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The Economics of Standardization: An Update

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Policy Makers' Summary

1. This report provides an update of the 2000 report for DTI: *The Economics of Standardization*. The present report does not displace the 2000 report for, in the author's opinion, everything in that earlier report still stands as an accurate account of the economics of standardization at the time. Moreover, no attempt has been made to merge the 2000 and 2010 reports into a single document. The main emphasis in this new report is on the *new* things that have been learnt in the last ten years.

2. In four particular areas of the economics of standardisation, there has been marked progress over the last ten years. These are described in Section 2.

a) *Standards, Growth and Productivity*: Several detailed econometric studies have established a clear connection at a macroeconomic level between standardisation in the economy, productivity growth and overall economic growth. These studies have been carried out for the UK, Germany, France, Canada and Australia. Estimates vary somewhat from study to study, but overall, the growth of the standards catalogue over recent years may account for between one eighth and one quarter of productivity growth over the period. Some recent developments in the literature also offer a (partial) explanation of these effects on growth and productivity.

b) *Standards and Trade*: Many detailed econometric studies have explored the linkage between standardisation and trade. For those standards concerned with removing technical barriers to trade, the most common patterns are as follows. The use of international standards in country X increases exports from *and* imports into country X. The use of national standards in country X increases exports from country X, but the implications for imports into country X is less clear: in some cases, standards facilitate such imports, but in other cases standards obstruct such imports. For those standards concerned with Sanitary and Phyto-Sanitary factors (e.g. food safety), however, the pattern is different: here standards are more likely to block imports – especially imports from developing countries. Again, recent developments in the literature also offer a (partial) explanation of these effects on trade.

c) *Standards and Innovation*: While it is commonly believed that standards obstruct innovation, the evidence suggests a rather different story. Surveys of innovating firms find many enterprises say that standards are a source of information that helps their innovation activities. Moreover, while many say that regulations do also *constrain* their innovation activities, these constraints do not necessarily *prevent* innovation. Moreover, these 'informing' and 'constraining' effects tend to occur together. The implication seems to be that the most innovative firms are good at finding information in standards, and, because they are 'pushing the boundary', they also find that regulations *constrain* their innovative activities - but do not *prevent* these. Again, recent developments in the literature also offer a (partial) explanation of these effects on innovation.

d) *Inside the Standards' Black Box*: An important development over the last ten years has been to open up the earlier, 'black box' models of standards and the economy, and to understand the various mechanisms through which these effects operate. To achieve this, it is necessary to adopt a more detailed taxonomy of the purposes and aspects of standards than was used in the 2000 report. Having done that, it has been shown how standards can help: (i) the exploitation of

economies of scale; (ii) the effective division of labour; (iii) the building of competencies; (iv) to reduce barriers to entry; (v) to build network effects; (vi) to reduce transaction costs; and (vii) to increase trust between trading partners.

3. The report then presents (in Section 3) a simple schematic model of the beneficial (and dysfunctional) effects of standards. This is summarised in a simple flow diagram on page 18 of the report.

a) The model recognises eight different purposes or aspects of standardisation: variety reduction; quality and performance; measurement standards; codified knowledge; compatibility and interoperability; vision; health and safety; environmental. The model recognises that these aspects of standardisation can impact on eight intermediate economic variables: scale economies; division of labour; competencies; barriers to entry; network effects; transaction costs; precision; trust and risk. And finally, the model recognises that these intermediate variables can impact on eight ultimate economic variables, of policy interest: price; productivity; entry; competition; innovation; trade; outsourcing; market failure. The model builds on both the literature surveyed in the original report (2000), and the new literature surveyed in this updated report (2010).

b) Although the diagram is fairly simple to understand, the model shows that there are many different routes from standards to their economic effects. This is important for several reasons. First, it implies that the effect of a standard in a ‘black box’ econometric model can only be estimated with an element of uncertainty, depending on the routes and mechanisms involved. Second, it implies that further progress in estimating the economic effects of standards requires that research moves on beyond the aggregate macroeconomic (‘black box’) models and starts to use models that take account of the rich structure within the ‘black box’. Third, it underlines the fact that several of the economic effects of standards are found together. So, for example, as the model shows, any standard which enhances an effective use of the division of labour (say) will lead to increased productivity, innovation, outsourcing and trade. These last effects are all inter-related.

4. The report then examines the rationale for different types of government policy towards standardisation. It does this by assessing whether the market failure rationale or the system failure rationale for policy is relevant to nine current (or possible future) policy initiatives.

a) First, the report provides a refresher on the basic economic rationale for policy. Section 4.1 summarises the best-known rationale – the market failure rationale. From this perspective, there is only a good case for policy measures if there are good reasons to suspect a market failure. That is, there needs to be a clear case why the market outcome is not the optimum outcome. As Section 4.1 shows, there are several phenomena that can lead to market failure, so the case for policy rests on how important these are in practice. Section 4.2 summarises the system failure rationale, which is perhaps the less well-known of the two, but is growing in importance as it gives a better indication than the market failure approach to identifying the form, symptoms and locations of any ‘failure’.

b) Second, the report then sets out (in Section 5.1) some nine current (or possible future) policy initiatives. These include: the engagement of stakeholders in standardisation; reorganising the standardisation process; updating the stock of standards; education about standards; the use of

standards to resolve ‘big issues’; integration of researchers and innovators into standardisation; access to standards and pricing of standards; coordination of different government standardisation activities; better regulation through standards. Many of these are highly relevant initiatives at the present time.

c) Third, the report then examines (in Section 5.2) the case for each of these policy initiatives from the market failure and system failure perspectives in turn. This finds that the majority of these initiatives find strong support from both the market failure rationale and the system failure rationale. That is interesting because in some areas of policy, it is found that the system failure perspective tends to provide more support than the market failure perspective. In this case, however, the level of support is comparable. The five policy initiatives that receive the strongest support are probably the following: engagement of stakeholders; updating standards stock; using standards to resolve ‘big issues’; integration of standardisation with research; improving access to standards and pricing of standards. However, the other initiatives also receive some support.

5. The last section of the report discusses some examples of good practice in standardisation policy. By ‘good practice’ we mean a generic policy initiative that enjoys a strong economic rationale in terms of the arguments in Section 5, and which focuses on areas where market failure or system failure seem most relevant.

We see that the National Standardisation Strategic Framework (NSSF) helped to ensure that standards-setting would involve a wide variety of stakeholders, and this principle is enshrined in BS 0. In the same way, the principle that the standards stock should be kept up to date and relevant is also well enshrined in BSI policies and practice (including BS 0). While much past BSI activity has been directed at educating business about the benefits of standards, we argue that the greater market failures lie in the lack of understanding about standards amongst consumers and in government. The Consumer and Public Interest Unit of BSI has been active in demonstrating how standards benefit the consumer. Equally, a large part of the work of BSI has been concerned with educating the public sector about the value of standards.

The use of standards to help manage ‘big issues’ (such as environmental issues) emerges as a high priority in this report. While this is an under-developed area, BSI has nonetheless a track record of activity. In particular, BSI has carried out various ‘trials’ of standards in development, notably in energy management and sustainable events management. The integration of research and standardisation is also an underdeveloped area, but one of the first advances in this area has been the establishment of a joint group (STAIR) by CEN and CENELEC to address the relationship between standardisation and research.

Finally, while it is recognised that the widespread dissemination of standards would be easier to achieve if standards were made freely available, such a step would compromise the funding for standards development. One approach which tries to reconcile these two perspectives is an application of price discrimination. This is already being used to some extent, but there is arguably scope to develop this approach further.

1) Introduction

1.1 Specification

The specification for this project was as follows.

The project will be a contribution to refreshing and developing the evidence base for standardization policy. The key deliverable will be an update of Professor Swann's 2000 paper 'The Economics of Standardization'. The paper would include:

- a) A (selective) review of the literature produced in the field since 2000;
- b) A simple overall model describing the economic benefits of standardization;
- c) A discussion of possible roles for government stemming from this simple model;
- d) A discussion of an 'ideal model' for government activity;
- e) An assessment of current BIS and wider Government activity from the perspective of (c) and (d);
- f) Case studies of good practice, drawing on (e).

1.2 The 2000 Report and this Report Compared

The 2000 report was also organised around headings very similar to (a)-(e) above. The present report does not *displace* the 2000 report. Indeed, in the author's opinion, everything in the 2000 report still stands as an accurate account of the economics of standardization in 2000. For that reason, I have not attempted to merge the two into a single document. Moreover, very little of the 2000 report is repeated here. The main emphasis in this new report is on the *new* things that can be said about these headings.

The 2000 report contained almost 500 references to the literature. As the literature on the economics of innovation has grown sharply since then, full survey of all the literature since 2000 could add 1500 or more *new* references. It was clear from my conversations with BIS that a comprehensive survey of all this was not wanted – and would, in any case, take far more than the time budget for this project! Accordingly, the additions to the literature review are my selection of some of the most important work that has appeared since 2000, and also some of the less well known work of the most influential researchers, where I consider it adds an interesting new dimension to the literature. I have, for the most part, omitted studies which, interesting though they are, mainly confirm findings and perspectives that were set out in the 2000 report.

While the literature review in the present report is much shorter than in the 2000 report, the discussion of components (b)-(e) above contains quite a lot of new material. The simple overall model contains a good deal more detail than in the 2000 report. The discussion of possible roles for government, an 'ideal model' for government activity and the assessment of current government activity goes some way beyond what was in the 2000 report. Finally, the discussion about case studies of good practice is a new item in the present report, and was not included in the 2000 report.

The structure of this report is as follows. We don't follow headings (a) – (f) from the Specification *in that exact order*, because that would lead to some repetition, but we *do* cover all those themes in the report.

After a selective literature review (Section 2), we discuss a simple overall model of how the different aspects and purposes of standards have their economic effects (Section 3). The aim here is to 'open up the black box' of the econometric studies which correlate standards with trade, growth and innovation, and ask *how* these mechanisms work. The model can be distilled in a relatively simple flow chart (Figure 2) which will be useful throughout the report. Then in Section 4, we start our discussion of the possible roles for government in the simple model with a summary of two basic economic rationales for government policy: the market failure rationale and the system failure rationale. In Section 5, we assess how current government interventions in the standards area and possible future activities look from the perspectives described in Section 4. In Section 6, we draw on Section 5 to summarise an 'ideal model' for government activity: this 'ideal model' is defined as those initiatives that have a strong economic rationale. Section 6 concludes with some examples of good practice in standards policy.

2) A Selective Review of the Literature since 2000

My 2000 report contained almost 500 references to the literature. In addition to the work by pioneers of the subject (D. Henenway and Wilfred Hesser), several authors collected five or more references in that report:¹ Cristiano Antonelli, Stanley Besen, Knut Blind, Carl Cargill, J.P. Choi, Robin Cowan, Paul David, Nicholas Economides, Joseph Farrell, Dominique Foray, Neil Gandal, Shane Greenstein, John Hudson, Phil Jones, Michael Katz, Ken Krechmer, S.J. Liebowitz, Al Link, S.E. Margolis, Carmen Matutes, Pierre Regibeau, Garth Saloner, Carl Shapiro, Mark Shurmer, W. Edward Steinmueller, Greg Tassey, Paul Temple and M.B.H. Weiss.

As the literature on the economics of innovation has grown sharply since then, full survey of all the literature since 2000 could easily add 1500 or more *new* references – and perhaps many more.² However, I do not attempt such an ambitious project which would be well outside the time budget for the project. Instead, I shall identify a selection of what I consider to be the most important references since 2000.

