so differences in the approach to standards may have a diminishing role in explaining productivity growth differentials within Europe. Whilst cross-country estimates of the economic impact of standards are not available, Temple *et al.* estimate that about 13% of aggregate growth in labour productivity in the postwar period in the UK is associated with standards [8].

The economics of standards

Four main economic benefits have been identified in relation to standards [9].

- Providing for interoperability or compatibility between different parts of a product or more generally between different elements in a system or network. Interoperability not only allows systems to work, but provides some assurance to investors, including consumers, that their investment will continue to produce returns/benefits [10].
- The provision of a minimum level of quality, which may be defined in terms of functionality or safety of products.
- The reduction of variety, allowing for economies of scale in production, e.g. equipment and competition between equipment producers.
- The provision of information including standard service descriptions.

Whilst standards are created by individual market players and voluntary consortia, unaided, markets may under-provide for standards since the gains may not always be appropriable by an individual firm that develops standards. There might also be additional economic reasons why standards would be under-provided, in particular bargaining problems with asymmetric information and strategic complementarities whereby a coordinated move across a number of areas is required to realise the benefits of a new technology and a single strategic view is required to achieve the shift [11].

Privately produced standards may also not possess two qualities associated with institutionally produced standards, namely openness and credibility or confidence which may be associated with a standard coordinated by government institutions.

It is helpful to elaborate on the potential economic costs and benefits of standards, since standards may or may not be appropriate in a particular context, and standards might be more or less flexible. In association with intellectual property rights or patents, the adoption of standards can provide an incentive to innovate. However, this advantage may also enable lock-in of consumers to particular technologies, because of the network externalities arising from the adoption of standards, thereby reducing potential competition from rivals.

A 2004 study for Ofcom considered the costs and benefits of radio standards and frequency harmonisation, setting out a general framework and analysing specific technologies [12]. This

Table 14.1 Benefits and costs of standardisation.

Benefits	Costs
Economics of scale in equipment manufacture and service provision	Regulatory capture, in which the regulator is persuaded to adopt standards that benefit producers rather than consumers or some groups of producers at the expense of others
Increased competition in equipment production and between service providers arising from reduced consumer switching costs and improved interoperability of terminal equipment and networks	Reduced innovation and consumer choice because of variety reduction and exclusion of alternative uses
increased trade flows and the competitive benefits these yield	A possible reduction in competition in service/ product provision arising from network effects. This is double edged because, while monopolisation means there are no 'orphaned' users as network effects take hold, at the beginning of the process one wishes to avoid lock-in to inferior standards due to a lack of competition
Reduced transaction costs between producers and consumers and between producers	
Network effects leading to faster take-up and greater willingness to pay for services than would otherwise occur	Delays in service introduction as the standardisation process itself takes time
Reduced risk for producers and consumers	Increased administrative costs associated with the processes for agreeing standards in circumstances where standards are developed collectively
Accelerated take-up and diffusion of new technologies	
Stimulus to innovation in certain circumstances	

study provides a starting point for our elaboration of potential costs and benefits. Table 14.1 summarises the benefits and costs identified by the study.

More generally, developments in relation to ICT and globalisation point to specific dynamic considerations in relation to innovation and the diffusion of technology and services that flow from standards.

- Elements of open source software have been adopted and developed commercially as a basis for mobile, computer, server and browser software platforms. The balance between closed and open systems has shifted in favour of open systems as service providers seek to speed development and build an ecosystem of applications around their platform.
- Global production is undergoing what has been called the 'great unbundling' as communication and coordination costs fall, partly as a result of *de facto* standards such as Internet Protocol and the World Wide Web.
- Software development has become more modular with the use of application programming interfaces such as Windows, Google Maps and iPhone; and Widgets, data mashups between websites and tools for creating data mashups.

The development of *de facto* standards around the Internet and software, and the use of the Internet and platforms such as the iTunes apps store for distribution, allows rapid and much smaller scale development and dissemination of applications. The growing importance of software in a wide class of products gives these developments increasing prominence.

Software/device platforms compete in order to 'escape' from competition and earn economic rents – though each successive successful innovator must continue to innovate to survive [13]. Firms may compete to become an industry standard, but they know they will only survive as long as they innovate successfully to fulfil consumer demands.

Application to wireless services

Marks *et al.* [12] consider the economics of standardisation and harmonisation in relation to radio spectrum applications, and Table 14.2 summarises the high-level categories of benefits and costs identified in relation to standards.

The conclusion of Marks *et al.* [12] was that the impact of standardisation on economic welfare depended on the particular service and circumstances in question. In the case of TETRA, the standardisation process itself took many years and the outcome contained many options and compromises. In this time the potential market for digital public mobile radio was partly eroded by unlicensed private mobile radio and cellular services.

In the case of GSM 900 and 1800 services, there were significant economies of scale and international mobility was valued, so standardisation was valuable. In the absence of formal standardisation (and harmonisation) there may have been delays in clearing spectrum (occupied by defence) for GSM services, which would have reduced the market size initially leading to higher equipment costs; and resulted in cross-border interference constraints, reduced competition and limited roaming capability initially.

The GSM 900 and 1800 standards were enshrined in the 1987 European GSM Directive (87/372/EEC). Subsequently the GSM Directive has become a barrier to re-farming of spectrum for 3G and LTE, and the European Commission proposed its repeal in July 2007 (in line with wider support for technology and service neutral spectrum assignment). However, the Directive has yet to be repealed, and other delays to liberalisation are likely to occur in countries where the spectrum holdings of operators differ significantly and/or are not suitable for 3G services (i.e. are not in 5 MHz blocks).

The inability to re-farm spectrum for 3G use is now imposing economic costs in terms of limited wide area coverage, poor in-building coverage, more costly support for traffic growth

Table 14.2 Benefits of standardisation in relation to radio equipment.

Benefits	Costs
Avoid harmful interference and promote spectrum efficiency and so increase spectrum use and competition	Restricted use of equipment developed elsewhere, which may be cheaper or have greater functionality
Promote international mobility (of terminals)	
Create large equipment markets	Reduced innovation and potential lock-in to an inferior standard
Promote competition between equipment suppliers	Delayed introduction of new services and equipment caused by the time taken to agree standards
Promote interoperability between terminals and public networks (thereby reducing consumer risk)	
Promote competition between service and application suppliers	

and potential delays for the deployment of LTE. The costs of a lack of flexibility are now more apparent given rapid recent growth in mobile broadband and projected continued rapid growth [14].

In the UK Ofcom published a consultation on the application of spectrum liberalisation and trading to the mobile sector in September 2007 [15]. Ofcom proposed liberalisation to allow 3G use and release some of the 900 MHz spectrum by Vodafone and O2 to remove the existing asymmetry in 900 MHz spectrum allocation (Vodafone and O2 have 900 MHz and 1800 MHz spectrum, T-Mobile and Orange have 1800 MHz and all operators including H3G have unequal allocations of 2100 MHz spectrum). The Ofcom views and analysis were contested by respondents. Ofcom has yet to make a decision and stated in June 2008 that it would issue a further paper later in 2008.

In Ireland ComReg is consulting on licence reissue and liberalisation options (in Ireland two 2G mobile licences expire in 2011 and a third expires in 2015) [16]. ComReg proposes that 900 MHz spectrum is auctioned, including some unassigned spectrum, with the remainder assigned to the three incumbent operators. Again there are asymmetries in relation to existing allocations, and the proposal to auction existing 900 MHz allocations in their entirety seems likely to be contested by operators.

Such delays have not occurred in Australia where spectrum licences are service and technology neutral. The mobile market is currently served by four operators – Hutchison, Optus, Telstra and Vodafone. Vodafone and Optus share infrastructure (on commercially agreed terms) as do Telstra and Hutchison, and Hutchison has a commercially negotiated roaming agreement with Telstra. In addition to the four network operators there is competition from resellers and MVNOs, and again these arrangements are commercially negotiated. Operators have service and technology neutral spectrum licences at 850 MHz, 1800 MHz and 2.1 GHz which were acquired at auction, and in the case of Hutchison in the secondary market. Licences at 900 MHz were not issued by auction though these are also technology neutral and tradable.

The different frequency bands used to deliver cellular mobile services are complementary and potential substitutes, in the sense that they jointly provide capacity that the operators need for 2G and 3G services and bands have been migrated from 2G to 3G services. Telstra and Hutchison ran 2G networks at 850 MHz but have closed them in favour of deploying 3G services in this band. Similarly Vodafone and Optus are jointly upgrading to 3G at 900 MHz in major metropolitan areas [17].

Coverage is a key competitive feature of the mobile market. Telstra has deployed 3G network with 99% coverage using its 850 MHz spectrum [18]. Optus plans to achieve 98% population coverage with its 3G network using 900 MHz spectrum by 2009 [19]. Rapid growth in demand for 3G services means that operators are planning to deploy LTE in the next 2–3 years, possibly at 1800 MHz or 700 MHz should the latter be released as part of the digital dividend. Telstra is currently undertaking an LTE trial. The timely and relatively low-cost migration from one technology to another is assisted by the flexibility of spectrum licences and the availability of 'spare' spectrum in other bands in which to 'park' existing use. A more hands-off approach to promoting competitive neutrality has also been sustained in Australia, with any intervention having to be justified by a ruling from the competition regulator.

Lessons

A number of lessons can be drawn from theory and experience in relation to standardisation.

- First, whilst standardisation can be economically valuable, there are no *a priori* grounds for assuming that government intervention to promote standardisation is beneficial when account is taken of the potential impact of government intervention in practice.
- Second, the government and quasi government bodies can play a facilitating role in relation to standards setting, particularly where it is important for the development of trade in services and underlying markets may not be fully competitive (as is the case, for example, in relation to telecoms access infrastructure in certain locations).
- Third, where standards are promoted, the most flexible approach consistent with achieving desired outcomes should be adopted. Where less flexible approaches such as Directives are adopted, consideration should be given to including explicit sunset clauses.

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Biographies

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