This is inevitably a selective sample and the selection reflects a bias towards:

- a) authors who have made a substantial contribution in the last 10 years, but are not in the above list
- b) aspects of standardization where research was underdeveloped at the time of the 2000 report
- c) empirical studies
- d) sectoral or macroeconomic studies
- e) formal standards (set by standards organisations or consortia)
- f) studies that seem most relevant to policy makers

and a bias against:

- g) aspects of standardization where research was already well developed at the time of the 2000 report
- h) theoretical studies
- i) work on *de facto* standards
- j) individual company case studies

Because of (a) this list will probably not do justice to the recent work of the above-named authors. That is unfortunate, but at least these authors are properly acknowledged in the original report. Indeed, some different names will appear amongst the most cited authors in the present survey (Knut Blind, Henk de Vries, Tineke Egyedi, Kai Jakobs, John Hudson, *inter alia*). The reason for neglecting (h) and (i) is that work of this sort dominated the field at the time of my earlier report (2000). And the reason for neglecting (j) is that these are arguably of less direct

¹ I don't include (self-) references to my own work in this calculation.

² Henk de Vries of Rotterdam School of Management, one of the two or three most active and influential researchers on standardization in Europe, maintains a large database of the literature on standardization, currently containing around 1400 items.

relevance to the present study which is to assess the case for *public* investment (as opposed to *private* investment) in standardization activity.

I have grouped this selective literature review into five sections: (2.1) macroeconomic or sectoral work on standards, growth and productivity; (2.2) macroeconomic or sectoral work on standards and trade; (2.3) work on standards and innovation; (2.4) work that helps to open up the black box, and explain *how* standards have their beneficial economic effects; and (2.5) other work of significance that doesn't fit into categories 2.1-2.4.

2.1 Standards, Growth and Productivity

At the time of the 2000 report, this area was fairly underdeveloped. The main contribution – and a very substantial contribution too – was that of DIN (2000) and the background papers to that report. The following findings are most relevant to this section:

- Standards contribute at least as much as patents to economic growth
- The macroeconomic benefits of standardization exceed the benefits to companies alone

The papers underlying the macroeconomic part of the DIN study were essentially econometric in character. Blind and Grupp (2000) consider that time series data on standardization is a good measure of the extent of technological diffusion. They find that for Germany, half of the observed macroeconomic growth can be explained by innovation while about a third is attributable to diffusion and standardization, rather than innovation. They argue that standardization is an important component of the national system of innovation.

Blind et al (1999b) and Jungmittag et al (1999) use advanced econometric methods to examine German macroeconomic growth between 1961 and 1996, and to try to identify the comparative contribution of capital, labour, patents, license expenditures and standards to growth. While the results obtained differ markedly after German unification, the average results over the period 1961-1990 indicate that capital contributes 1.6 percentage points per annum and standards 0.9 percentage points per annum towards a trend growth rate of 3.3 percent. The contribution of other factors, notably patents, is more modest.³

While patents and standards both play a key role in innovation, in diffusion and in codifying knowledge, formal standards have one important advantage. They are open, and act as a public infrastructure for innovation. Patents, by contrast, are proprietary, and may be used to maintain exclusivity. Swann (2000) discussed what seemed, at that time, a growing conflict between IPR and standardization, and how this could have implications for innovation-led growth.

Since then a number of major studies have looked at the implications of standards for productivity and/or growth. One is the book by Blind (2004) which brings together much of his work to that date on the macroeconomic effects of standards. Chapter 18 of that book describes a more recent study of the contribution of standardization to the macroeconomic production

³ The DIN (2000) report also draws on several other macroeconomic studies, including Blind et al (1999a), Thierstein and Abegg (2000).

function. The results agree with the DIN study that standardization contributes to GDP growth at the rate of about one percentage point per annum. However Blind suggest that the earlier results suggesting that standards contributed to the growth of *company turnover* at the rate of 1 per cent per annum were probably over-estimates.

DTI (2005) contains three analyses of the macroeconomic implications of standardization. One project relates to standards and innovation and is discussed in Section 2.3. The other two projects relate to standards, productivity and growth.

In the first, Temple, Witt and Spencer examine the contribution of standards to growth in the UK context, following on from the work of Jungmittag et al (1999). They estimate that the elasticity of the growth in output attributable to a 1% increase in the size of the standards 'catalogue' is about 0.05. This may seem like a small elasticity, but set against that is the rapid rate of growth of the catalogue. Temple *et al* estimate that growth in the standards 'catalogue' over the period 1948-2002 contributed about 13% (one seventh) of the growth in labour productivity in the UK experienced over that period. To put this in context, GDP grew by 2.5% per year over that period. Of this, labour and capital growth together accounted for 1.5 percentage points, and technological change from all sources contributed 1 percentage point. Temple *et al* estimate that standards growth accounts for more than a quarter of this latter 1 percentage point. But they stress that the result needs to be interpreted with care, since they believe that standardisation primarily acts in conjunction with other factors such as innovation – and not independently, on its own.

In the second project, Blind and Jungmittag compare the macroeconomic effects of standardization in Germany, France, Italy and UK. They estimate a wide variety of model forms and it is difficult to summarise all the results here. But overall, their range of estimates for the elasticity of the growth in output attributable to a 1% increase in the size of the standards 'catalogue' is between 0.02 and 0.1. The result of the first project lies in the middle of this range.

Similar studies have since been carried out by/for the Standards Council of Canada (2007) Standards Australia (2007) and AFNOR (2009).

The Standards Council of Canada study (2007) was based on the same research methodology originally used by DIN (2000) and the DTI (2005), adapted to the Canadian situation. The empirical analysis clearly showed that standards play an important role in enhancing labour productivity, measured as output per hour worked. Over the study period of 1981-2004, standardization accounted for 17 per cent of the growth rate in labour productivity which translates into approximately 9 per cent of the growth rate in real GDP. The 17 per cent estimate is similar to the figure estimated for the UK by Temple et al in DTI (2005). The econometric results were backed up by interviews which provided useful qualitative data supporting the benefits of standardization.

The study for Standards Australia (2007) indicated a similar relationship between the stock of standards and productivity. Over the 40 years to 2002, a 1 percent increase in the number of Australian Standards is associated with a 0.17 per cent increase in productivity across the economy. This is a relatively high elasticity compared to the UK and European studies in DTI (2005). Additionally, Standards Australia argues that standards can be considered, together with

R&D expenditure, as contributing factors to the stock of knowledge. The study finds that a 1 per cent increase in this joint stock of knowledge leads to a 0.12 per cent increase in economy-wide productivity.

Finally, the study by AFNOR (2009) used a similar econometric approach combined with a survey of companies and their views on standardization. The econometric study estimated the elasticity of total factor productivity (TFP) with respect to the stock of standards is 0.12, indicating that 1% increase in the stock of standards is related to an increase of 0.12% in the growth of the TFP. AFNOR note that the elasticities are close to those found by Blind and Jungmittag for Germany in DTI (2005). In summary, standardization contributes an average of 0.8 percentage points to growth per year, or almost 25% of GDP growth. This is in line with the estimate figures for Germany in DIN (2000) and DTI (2005), though a bit higher than in the UK.

2.2 Standards and Trade

At the time of the 2000 report, empirical work on the implications of standards for trade was also an underdeveloped area. As far as we know, the first study of that sort was by Swann et al (1996) which studied the effects of standards-setting activity on trade performance, measuring the strength of BSI standards setting activity in each industrial sector by comparing counts of relevant BSI standards based on Perinorm, with counts of relevant DIN standards. Broadly speaking, this study found that standards are trade creating, but there was also some evidence that they increase competitive advantage.

In 2000, there were few other studies with which to compare this. Between 2000 and 2009, however, a large number of similar studies have been carried out, including: Baller (2007), Blind and Jungmittag (2001, 2005), Blind (2001), Chen and Mattoo (2004), Chen et al (2006), Clougherty & Grajek (2008), Czubala et al (2007), Disdier et al (2007), Fontagné et al (2005), Grajek (2004), Henry de Frahan & Vancauteran (2006), Kim & Reinert (2009), Michalek et al (2005), Moenius (2004), Moenius (2006a), Moenius (2006b), Sánchez et al (2008), Temple and Urga (1997), van Beers and van den Bergh (1997), Vancauteran & Weiserbs (2005), Wilson et al (2002). These are surveyed in detail by Swann (2009a),⁴ but Table 1 offers a compact summary of these various studies (alongside the results of Swann et al, 1996).⁵

In most studies, when exporting countries use international standards, this has in most cases a positive (or at least neutral) effect on their export performance. There are only two exceptions: one of these refers to trade in agricultural products, and this is one of the sectors in which it is quite often found that standards restrict trade; the other exception seems anomalous. But the balance of evidence here is towards a positive effect of international standards on exports.

When an exporter from country X uses national standards (i.e. standards specific to country X), that may also lead to superior export performance by X. This time there are just three exceptions. Two of these are relatively easy to explain: they are both studies on the effects of environmental

⁴ AICGS (2004) also discusses the role of standards in trade.

⁵ Sub-Section 2.2 draws on Swann (2009a).

Table 1
Effects of Standards and Regulations* on Exports and Imports

Effects of Standards and Regulations* on Exports

(i) Effects of International Standards* in Country X on Exports from X				
(a) Negative and Significant	(b) Negative	(c) Negligible	(d) Positive	(e) Positive and Significant
$1 + 0 + 0$	$1 + 0 + 0$	$2 + 0 + 0$	$2 + 0 + 0$	$7 + 1 + 2$

(ii) Effects of National Standards* in Country X on Exports from X				
(a) Negative and Significant	(b) Negative	(c) Negligible	(d) Positive	(e) Positive and Significant
$0 + 0 + 2$	$1 + 0 + 0$	$1 + 0 + 0$	$0 + 0 + 0$	$5 + 0 + 0$

Effects of Standards and Regulations* on Imports

(i) Effects of International Standards* in Country X on Imports into X				
(a) Negative and Significant	(b) Negative	(c) Negligible	(d) Positive	(e) Positive and Significant
$2 + 2 + 0$	$0 + 0 + 0$	$5 + 1 + 0$	$1 + 0 + 0$	$6 + 5 + 2$

(ii) Effects of National Standards* in Country X on Imports into X				
(a) Negative and significant	(b) Negative	(c) Negligible	(d) Positive	(e) Positive and Significant
$2 + 3 + 3$	$2 + 0 + 0$	$1 + 0 + 2$	$1 + 0 + 1$	$3 + 0 + 0$

* Studies marked in yellow refer to standards
 Studies marked in green refer to standards *and* regulations
 Studies marked in blue refer to regulations

Source: Abbreviated version of Table in Swann (2009a)

regulations in country X on exports from X. The reason for the negative effect here is not that regulations make the products of country X less attractive in export markets, but that regulations make it harder for producers in X to remain competitive while also observing strict environmental regulations. Once again, the balance of evidence here is towards a positive effect.

When the importing countries adopt international standards, the most common effect is also to increase imports. But this time, there are four exceptions. One of these refers to trade in agricultural products, and as noted before, this is one of the sectors in which it is quite often found that standards restrict trade. Another relates to harmonization which increases exports from included developed countries but reduces exports from excluded developing countries. Harmonised standards in a region are likely to be quite strict compared to what developing countries are used to, and as a result any benefits of harmonisation are outweighed by the increased costs of meeting a stricter standard. The third exception is amenable to a (rather technical) explanation, while the fourth is anomalous. So, once again, the balance of evidence here is very much towards a positive effect.

In this last part of the table, relating to national standards and imports, the results are much more diffuse. If an importer uses national standards, that may either facilitate imports or constrain imports: it depends on the study in question. Focussing on the studies that relate exclusively to *standards*, the effects are distributed pretty evenly across the table: four positive effects, four negative, and one negligible. But when we turn to the studies concerned with regulations (or regulations *and* standards) the weight of evidence is definitely towards a *negative* effect on national standards on imports. Here it is best to conclude that:

- (a) the effects on national standards on imports are uncertain: they can be positive or negative;
- (b) the effects of national regulations on imports are generally negative.

It is arguable that to form a balanced opinion of the empirical relationship between standards and trade, the trade economist must consult with development economists and agricultural economists, on the one hand, and industrial economists and innovation economists on the other. As a broad generalisation, development and agricultural economists are better placed to see the bad side of standards. They can see the barriers to trade created, in the main, by rich countries that restrict imports from poor countries – whether by accident or design. By contrast, industrial economists and innovation economists are better placed to see the good side of standards. They can see how such standards can open up opportunities for firms in poor countries to export to the richest countries.⁶ There is a good side and a bad side to the effects of standards on trade, and we need to understand when we expect to see the good side, and when by contrast we expect to see the bad.

An important study by WTO (2005) gives their views on the benefits that standards can deliver in terms of information for consumers, environmental protection and compatibility of related goods and services. But it also draws attention to the fact that technical standards *can* also be used as protectionist measures and can result in higher operating costs for developing country producers.

⁶ For example, the globalisation of standards in the personal computer industry has allowed firms in the Philippines to provide some of the components for personal computers sold in Europe.

One of the three main sections of this report focuses on the role of *standards in relation to international trade*, taking into account the functions of standards and the needs that they meet, and the conditions under which standards are likely to create or impede trade. The role of harmonization, equivalence and mutual recognition in reducing the trade-hampering effects of standards is then examined. The WTO (2005) study also surveys the available empirical literature on the relationship between standards and trade – though the survey described above covers a larger proportion of the literature.

2.3 Standards and Innovation

The 2000 report identified some of the ways in which standards might help innovation and provided some limited evidence. The report emphasised the following factors:

- a) Standardization helps to build focus, cohesion and critical mass in the formative stages of a market (e.g. Krechmer 1996a; Swann and Watts, 2002)
- b) Standardization of measurements allows innovative producers to demonstrate to the satisfaction of the customer that products are as innovative as they claim to be (e.g. Tassey, 1982; Swann, 1999)
- c) Standardization codifies and diffuses state of the art technology and best practice (e.g. Krechmer 2000, 2005a; Blind and Grupp, 2000)
- d) Open standards are desirable to enable a competitive process of innovation-led growth (e.g. Krechmer, 1998; Swann, 1990)

In short, standardization is an essential part of the microeconomic infrastructure: it enables innovation and acts as a barrier to undesirable outcomes. This point is well founded in the literature - for example, Branscomb and Kahin (1995), Krechmer (1996a, 1996b), Link and Scott (1998), Monteiro and Hanseth (1999), OTA (1992), Tassey (1992, 1995, 2000), and other references cited in Swann (2000, section 1.3).

It is often asked whether, on balance, standardization acts more to constrain innovation or to enable innovation. This *infrastructure* perspective considers that these two activities are *inextricably linked*. Any infrastructure may appear to limit the user's options, but it also opens up opportunities. David (1995) describes standards as the "flux between freedom and order" and Hanseth et al (1996) talk about the "tension between standardization and flexibility". Certainly, standardization does constrain activities but in doing so creates an infrastructure to help trade and subsequent innovation. Standardization is not just about limiting variety by defining norms for given technologies in given markets. Standardization helps to achieve credibility, focus and critical mass in markets for new technologies. Moreover, well-designed standards should be able to reduce undesirable outcomes.

The 2000 report went on to compare the role of standards towards innovation with the role of pruning and training fruit trees to promote fruitfulness. Yes, pruning and training constrains and limits the growth of the tree; but done right, it can help to promote the growth of healthy fruit. Not everyone likes this metaphor (!) but at this time it is, in our opinion, the best way to capture the somewhat paradoxical idea that standards (which appear to limit and constrain) can actually end up promoting innovation.

While there is still only limited research evidence in this area, the literature has made some useful steps forward in the last ten years.

The third project in DTI (2005) uses data from the Community Innovation Survey (CIS3) to examine the question: “Do standards enable or constrain innovation?” The results demonstrate, as predicted in Swann (2000), that standards enable *and* constrain. The basis for this conclusion is found in the responses given by different CIS respondents to the following CIS questions:

- a) How important to your enterprise’s innovation activities is the following information source: technical, industry or service standards?
- b) How important a constraint to your innovation activities was: the need to meet UK/EU regulations?

The DTI (2005) study found that the answers to these two questions were positively correlated. Amongst those who said that standards were a source of information for innovation activities, the majority also said that regulations were a constraint on their innovation activities. And, amongst those who said that standards were *not* a source of information for innovation activities, the majority also said that regulations were *not* a constraint on their innovation activities.

This third project also went on to explore to what extent the informing and constraining role of standards depended on the size and condition (average age) of the standards stock. The DTI (2005) study finds that the information content of the stock of standards increases with the number of available standards and, up to a point, also increases with the median age of this stock. However there is a limit to this; beyond a certain point, an increasingly elderly stock of standards begins to lower the stock’s information content. A similar non-linear effect is found in the constraining role of standards: it seems likely that both rather old and rather new standards constrain innovation – the first because it locks the innovator into legacy systems and the latter because it challenges the innovator.

King (2006) carried out a very thorough exploration of these hypotheses using more recent data, including a series of extensions and robustness checks on the above results. King found that some of the non-linearities in the last paragraph are dependent on the specific model used, and are not robust. In particular, it is not certain whether the idea of an optimum age of the standards stock is well defined. But the positive correlation between the ‘informing’ and ‘constraining’ effects *does* seem to be robust. As King (2006, p. 76) says:

“It is clear the pattern for the constraint imposed by regulations paralleled that given above for the use of standards as a source of information. This suggests that those who make use of standards to help them achieve a particular goal feel to some extent constrained by them. Moreover, Swann argued that the ‘informing’ and ‘constraining’ roles of standards were complementary, and these results support his claim. Standards documents provide guidance and stipulations concerning best practice for ensuring rigorous quality control, and specifications to enable compatibility and minimum levels of performance. Hence, standards inevitably constrain a firm’s activities if they wish to receive the benefits that standardization brings. Finally, regulations may force

firms to innovate and adapt their practices in order to comply with regulation, and in such circumstances firms are necessarily constrained by regulation. In essence, taking account of standards and regulations is part of the routine that successful firms follow.”

This is a compelling explanation of what was, at first sight perhaps, a paradoxical result.⁷ Another is provided by de Vries (2006a) who discusses the ‘paradox of standardisation and innovation’ in a special issue of *ISO Focus*.

Blind (2009) notes that, “the traditional view has always been that standards and innovation contradict each other”, but argues that there are several ways in which standards can promote innovation. Blind uses the metaphor of standards as a catalyst – a material that helps a reaction take place, but is itself chemically unchanged by the fact of that reaction. Blind summarises these catalytic properties as follows – while recognising that there are also shortcomings and problems in the relationship between standards and innovation (Blind, 2009, p. 30):

“The three different areas and the examples have illustrated several catalytic functions of standards for innovation. First, the standardisation process reduces the time to market of inventions, research results and innovative technologies. Second, standards themselves promote the diffusion of innovative products, which is most important for the economic impact of innovation. A third more indirect, but important function of standards is that they level the playing field and therefore promote competition and consequently innovation. Fourth, compatibility standards are the basis for innovation in network industries e.g. for communication networks (e.g. GSM), which are increasingly penetrating our economies. In network industries, standards also facilitate the substitution of old technologies by new ones, e.g. by forward and backward compatibility, and also to allow the coexistence of old and new technologies. New platform standards are often the basis for innovation in downstream markets (e.g. GSM as platform for numerous mobile services), but also in upstream markets. Besides these network related functions, a generic characteristic of standards is that they reflect user needs and therefore promote the purchase, i.e. the diffusion, of new products by early adopters. Finally, standards set the minimum requirements for environmental, health and safety aspects and consequently promote trust especially in innovative products.”

Finally, in a very recent paper, Swann and Lambert (2010) revisit the empirical analysis of the ‘informing’ and ‘constraining’ roles of standards in the DTI (2005) study. They find that the same basic positive correlation between the ‘informing’ and ‘constraining’ roles of standards also applies in later CIS surveys. Swann and Lambert also find that those CIS respondents who say that standards inform *and* constrain, are also those who score highest on many of the CIS measures of innovation. Those that say standards inform their innovation are (unsurprisingly) more innovative than those who say standards do not inform. Those that say that regulations constrain their innovation are (perhaps more surprisingly) more innovative than those who say regulations do not constrain.

⁷ Using Community Innovation Survey data for Luxembourg (CIS 2006), Mangiarotti and Riillo (2009) also find that use of ISO9000 has a positive association with innovation when innovation is interpreted broadly.

Swann and Lambert (2010) offer two further interpretations of these results. First, they note (as we discuss in more detail below) that standards have several different purposes and/or aspects. Some of these are primarily informative (e.g. codified knowledge) while some are primarily constraining (health and safety). But any one standard may contain several of these aspects and purposes. Taken as a group, the set of standards relevant to any one company will contain a mix of information and constraints. To presume that standards will *either* be informative *or* constraining is to create a false antithesis: any one standard *may* have both of these effects at the same time, and any *group* of standards is *highly likely* to contain both. Second, they observe that those firms who say that standards inform innovation and regulations constrain innovation are very innovative firms who are good at squeezing information from standards, and who are also pushing the innovation boundary, and hence are constrained (but not prevented) by regulations. By contrast, as those firms who say regulations do not constrain tend to be less innovative than the rest, they are not pushing the innovation boundary and so are neither constrained (nor prevented) by regulations.⁸

2.4 Inside the Black Box

The studies surveyed in Sections 2.1 and 2.2 (in particular) and also in Section 2.3 are mostly based on ‘black box’ econometric models linking standards with productivity, growth, trade and innovation. But these studies tell us little about the mechanisms by which standards have these beneficent economic effects: at best they are simple ‘black boxes’ that disguise a complex of relationships. For this reason, we believe that a priority for future research must be to open up the ‘black box’ and start to understand the mechanisms that link standards and these economic variables of prime policy concern. Swann (2000) lists some evidence relating to some of the linkages in the black box, but obviously this does not cover material published since 2000. In this section, we provide a preliminary sketch of *some* of the more recent evidence on these links, in no particular order.⁹

Standards and Variety

In the usual typologies of standards, one is the ‘variety reduction’ standard. This may be a slightly misleading label in that variety reduction is not necessarily an explicit objective of the standards, but rather the net effect of the standard. Nonetheless, this outcome is highly relevant in this context. Standards sometimes seek to reduce variety in order to exploit economies of scale. Bongers (1982) gives a striking example of this in the context of concrete posts. That reduction in variety may in some circumstances lead to a reduction in trade.

On the other hand, the reduction in variety may also lead to a reduction in transaction costs. A good example of that is given by Raballand and Aldaz-Carroll (2005). They note that the *multiplicity* of different standards in pallet sizes increases the transaction costs of would-be exporters. When there is such a multiplicity, the exporter must unload the traded items from one

⁸ Other studies on standards and innovation include Egyedi and Sherif (2010), ISO (2006), Jakobs (2006a, 2006c), Jakobs et al (1998b), Jakobs and Williams (1999), Krechmer (1999).

⁹ Sub-Section 2.4 draws on Swann (2009a), but with some additional material.

size of pallet onto another which is compatible with the destination country standard. Raballand and Aldaz-Carroll show that traders must therefore carry a stock of pallets of different sizes, and that poses a particular problem for the least developed countries (LDCs), when there is neither a rental market, nor an exchange market for pallets. Moreover, exports from the LDCs tend to have a low value per tonne or per unit volume, which means that LDC exporters are more sensitive to the cost of pallets.

An interesting counterpoint to this is the standardization of container sizes, which has dramatically reduced transaction costs and the shipper's transport costs, and has radically changed the worldwide transport infrastructure (Butter *et al*, 2007). In the container case, moreover, network externalities play a major role in the use of standards.¹⁰

Standards, the Division of Labour and Outsourcing

A commonplace in economic theory is that if standards can reduce transaction costs, then they will support the division of labour and the outsourcing (and in some cases, *off-shoring*) of various activities. Steinmueller (2005) discusses the role of standards in co-ordinating the division of labour in industries that produce complex systems (such as civil engineering projects). Grimaldi and Torrisi (2001) describe the same process at work in the software industry. They also describe the relationship between standards and codified knowledge – a theme that will recur below.

Butter (2007) shows that the fragmentation of production into ever more complex supply chains is one of the key features of globalisation, and the steady reduction of transaction costs is an important element in that. Butter and Pattipeilohy (2007) estimate a production function for the Netherlands covering the period 1972-2001, and find that off-shoring has a clearly positive effect on total factor productivity (TFP) – indeed this effect is larger than the effect of R&D on productivity.¹¹

Standards, Codified Knowledge and Institutions

Several of the econometric papers described above suggested that standards can play an important role as the carrier of codified knowledge. Cowan *et al* (2000) pay particular attention to the role of standards in the codification of knowledge. Bénézéch *et al* (2001) look at similar issues, but this time in the specific context of the ISO 9000 registration process. The ISO 9000 standards provide a common language, which can be used within firms to help their process of knowledge codification. Bénézéch *et al* break the standards implementation process into three steps: (1) the starting point of the implementation; (2) the substance and behavioural characteristics of the production process; and (3) the impact of ISO 9000 implementation on the firm's capacity to accumulate knowledge. When standards are not consistent and implementation is incomplete, knowledge about products and production does not travel easily. Velkar's (2007) case study of wire standards in the nineteenth-century British iron and steel industry shows how inconsistent standards inhibited the transport and communication of facts about wire products.¹²

¹⁰ See also Egyedi (2000, 2001) and Koehorst *et al* (1999).

¹¹ See also Hudson and Jones (1997) on how standards reduce search costs.

¹² See also de Vries and van Delden (2006) on standards and knowledge management.

Institutions and Trade

A popular theme in recent trade studies has been the role of institutions in breaking down barriers to trade. In Section 2.2, we referred to the work of Kim and Reinert (2009) who found that two aspects of institutional capacity (informational capacity and conformity capacity) have strong and significant effects on developing country exports, and that developing countries cope better with stringent standards in food products when they have stronger institutional capacity. They measured a country's conformity capacity by the extent of diffusion in certification to the ISO 9000 standards.

Two other recent studies have also examined the role of institutions in promoting trade. Berkowitz *et al* (2006) show how good institutions in the exporter country enhance international trade. They argue, from a theoretical point of view, that this is of special relevance in the case of trade in complex products, where it is hard to write a complete contract covering all relevant characteristics of the product. They find strong empirical evidence for their arguments: countries with good institutions (by their measures) tend to export more complex products and import more simple products. Islam and Reshef (2006) also show that good institutional quality can help to promote international trade by reducing transaction costs. Using a gravity model of bilateral trade, they find that the trade-promoting effects of good institutions outweigh any trade-reducing effects that arise from differences in legal systems.

Standards, Network Effects and Innovation

It is well known that in industries such as the information and communication technologies, standards play an essential role in ensuring compatibility. Such standards can serve to increase network effects and that in turn supports innovation. Swann (1990) provides a striking example of this in the context of the PC software industry. Following the emergence of Lotus 1-2-3 as the industry standard spreadsheet software package during the MS-DOS era (i.e. up to early 1990s), and the decision by Lotus to open up some of its code to third party software developers, there was a rapid growth in innovative add-ons for 1-2-3, produced by third party software houses which took advantage of the large network of 1-2-3 users. Langlois and Robertson (1992) find a similar phenomenon in personal computers and stereo systems.¹³

Measurement and Innovation

In addition, those standards that support accurate measurement can also support innovation. Swann (1999) conjectured that the innovator's incentives to produce products with particular characteristics hinged on the ability of the innovator and the customer to measure (and verify) those characteristics. King *et al* (2006) tested this hypothesis using data from the Community Innovation survey and data on the use of the National Measurement System (NMS) by different industrial sectors. They found that NMS activity has a clear positive and statistically significant

¹³ Open standards are essential to enjoy the full effects of network effects. On this see Krechmer (2005b, 2006a, 2007a). The tension between IPR and standards was discussed at length in our original 2000 report, but other contributions to that literature include Blind and Thumm (2004) and Iversen (2000, 2001). The topic of standards battles was also discussed at length in our original 2000 report, but other contributions to that literature include Ballon and Hawkins (2009), Hawkins and Ballon (2007), de Vries (2001), de Vries and Hendrikse (2001) and de Vries *et al* (2008).

influence on product innovation, but the effects on process innovation are less clear. This is discussed further in Swann (2009b).

Standards, Quality and Compliance Costs

Jones and Hudson (1996) and Hudson and Jones (2001, 2003a) provided important explanations for some of the econometric results in Section 2.2 – especially those that find the effects of national standards on trade exceed the effects of international standards. They show how standards can serve as an important quality signal in trade and thus help to promote the competitiveness of those that meet stringent standards. Leland (1979) showed that stringent standards can help to overcome the ‘lemons’ problem, where incomplete and asymmetric information on the quality of products leads to a market failure and a reduction in average product quality.

That is the good side of having stringent standards. The bad side is that they can raise barriers to entry by increasing compliance costs. The World Bank TBT Survey, discussed in Section 3 has already shed some light on this, and the econometric study by Maskus et al (2005) estimates the costs of complying with standards. Such compliance costs will influence whether some exporters find it profitable to start trading or whether instead they find the barriers to trade are too great. The Maskus *et al* study uses firm-level data from 16 developing countries in the World Bank Technical Barriers to Trade (TBT) Survey Database. They find that standards do increase short-run production costs, and that a 10 percent increase in investment required to meet compliance costs will raise the variable costs of production costs by around 1 percent. They also find that the fixed costs of compliance are by no means trivial.¹⁴

Trust and Trade

Standards are a mark of trust. Hudson and Jones (2003b) use data from the NOP National Random Omnibus Survey of September 1995 which asked a sample of about 1000 adults in the UK: “How would you reassure yourself that the household products you buy are safe enough for your purposes?” Consumers were allowed to cite one or more reassuring factors, and the four most important were: producer’s name (30%), self-assessment (26%), the Kite Mark ® symbol of quality (24%) and the fact that a product conforms with a British Standard (18%). Conformity with other standards was only mentioned by a small proportion of the sample, leading and Jones and Hudson to conclude that UK citizens tended (at that time) to put more weight on UK standards than international standards.

The Kitemark® symbol is perhaps the oldest and best known symbol of trust, integrity and quality. Kitemark® schemes have been running since 1902 and cover a wide variety of products and services, including electrical contractors, double glazed windows, printed circuit boards and cattle tags. Recent research for Kitemark® (2006) found that about 82 percent of customers recognise the Kitemark® symbol, and of these, 93 percent believe the product is safer as a result of carrying this symbol, and 88 percent consider it is a sign of trust and integrity.

¹⁴ See also den Butter and Hudson (2008) and Hudson and Hudson (2008).

Butter and Mosch (2003) have studied the hypothesis that trust helps to reduce transaction costs and therefore supports trade. They estimate a gravity model of bilateral trade for 25 countries and find that different measures of trust (taken from the Eurobarometer Survey) have a positive role to play in promoting trade. They find, moreover, that the causal relationship runs primarily from trust to trade.

Measurement

The report for NMO, *The Economics of Metrology and Measurement* (Swann, 2009b), describes the economic effects of measurement and some of the literature on that theme. Amongst many interesting linkages, three themes stand out as especially relevant here.

First, the use of measurement can increase the productivity of organisations. This was first seen in the eighteenth and nineteenth centuries with the development of interchangeable parts; this became an important aspect of the so-called *American System* of manufacturing. The use of precise measurement revolutionised interchangeable manufacture because it enabled an effective and efficient division of labour. Later, measurement became one of the integral parts of process control and continues to be integral to advanced manufacturing. The more precise is the measurement and the more rapid is the feedback from measurement to control, the greater are the effects on efficiency, quality and productivity.

Second, measurement supports innovation. It can do this in a variety of ways. Swann (2009b) describes the example of how the Wright brothers used measurement as part of their research into the aerodynamics of aircraft wings and, building on that, as part of their development effort to build the first viable aeroplane. Swann also cites more modern examples of how publicly funded metrology activities have helped to support innovation by Rolls Royce and Boeing. These examples all illustrate a *virtuous circle* in which measurement supports R&D and innovation. Measurement is also important to the innovator as it offers an objective way to demonstrate to customers that an innovative product is indeed superior to the competition. In the absence of any such measurements, the sceptical customer may be unconvinced, but if the superior product characteristics can be measured in an objective (and independently verifiable) way, then this supports the marketing effort of the innovative producer.

Third, improvements in measurement can help to reduce the transaction costs between suppliers and customers in a market economy. One of the most common sources of market failure is asymmetric information between buyers and sellers, where the buyer cannot distinguish good products from bad and therefore does not buy. Often this arises because measurement is difficult or expensive. As measurement improves and becomes cheaper, then buyers can measure any product characteristics they wish to, and that eliminates the asymmetric information and reduces the transaction costs.

2.5 Other Studies of Note

Several other recent studies are worthy of mention here. They add insights and value in different directions from those covered in Sections 2.1-2.4. We simply note these here in the form of an

annotated bibliography.¹⁵

Temple and Williams (2002) examine standards from a broad historical perspective, as a “public good”, and also as an instrument of marketing policy in the life cycle of products. They examine issues behind the provision of standards by the market only and/or by intervention of public authorities. They analyze the relationship between the product life cycle and the development of standards. They conclude that standards are beneficial to the overall structure of industrialized economies and explain how diverse stakeholders – including industry, governments and citizens/consumers - implicitly rely on and gain from standards.

A major study by ISO (2010) tried to move beyond the macroeconomic and ‘black box’ studies described above, and to set out a methodology to assess and communicate the economic benefits of consensus-based standards. The methodology has three objectives (ISO, 2010):

- “to provide a set of methods that measure the impact of standards on organizational value creation with an emphasis on business organizations”;
- “to provide decision-makers with clear and manageable criteria to assess the value associated with using standards”;
- “to provide guidance on developing studies to assess the benefits of standards within a particular industry sector.”

The first application of this ISO Methodology was to examine the benefits of standards in the global automotive industry. Most of the companies included in the study confirmed the importance of standards and their impact on sales and costs. It is argued that standards have particular relevance in this industry because of its complex products and value chain, and the complex international division of labour. The estimates of economic benefits of standards vary, but for the engineering, manufacturing and procurement functions most, it is estimated that standards increase total sales revenue by something between 0.5% and 2.5%.

A study by NIST (2007) examined 55 case studies where NIST played an active role in the development or implementation of documentary standards that have been broadly adopted and/or have produced or are expected to produce significant economic or societal benefits. This study reports on the results of this survey. The impact and benefits were assessed primarily from interviews with the participants.

Impacts were divided into two primary categories: economic impacts and social impacts. The former (economic) were considered to be the main impact in two thirds of cases, and included:

- (i) market creation or increased market access leading to increased revenues;

¹⁵ It is not practical to provide an exhaustive survey here, but readers should also keep an eye on the ISO/IEC Inventory of Studies on The Economic and Social Benefits of Standardization (ISO/IEC, n.d.), the papers presented at EURAS conferences (EURAS, n.d.), and the papers presented at SIIT Conferences (e.g. SIIT, 2009). The special issue of *ISO Focus* (2007) on ‘Economic and Societal Benefits of Standardization’ also gives an interesting overview.

- (ii) providing for interoperability or compatibility between products as part of a system or network or between different parts of a product which lowers the cost of designing and producing the products;
- (iii) improved quality or reliability which improves functionality and increases consumer satisfaction and perception of the product and results in fewer recalls;
- (iv) providing information (producer/user/public) to overcome market failures.

The latter (social) were considered to be the main impact in a third of cases, and included:

- (v) improved public and individual safety;
- (vi) health benefits;
- (vii) environmental benefits; and
- (viii) improved voter confidence through voting systems standards.

The RRAC (2009) study of *Standards Setters and Public Risk* examines how standards setters may directly or indirectly affect decisions on the acceptability of public risk. The report takes a broad interpretation of ‘standards setters’ to include obvious agencies such as CEN and BSI, but also other agencies which disseminate formal advice on how risk should be managed – such as the HSE and FSA, as well as some voluntary organisations. The study identifies (at least) eleven mechanisms which impinge upon risk decision making in the public arena. The publication of advice by standards-setters has two kinds of effect: first, a direct effect upon how public bodies manage risk; and second, an indirect effect via the courts and insurers, who also take careful note of this advice and use it as guidance for their own purposes. The study argues that the important role which standards setters play in the management of public risk could be enhanced. It suggests that it would be timely to issue new guidance on how public risk should be assessed. The emphasis is very much upon risk minimisation to the exclusion of all else, and there is little or no explicit reference to any need to weigh the benefits of public activities in risk decisions.¹⁶

The OFT (2008) study of *The Competition Impact of Environmental Product Standards* recognises that environmental policy and regulations are becoming ever more important, for obvious reasons, but that such regulations may have an adverse effect on competition. The OFT study concludes that, in some circumstances, product standards pose no significant competition risks. However, OFT considers that there are particular combinations of standards, market conditions and implementation measures that do give rise to competition concerns. In particular, OFT is interested in those cases where the outcomes for consumers (in terms of price, quality, choice and innovation) because the implementation of a product standard leads to a change in the nature or intensity of competition in a market. OFT argues that such concerns are most likely to occur in markets that are characterised by imperfect competition – small numbers of firms or a few large firms facing a fringe of smaller firms, differentiated products and some degree of entry barriers. But OFT considers that such concerns are also likely to arise if (i) the product standard has an asymmetric effect on firms operating in the market, and/or (ii) the product standard gives rise to strategic behaviour on the part of firms.

¹⁶ This seems exceptionally topical in view of the eruption of the Eyjafjallajökull volcano in Iceland in April 2010, and the six day closure of UK airspace because of fears that volcanic ash could damage aircraft engines, with possibly disastrous consequences.

Finally, the BSI (n.d.) report on *Standards and Lighter Touch Regulation* notes that both the *Hampton Report* and the *Better Regulation Task Force* have strongly recommended the greater use of standards to assist in developing better regulation. The view has been endorsed by other key stakeholders who recognize ways in which standards can help regulators to conduct their work more efficiently and effectively. So long as standards are produced by consensus and supported by a wide cross-section of society, including consumer representatives, industry and regulators, they can provide reassurance to all stakeholders and help to get markets working more transparently. But standards are not a ‘soft option’ and can be demanding: that means they provide a valuable stimulus to businesses to do things better, more safely, more reliably and more cost effectively while still offering a lighter touch approach to regulation.¹⁷

¹⁷ Other interesting areas of work on standards lie down the boundaries between political economy, law and government – see for example, Graz (2006, 2010) and Graz and Niang (2009).

3. Simple Model of the Economic Benefits of Standardization

We said in the previous section that most of the macroeconomic studies of standards treated the relationship between standards, on the one hand, and productivity, growth, trade and innovation, on the other, as something of a ‘black box’. The model developed in this section is a simple representation of some of the linkages we find inside the ‘black box’.

Before we start to describe this simple model, it is worth stressing that the main effects we are studying here are ‘economic’ in a relatively narrow sense. In terms of Figure 1, therefore, we are looking at the effects of standards as they help (or hinder) the linkages from creativity to innovation, the workplace, the marketplace and consumption. This is marked as a simple one-directional chain in the upper half of Figure 1. In reality, of course, the linkages from creativity to wealth and well-being are not so simple. But the main point here is that we are giving much less attention here to the implications of standards for other social purposes. In terms of Figure 1, we shall say relatively little here about the linkages in the lower half of the diagram. That does not imply that the latter are unimportant – far from it. It simply reflects that many other issues are involved here beyond the narrowly ‘economic’.

Most of the economic linkages here have also been discussed in Section 2 above, or in the earlier report (Swann, 2000). We shall not attempt to repeat the explanation of these effects, or to repeat *all* the references to relevant publications that describe these effects. We shall however insert a few cross-references in Section 3.2 to help the reader.

3.1 Inside the Black Box: A Simple Map

Figure 2 below shows an (incomplete) representation of what is to be found inside the ‘black box’. We say ‘incomplete’, because there are other linkages that are not made explicit here; the diagram quickly becomes unmanageable if we try to include everything. But those shown in Figure 2 are probably some of the most important. The map in Figure 2 distils many of the ideas in 2000 version of this report, and in the subsequent literature described in Section 2 above.

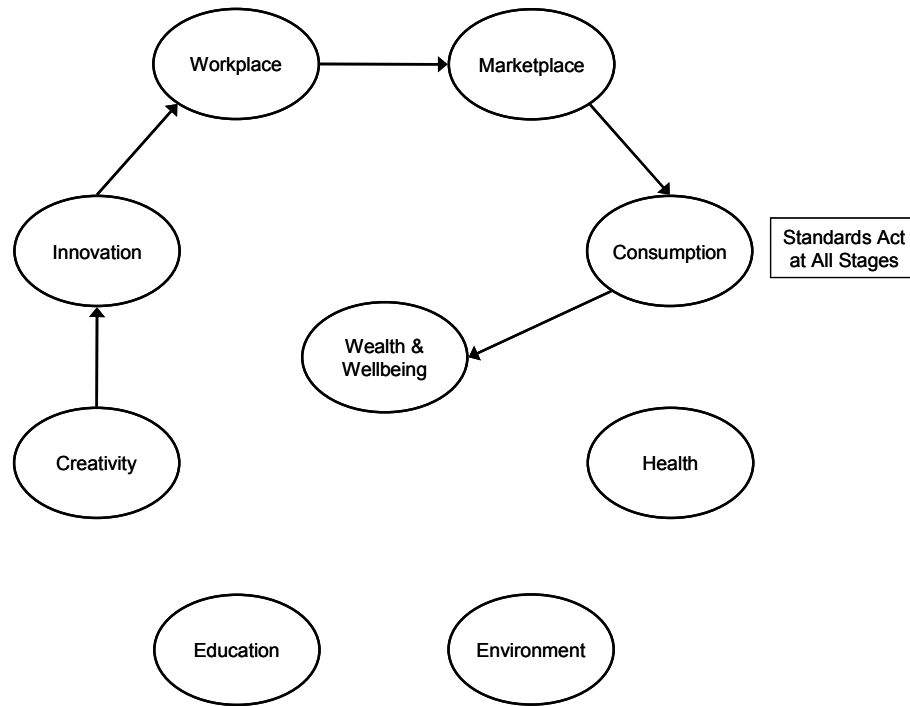
The map is in three parts. The left hand side distinguishes eight aspects or purposes of standards. The middle of the map identifies eight intermediate effects of standards. These are some of the effects which are of interest to professional economists but perhaps of less immediate concern to policy makers. The right hand side of the map identifies the ultimate effects of standards on variables of immediate policy concern.

Let us take each part in turn. The eight aspects or purposes of standards identified on the left hand side of the map include the common four-way classification of standards into:

- Variety reduction
- Quality and performance
- Measurement standards
- Compatibility and interoperability

Figure 1
Location of Effects of Standards

A Narrow 'Economic' View of Standards



Some Components of a Broader Social View of Standards

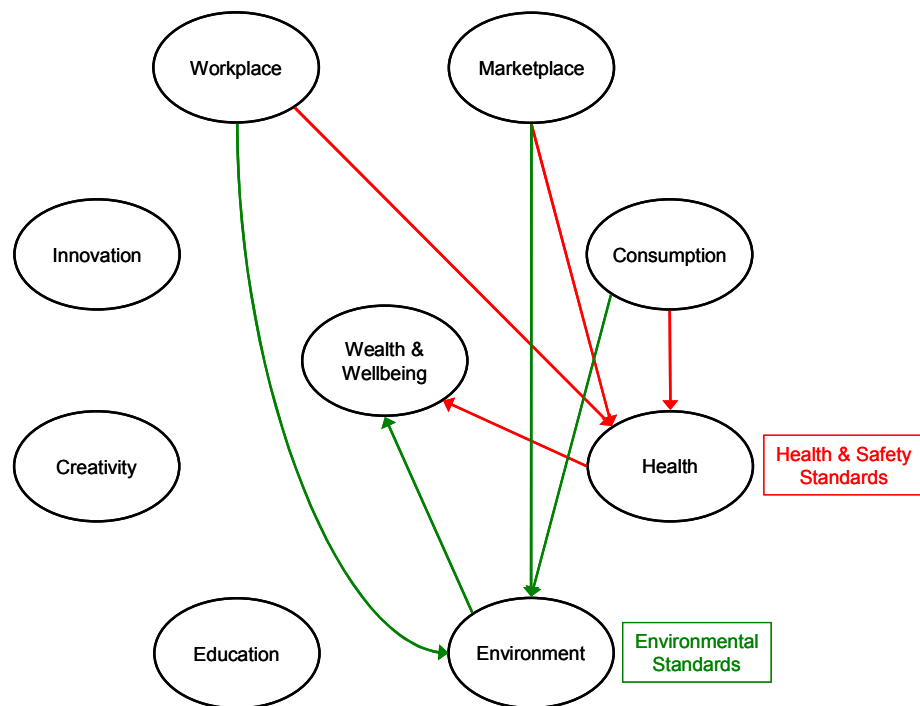
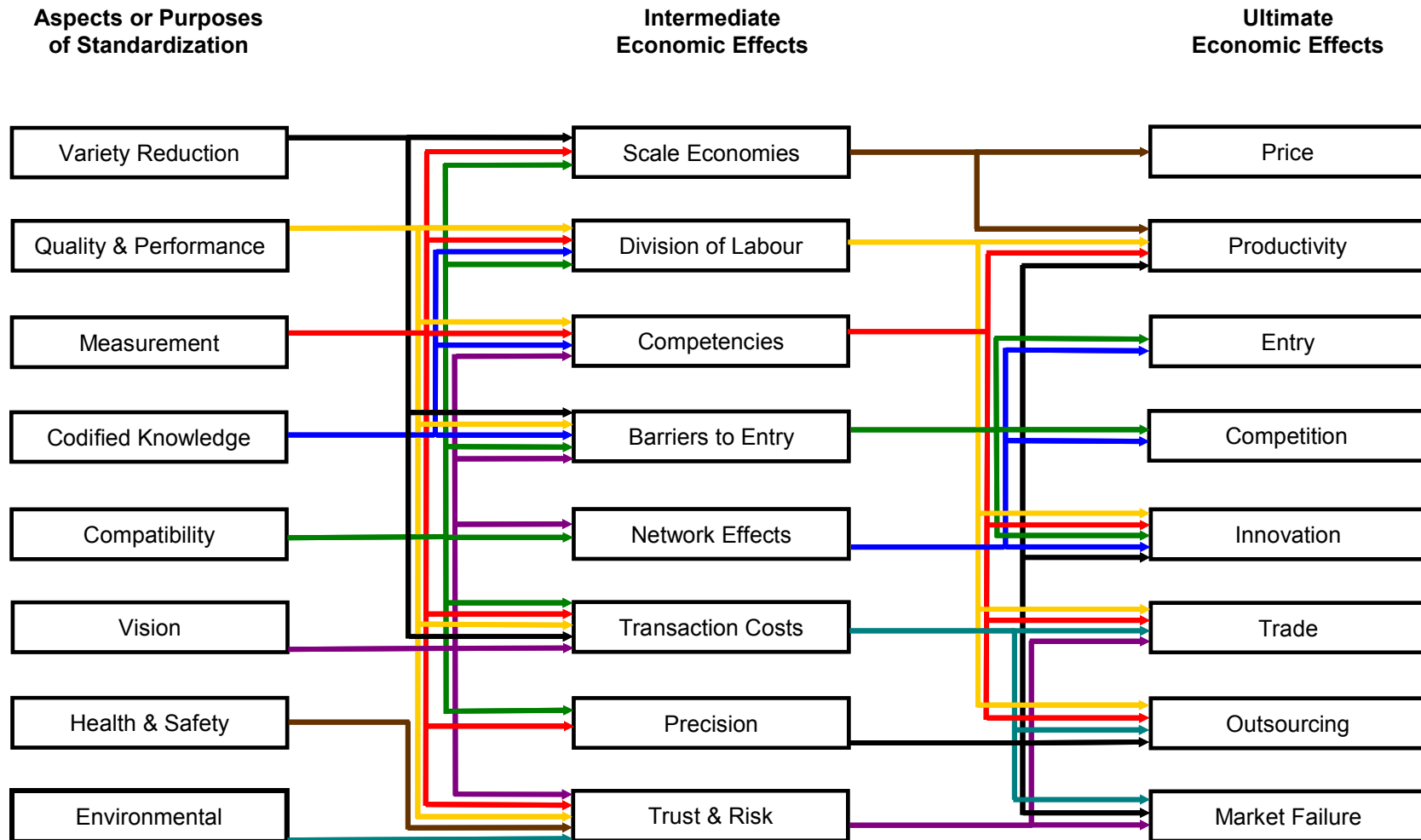


Figure 2
Model of Economic Effects of Standardization



But the list goes further and recognises two further categories:

- Health and Safety
- Environmental

and also recognises that standards serve (at least) two other functions:

- Codified knowledge
- Vision.

That is, standards serve as an important instrument in the dissemination of knowledge, and in new industries (e.g. nanotechnology) standards serve as a sort of public ‘vision statement’ about the likely future and development of the industry. The inclusion of these four last items is an important advance on the state of the field in 2000, where the original four-way classification was the norm.¹⁸

The middle of the map identifies eight intermediate effects of standards. These are the effects of standards on:

- Economies of scale
- Division of labour
- Competencies
- Barriers to entry
- Network effects
- Transaction costs
- Precision
- Trust and risk.

All of these phenomena are of interest and importance to professional economists because of the subsequent effects they all have on the workings of a market economy, but are perhaps of less immediate concern to policy makers.

The right hand side of the map shows the ultimate effects of standards on variables of prime policy interest – via the effects on intermediate variables. These policy variables include:

- Prices
- Productivity
- Entry
- Competition
- Innovation
- Trade
- Outsourcing

¹⁸ The work of Baskin, Krechmer and Sherif (1998) was a farsighted exception, which used a six-way classification. See also Krechmer (2006b). The report by NIST (2007), listed in Section 2.5, also mentions most of these eight purposes and aspects.

- Market failure

The left hand side of the map shows several linkages from each of the aspects or purposes of standardization to the various intermediate economic variables, while the right hand side of the map shows several linkages from each of the intermediate economic variables to the economic variables of policy interest. There are, of course, further linkages between this last group of variables: for example, entry and competition should reduce prices. These have not been drawn in here as they are not directly related to our prime concern here: the effects of standards on economic variables of policy interest.

We shall offer an explanation of these various linkages in the next sub-section. But it is worth dwelling on the implications of this map for the ‘black box’ studies described above. The simple measures of standards stocks used in the various studies surveyed above do not (and indeed *cannot*) distinguish between the eight starting points identified here. This sort of ‘count’ variable is very much a ‘mixed bag’,¹⁹ and will presumably contain a mix of standards that follow quite different routes through Figure 2. The size of the net effect of standards on growth, productivity, trade and innovation identified in the ‘black box’ econometric studies will depend on two things: first, the magnitude of each of the linkages drawn in Figure 2; and second, the relative amount of “traffic” along each linkage. From this, it is readily apparent that according to the mix of types of standards counted in any particular stock, we can expect to obtain a different average result. Moreover, while the majority of effects in Figure 2 are positive, some of those effects are negative. When we look at the results in Section 2 (macroeconomic econometric studies) from this perspective, it is not surprising to find some diversity in the results.

3.2 An Explanation of the Linkages in the Map

Here follows a very brief explanation of the linkages described in Figure 2. We start with the linkages on the left hand side of the map.

Variety reduction may not be an explicit objective of a particular standard but there is little doubt that standards can serve to reduce variety.²⁰ This is usually done with reference to a trade off between the desire for variety (or diversity in demand) and the potential advantages in terms of scale economies, stockholding and so on, that arise if variety is limited. Clearly any standard that reduces variety is likely to lead to benefits in the form of scale economies. But the benefits are not limited to that.

Variety reduction can also have implications for barriers to entry and for transaction costs, but these effects could cut either way. As is well known, variety proliferation is sometimes used by incumbents in an attempt to limit competition from small scale entrants who cannot match the same degree of variety.²¹ To the extent that variety reduction standards limit such strategies, then they may serve to reduce some barriers to entry. On the other hand, variety reduction standards can be captured by some incumbents to restrict entry by companies with an idiosyncratic product

¹⁹ Swann (1994) describes some of the problems about using ‘mixed bag’ data for econometric analysis.

²⁰ See Bongers (1982), David (1987) and other references cited on pp. 12-13 of this report.

²¹ See Scherer (1979) and Schmalensee (1978).

specification. Equally, variety reduction standards can reduce transaction costs if choice becomes easier in the absence of what seems to the buyer an unmanageable variety of choice. But in some areas (e.g. clothes sizes and shoe sizes), variety reduction standards deny those of unusual shape or dimensions an 'off the peg' product and increase the transaction costs of these customers.

Setting standards for quality and performance, in contrast, will usually be an explicit objective of some standards. Such standards have a number of beneficial effects on our intermediate variables. Such standards reduce transaction costs because, when they work properly and when certification is credible, these standards make it easier for the buyer to buy in confidence that their purchases will meet their needs. This can also serve to increase trust between trading partners and reduce the risk born by the buyers, and that in turn makes it easier to achieve an efficient division of labour. Moreover, to the extent that quality and performance standards don't just state a target level of quality and performance, but also give some direction on how to achieve that target level, these standards may help to disseminate best practice and build competencies.²²

On the other hand, the effect of such standards on barriers to entry is uncertain. There is a general presumption that when product characteristics are written down in an open standard, that levels the playing field between incumbent and entrant. In the absence of that, incumbents have an informational advantage over entrants, but standards can in principle even that out. On the other hand, quality standards can be captured by entrants and set at an unnecessarily high level in order to deter entrants. (Even if unnecessarily high standards impose a cost burden on incumbents, the strategy makes sense if the cost burden on entrants is greater still.)

Measurement standards (and the ability to measure to those standards) have multiple effects within Figure 2.²³ Measurement standards can enable advances in process control which help to develop economies of scale. Measurement standards (and the ability to measure to those standards) enable precision manufacture, and help those traders who produce superior products and services to demonstrate the superiority of these. Equally, measurement standards help to reduce transaction costs, reduce the risk born by traders and help to enhance trust between traders. This in turn helps to enable an effective division of labour. Another possibility (though this may be less relevant in some cases) is that the existence of measurement standards will help to build competencies – on the general principle, that if you can't measure to a well-understood standard, then you can't manage.

There is no doubt that standards, containing - as they do - a lot of codified knowledge,²⁴ act as important instruments in the dissemination of best practice. They can be seen as essential instruments of technology transfer. The special issue of *Wissenschaftsmanagement* (2007) argues as follows:²⁵

²² See references cited on p. 13 of this report.

²³ Swann (2009b) discusses these various effects in detail, and gives many references for individual effects.

²⁴ See references cited on p. 13 of this report.

²⁵ See also Temple and Williams (2002)

“Standards are codified knowledge. They express the work and experience of generations. They define how technologies, interfaces and products must be made in order to work properly and fit together. Whereas many companies play an active role in designing standards and in this way improve their market opportunities, scientists are not adequately represented on standards committees. Yet early involvement by researchers in the standardization process is crucial if new technologies are to succeed in the market.”

This role of standards as carriers of codified knowledge has a number of effects in Figure 2.

Use of standards can clearly help to build competencies – that seems clear enough.²⁶ Moreover, the fact that essential production knowledge is codified in open standards helps to level the playing field between incumbent and entrant. In the absence of that, incumbents have an informational advantage over entrants. As a result, this property of standards can help to reduce barriers to entry. Moreover, the fact that standards codify essential production knowledge can help to reduce transaction costs between companies and their sub-contractors. This in turn makes it easier to write job descriptions, and hence to achieve a workable division of labour.

The effects of compatibility standards are also seen throughout Figure 2. Most obviously, network effects depend on the existence of compatibility standards. Even if the compatibility standard achieved is a ‘lowest common denominator’ standard (such as those used to ensure the work of the WWW),²⁷ networks cannot function in the absence of compatibility and interoperability. Compatibility standards help to reduce transaction costs in an obvious way: if we know that a particular piece of software is compatible with a particular operating system, then we can buy with confidence that our software will work as expected. In the absence of that, the burden on the ordinary user to verify that a piece of software will run as expected would be a large one.

These reductions in transaction costs also facilitate the division of labour.²⁸ This is most obviously visible in the computer industry, where any computer will contain components from all over the world. Indeed the emergence of internationally accepted compatibility standards in that industry has led to the complete globalisation of that industry, where producers specialise in a small part of the value chain to achieve economies of scale, and sell their product around the globe.

The effects of compatibility standards on barriers to entry can cut both ways. The positive advantage of a generally accepted compatibility standard is that it reduces the barriers to entry for small scale entrants producing ‘add on’ products to work alongside a well-established standard. Again the computer and electronics industries offer many examples: the most recent is the growth of the cottage industry producing ‘Apps’ for the Apple iPhone. Many of these are micro-companies who could barely enter the software market at all in the absence of a well-established platform with generally accepted compatibility standards. On the other hand, if compatibility

²⁶ See references cited on p. 13 of this report, and also de Vries and van Delden (2006).

²⁷ Meeks and Swann (2009) compare the WWW standards with some other standards for business transactions (e.g. accounting standards). Holler and Nguyen (2007) also analyse standards for auditing of accounts.

²⁸ See references cited on p. 13 of this report.

standards are not *open*, then they can act as a barrier to entry, because the owner of the standard enjoys an advantage over entrants in supplying supporting products and services. This can lead to problems of monopoly around proprietary standards (see Windrum, 2004).²⁹

Standards that articulate a commonly understood vision of the future of a technology or an industry can have several effects in Figure 2. At the most obvious level, such visions play an important role in strategic planning and competence-building. Such visions also help to reduce the risk faced by market entrants, and that can help to reduce barriers to entry. Moreover, such visions can help to reduce transaction costs between traders when these traders share a common vision and understanding of where the technology is heading. That in turn may translate into a greater facility in developing network effects – as communication between network participants is reduced.

The final linkages on the left hand side of Figure 2 relate to the effects of Health & Safety and Environmental standards. As noted above in discussion of Figure 1, several effects of these are felt outside Figure 1. But within Figure 1, both of these standards can help to reduce the risk felt on the part of buyers and help to increase trust between traders. However, such standards can act as barriers to entry if captured by incumbents and set at an unnecessarily high level. This is clearly relevant in the context of some SPS³⁰ standards relating to trade in food and agricultural products.

For completeness, here follows a brief explanation of the linkages on the right hand side of Figure 2. These are mostly fairly obvious.³¹

Scale economics can be expected to have some obvious effects on labour productivity and (in the right competitive conditions) on prices. Equally, from the work of Adam Smith onwards, the division of labour has been recognised as a source of productivity growth and innovation – mostly incremental innovation. Growing competencies and greater precision in production processes would also be expected to increase to increased productivity and innovation.

The division of labour is also associated with outsourcing and a growth in trade – especially intra-industry trade. Declining transaction costs, greater precision and increased trust between traders are also associated with outsourcing and a growth in trade, and also with a reduced incidence of market failure.

Finally, declining barriers to entry and stronger network effects will generally have beneficial effects on new firm entry into markets, on competition and on innovation.

Conclusion

In conclusion, we could summarise the effects of standardisation in Figure 2 as follows. Standardisation is part of the knowledge infrastructure, and as such, provides codified information for all. Investments in this infrastructure make such information available to all, as

²⁹ See also references on p. 14 of this report.

³⁰ ‘Sanitary and Phyto-Sanitary’ standards.

³¹ Hesser et al (2007) and de Vries (2006b) look directly at the effects of standardization on company performance.

cheaply as possible, and the beneficial effects of this flow from the use of this information by experts in each market. As such, investments in standardisation (like any investments in knowledge infrastructure) look very attractive in a world where governments have imperfect information: the value of investments in standardisation does not depend on exceptionally well-informed decision-making by government, but on informed use by ‘local’ experts.

4) Economic Rationale for Government Policy

In this section, we explore some of the possible roles for government activity in the simple model summarised in Figure 2. This is in stages: we summarise the market failure rationale in sub-section 4.1, and the system failure rationale in sub-section 4.2. These arguments will be very familiar to some readers of this report, but this section is included here for the sake of those less familiar with this area of economics.³²

Before we start, we should add that while market or system failures may be a necessary condition to justify a government intervention, it is not a *sufficient* condition. It is also necessary that government can find policy devices which will actually improve upon the market outcome and in a cost-effective way. It is not just markets and systems that can fail: there may equally be *government failure*. In a world of very poor information, where government has little or no prior knowledge about the full extent of market and system failure, some would argue that the best policy is no intervention, even if some failures can be clearly identified. Nevertheless, these possible problems in designing effective innovation policies have not deterred most governments.

4.1 Market Failure

This is the traditional rationale in neoclassical economics for industrial or innovation policy. It says that policy interventions may be justified when there is *market failure* (as defined below), but such interventions are not justified or necessary when there is no market failure. As such, it provides some quite strict economic criteria to test whether policy interventions are worthwhile.

The concept of *market failure* is the idea that while a perfectly competitive market could under some conditions deliver an *optimum* organisation of economic activities, some economic phenomena may cause the actual outcome in markets to deviate from this optimum. The extent of the market failure is defined by the distance between this optimum and the actual market outcome. Industrial or innovation policy takes this optimum as a benchmark or target, and tries to steer the market outcome back towards the optimum.

Market failure analysis tends to focus on the economic phenomena (such as incomplete information, externalities and increasing returns) that lead to the failure rather than the particular form or symptoms of that failure. As a result it may seem at first rather abstract as it sets no limits on where these phenomena may occur nor gives any particular clues as to where they are most likely to be found. In this way, market failure analysis is rather different from system failure analysis (see below) because the latter is far more explicit about the locations of likely failures. However economists have identified that some economic activities (such as basic research) are especially prone to incomplete information, externalities and increasing returns, and as a result we learn to be on the look out for possible market failure in those activities.

However, if none of these phenomena exist which would cause markets to fail, then there is no case for policy interventions. This sometimes confuses non-economists who use evidence about

³² Sub-Sections 4.1 and 4.2 are abbreviated extracts from Chapter 2 of my report for BIS on the *Economic Rationale for a National Design Policy*.

the profitability of an activity (X) as part of the case for public-funding on X. But within the basic market failure perspective, such evidence is strictly irrelevant *unless* there is market failure. For if X is profitable, but there is no market failure, then we can take it that businesses will invest in X as much as it is profitable to do, and government has no business to invest any more.

The main economic phenomena that lead to market failure are as follows.³³

(a) Economies of Scale and Scope

It may seem strange to describe economies of scale and scope as a ‘failure’. In many ways, they are a sign of economic success rather than failure because they allow consumers to buy products at lower prices. But it is not the scale and scope economies that are the ‘failure’, but rather the market which fails to manage these scale and scope economies.

The first reason for this market failure is as follows. When there are economies of scale and scope that arise (say) from fixed costs of production, then a company cannot break even if it sells products at marginal cost. The company has to set prices above marginal cost in order to recover its fixed costs. As a result, some consumers, at least, are priced out of the market. By that we mean that the consumers would have been willing to pay the marginal cost of production, but cannot find the good priced at marginal cost, so do not buy.

The second reason for market failure is that where there are economies of this sort, the large scale producer can always undercut a smaller scale producer. This means that there is always a threat of monopolisation in the market. Ultimately, a monopolist producer will have lower average costs than any smaller scale competitor because the monopolist operates on a grander scale. But while monopolists may have lower costs, they will not generally pass on these lower costs in the shape of lower prices. On the contrary, monopolists will often try, if they can, to raise prices above minimum average cost. So the monopolisation of the market is in itself a form of market failure.

When we have scale or scope economies and these cause market failure, the sensible solution is not of course to get rid of these economies. That would make no sense, because the scale and scope economies are in themselves quite desirable. Rather, the sensible solution is to recognise that we have a case of *natural monopoly*. It is sensible to allow the monopoly to emerge, but to regulate it so that it does not set excessively high prices, or (in some special cases) to place it in public ownership.

(b) Asymmetric Information

Asymmetric information can be a source of market failure in many settings, but here we shall focus on one well-known example, the second-hand car market. In this market, sellers are usually well informed about the quality of their cars, while buyers are less well informed. The

³³ The classic statement of market failure in the provision of R&D is by Arrow (1962). Dasgupta (1987, 1988) and Stoneman (1987) offer comprehensive statements of the market failure rationale for industrial policy. The remainder of this section draws heavily on Swann (2009c, Chapter 22).

buyer may know, roughly speaking, what is the probability that any particular car is a good and reliable one, but cannot know for sure which cars are good and which are bad.

Because of this asymmetric information, the buyer faces a risk that the seller does not. And this fact also creates a problem for the seller of a good car. Whereas the seller of a good car knows that his car is good, the buyer does not know that. Unless the seller can convincingly demonstrate that his car is good, there is no obvious reason why a buyer will be prepared to pay a price premium for that car. Indeed, if the buyer simply cannot distinguish good cars from bad, then it is probable that good and bad cars will both sell at the same price. That is bad news for the seller of the good car, who would wish and expect to sell his good car at a premium, but is unable to do so. In that case, the seller of good cars may decide to withdraw his car from the market, because he simply cannot achieve an acceptable price.

We find, therefore, a phenomenon called *Gresham's Law*: the presence of bad cars in the market and the inability to distinguish good from bad means that 'bad drives out good'. If sellers of good cars withdraw their cars from the market, then the average quality will decline, and so will the market price. That makes it even more unattractive for the owners of good cars to try and sell their car in this market, and so even more withdraw from the market. Ultimately, we experience a severe market failure.

There are solutions to this problem, of course. Reputable car sellers can build up a reputation for reliability, and may also offer guarantees to the buyer. There are also independent agencies that can be paid to provide an informed assessment of the condition and value of a second-hand car. In many markets, sellers use standards and certification to demonstrate that their products meet certain standards, and are therefore worthy of a price premium.

All of these mechanisms remove some of the information asymmetries, and hence reduce the risk to the buyer. They also help to ensure that price and quality are more closely connected, and that makes it possible for the seller to get a fair price for a high quality product. That in turn may help to correct the original market failure - in part at least.

(c) Externalities

Consider two people, A and B. If A carries out some action which has an effect on B, but B is neither compensated for nor charged for this, then we say that A's activity causes an externality to B. If A's action imposes some cost or inconvenience on B, the externality is negative. Or if A's action generates a benefit or advantage for B, the externality is positive.

In either case, externalities can cause market failure. When there are negative externalities, markets fail to deliver the right outcome because they make certain activities look privately profitable when they are in fact socially costly. In this case, the market fails because it permits some 'wrong' activities to take place when ideally they *should not* take place. And when there are positive externalities, markets make certain activities look privately unprofitable when they are in fact socially desirable. In this case, the market fails because it prevents some 'right' activities from taking place, when ideally they *should* take place.

Once again, as with economies of scale and scope, we should emphasise that the ‘failure’ applies to the market rather than the externalities themselves. Positive externalities are not a failure as such; indeed, they can be quite benign. The ‘failure’ is the fact that there is no market for the harm or good caused by the economic activity because relevant property rights are not established.

There are three generic approaches to adjusting for externalities. One option is for the public sector to run privately unprofitable (but socially desirable) activities. A second option is for the government to subsidise activities that create positive externalities, and tax activities that create negative externalities. This system of taxes and subsidies corrects for the externalities and removes the market failure. The third option is to provide mechanisms for property (or intellectual property) protection. The provider of positive externalities may be able to charge the beneficiaries from these externalities a royalty for the benefit received. At the same time, those that suffer from negative externalities may be able to demand compensation from the producer of these externalities.

(d) Co-ordination

Themes (a), (b) and (c) are the three traditional sources of market failure considered in the mainstream literature. However, contrary to what is sometimes suggested, the neoclassical theory of policy does not live in complete isolation from ideas emanating from the ‘systems of innovation’ literature and the evolutionary literature. There is one further phenomenon that now forms part of an extended neoclassical account of the sources of market failure.

The economic analysis of standards races has recognised that there is a theoretical possibility, at least, that a market failure will occur where users get locked-in to an old standard when it would be in their joint best interests to switch to a new and better standard.³⁴ This failure happens because the transition to a new standard calls for a coordination of decisions across many different users, but managing such coordination is beyond the powers of companies on their own and requires concerted government action. Some writers treat the costs of coordination as transaction costs, so that government’s role is to reduce transaction costs. Others would not treat these coordination costs as transaction costs exactly, but would still accept that government can in principle achieve such coordination when individual companies cannot.

It is worth noting that some business people find the market failure perspective hard to understand. They accept that the best businesses will (by and large) make the right decisions in the absence of the factors that cause market failure – at least to the extent that government could not do any better and would probably do worse. But they are concerned that many of the less good businesses will (by and large) not make the right decisions even in the absence of the factors that cause market failure, and that government spending money to disseminate best practice could help to improve the performance of these less good businesses. The implication is that we have *business failure* not *market failure*. As a result, some business people are more interested in governments “doing things that will help business”, rather than the neoclassical economist’s preoccupation with having to prove market failure before government can do anything.

³⁴ David (1985), Arthur (1989)

4.2 System Failure

The system failure approach to industrial policy or innovation policy, in particular, stems from work on national systems of innovation. The first work in this field was by Freeman (1987), and other pioneering contributions were by Lundvall (1992), Nelson (1993) and Edquist (1997). As Lundvall (2007) has recently argued, the concept of a national innovation system can be seen simply as a useful analytical concept. But some governments have also used it as a *development tool*. As a result, some of the innovation policy measures based on the ‘systems’ approach are very vigorous. We shall return to this later in this section.

The system failure approach to policy seeks to identify failures or weaknesses³⁵ in a particular innovation system, and correct these by policy interventions. As such the scope is wider than the market failure approach. Some adherents to the system failure approach to policy would say that this will displace the market failure approach because it is unambiguously better. While I would agree that the system failure approach has several important advantages, it cannot replace the market failure approach because the two have some fundamental differences. We could say that market failure is about *why* policy may be needed and *how much* (but doesn’t immediately help us with *what* and *where*), while system failure is about *what* policy is needed and *where* (but doesn’t give us so much help with *how much*).

First let us explore the differences,³⁶ and then let us see why neither can displace the other. The system failure analysis of industrial and innovation policy stems from a rather different model of the innovation process than that used in neoclassical economics. An extreme account of this difference would be as follows:

- the neoclassical economics of innovation is based on the crudest ‘linear’ model of innovation – meaning that the flow of value from research to invention to innovation to wealth creation moves in one direction and operates along a single channel.
- the ‘systems of innovation’ analysis of innovation is based on a much richer interactive model where there are many channels from invention to wealth creation and many feedback channels too, and moreover where a wide variety of institutions, actors and intermediaries play an essential role.

In reality, few neoclassical economists of today would use anything as crude as that basic ‘linear’ model, because some of the richer ideas from the ‘systems of innovation’ literature have diffused into the neoclassical tradition. Nevertheless, it is certainly true that models in the ‘systems of innovation’ are much richer and more interesting.

³⁵ Smith (2000) has argued that the word ‘weakness’ is really more suitable in this context, but the literature has ‘locked in’ to the term system failure, so we shall use that term in what follows.

³⁶ Navarro (2003) and Nelson (2009) compare and contrast those two approaches to thinking about industrial policy. In an interesting paper, Schröter (2009) argues that the system failure approach really adds rather little over and above the market failure approach.

Moreover, one of the attractions of the system failure approach to policy, in comparison to the market failure approach, is that the former can give explicit guidance on when and where the failures are likely to occur. In particular, this approach identifies several different types of failure and their explicit location in the innovation system. We shall define those below.

However, there is one important respect in which the systems approach cannot (in general) match the market failure approach. While the market failure approach can define an optimum to which policy is directed, the system failure approach cannot provide a clear account of the *optimum*. This stems in large part from the fact that in evolutionary economics approaches (such as the systems of innovation literature) welfare economics is much harder than in the relatively simple neoclassical models.³⁷ As a result it is generally very hard to define an optimum and may indeed be too hard to say with authority whether the results of policy actions actually generate an improvement. And if we cannot define an optimum then we cannot measure the extent of a system failure with precision. The best we can do is say that an outcome is unsatisfactory in some degree. This is the sense in which the term system failure should be interpreted. As we noted before, Smith (2000) was right, and the term ‘weakness’ would really be preferable to the term ‘failure’ in this context.

The literature on system failure identifies the following categories, amongst others. The literature is not completely uniform on these points, but the categories below are found in many of the sources on system failure.³⁸

(a) Infrastructural Failures³⁹

These concern failures in the physical infrastructure (such as road, rail, airports, telecommunications) and the science and technology infrastructure (universities, research labs, national assets). System failure may occur because of the characteristics of infrastructure: large-scale investment, long time horizons for payback on investments and indivisibilities, all of which make funding difficult. These reasons for system failure are very similar to the scale economy and externality arguments that underpin market failure - see Sections 2.1(a) and 2.1(c) respectively.

The items included in the categories ‘physical infrastructure’ and ‘technology infrastructure’ vary according to author, but in general the two categories are defined as follows:

- physical infrastructure: road, rail, airports, telecoms, high speed ICT infrastructure, broadband, energy supply, etc.
- science and technology infrastructure: universities, research labs, libraries, national assets, scientists (and designers), applied knowledge and skills, testing facilities, possibilities for knowledge transfer, patents, training, education.

³⁷ Schubert (2009) offers some interesting steps towards an evolutionary welfare economics.

³⁸ I have found the following syntheses of the system failure approach to policy of particular use here: Bergek *et al* (2007), Dobrinsky (2009), Foxon (2006), Hauknes and Nordgren (1999), Lundvall (2001), Lundvall and Borrás (1997, 2004), Navarro (2003), Schröter (2009), Woolthuis *et al* (2005), and the references therein. In what follows, I also give some specific references on particular mechanisms and arguments.

³⁹ Several of the main contributors to the development of this system failure approach to policy refer to these infrastructure failures, including Edquist (2001) and Smith (1992, 2000).

Both the neoclassical market failure approach and the system failure approach to innovation policy recognise that infrastructure is a public good, and it is unlikely that such a public good would receive sufficient support if it is purely privately financed.⁴⁰

(b) Institutional Failures⁴¹

It is common to distinguish two types of institutional failure: hard and soft.

Hard institutional failures

These are failures in formal institutions (such as legal systems) that constrain innovation activity. The term, ‘formal institutions’ is taken to mean those that are specifically and purposively created and designed. An example of such a hard institutional failure would be ineffective IP protection, or problems in contract enforcement. Some also include in this category those regulations that constrain innovation.

Soft institutional failures

These are the failures in informal institutions (such as political and social culture, and values). The term ‘soft institutions’, is taken to mean those that are *not* specifically and purposively created and designed, but are more spontaneous than the hard ones. These soft institutions are important to innovation as they help to foster a climate of co-operation, risk-bearing, openness to change and a supportive attitude towards entrepreneurship.

(c) Interaction Failures

The links, interactions and cooperative relations between different actors in the national Innovation System are a central element of that system. These interactions embrace relationships with other firms, customers, suppliers, government, universities, commercial research labs and so on. In the literature, interaction failures may mean *too little* interaction or *too much* interaction. Carlsson and Jacobson (1997) distinguish between *weak* and *strong* network failures.

Strong network failures

These are sometimes described as a ‘blindness’ to developments outside the firm’s immediate network. A group builds up strong and long-lasting relationships (strong ties) which may become *too strong*. That leads to inward looking behaviour and a closure of the network to what is happening outside the network. Various dysfunctional phenomena (*GroupThink*,⁴² over-embeddedness,⁴³ myopia) are considered to be symptoms of strong network failures. In practice,

⁴⁰ The work of Tasse (1982a, 1982b, 1992, 2005, 2008) in particular has helped us to understand why essential parts of the science and technology infrastructure would be subject to market failure. See also Smith (1997). Berg (1989a, 1989b) and Kindleberger (1983) argue that standards fulfil the characteristics of a public good.

⁴¹ Several of the main contributors to the development of this system failure approach to policy refer to these institutional failures, including Carlsson and Jacobsson (1997) and Smith (2000).

⁴² Janis (1972, 1982)

⁴³ Granovetter (1985)

excessively strong ties *within* the group are sometimes found together with excessively weak ties *outside* the group.⁴⁴ This is unfortunate as the weak ties could help to overcome over-embeddedness.

Weak network failures

These occur because the lack of relations between complementary technologies or actors,⁴⁵ or non-complementarity of actors.⁴⁶ To the extent that innovation depends on interaction and collaboration, non-complementarities lead to an under-exploitation of resources and a lack of learning. These poor linkages between actors get in the way of articulating a common technological vision, and hence get in the way of co-ordination. Some aspects of cluster policy can be seen as an attempt to correct weak network failures.

(d) Transition Failures

These occur when firms are unable to adapt to environmental changes, and as a consequence may get locked-in to existing technological paradigms.⁴⁷ Smith (2000) writes of the inability of firms to adapt to new technological developments. He points out that new technologies not only have to compete with components of an existing technology, but with the *overall system* in which it is embedded. These systems comprise a complex of scientific knowledge, engineering practice, process technologies, infrastructure, product characteristics, skills and procedures. It is exceptionally difficult to compete against all this.

Chaminade and Edquist (2006) group these transition failures together with the next category, capability and learning failures.

(e) Capability and Learning Failures

Several authors have argued that these are as a form of system failure – see notes below. Some critics, on the other hand, would argue that these are the unavoidable symptoms of bounded rationality and *not* the result of a system failure as such. This is debateable. Nonetheless, in the spirit of giving a full account of the systems failure perspective on economic policy, we have included these here.

Capability and learning failures are failures in competencies and resources (technological, organisational, etc.) which restrict the firm's ability to learn and be innovative. Most firms have finite and limited technological competencies which consist of their knowledge, capabilities and skills in their comfort zone.⁴⁸ And most firms lack competencies in even quite closely related fields. For this reason, major technological shifts or changes in demand can lead to adaptation

⁴⁴ Granovetter (1983)

⁴⁵ Carlsson and Jacobsson (1997)

⁴⁶ Malerba *et al* (1999) and Malerba (2009)

⁴⁷ Malerba *et al* (1999), Smith (2000)

⁴⁸ Smith (2000)

problems, and the lack of capabilities soon turns into an inability to learn, which in turn leads to lock-in.⁴⁹

(f) The Use of the ‘Systems’ Approach as a Development Tool

As noted above, Lundvall (2007) recently argued that the concept of a national innovation system is not just a useful analytical concept; some governments have also used it as a powerful *development tool*. As a result, some of the innovation policy measures based on the ‘systems’ approach are very vigorous. Perhaps the most notable examples are the ambitious approaches to technology (and design) policy adopted by several SE Asian governments to build a very powerful national innovation system.

Tassey (2009, p. iii) points out:

“In these economies,⁵⁰ government, industry, and a broad infrastructure (technical, education, economic, and information) are evolving into increasingly effective technology-based ecosystems. Should the U.S fail to follow suit, its manufacturing firms will continue to compete largely as independent entities against these national economies. That is a race we⁵¹ cannot win.”

If, rather than envisaging technological competition as a battle between firms, we take the step towards envisaging technological competition as a battle between different national innovation systems, then there may be an economic rationale for making the national investment in R&D (and related expenditures) dependent on the typical level of national investment in R&D found in other countries. But once again, we would stress the prospect of ‘government failure’ – as identified at the start of this section.

The use of the ‘systems’ approach as a development tool is consistent with Smith’s (1992) argument that policy making should take an adaptive approach, and one that promotes experiments. It is also consistent Dearborn’s dictum: “If you want to understand something, try to change it.”⁵² And indeed, Mytelka and Smith (2002) have shown how learning about policy and innovation theory have co-evolved as a result of such an adaptive approach.

Rodrik (2004) makes a similar point, though from a different tradition:

“the task of industrial policy is as much about eliciting information from the private sector on significant externalities and their remedies as it is about implementing appropriate policies. The right model for industrial policy is not that of an autonomous government applying Pigovian taxes or subsidies, but of strategic

⁴⁹ Malerba *et al* (1999), Malerba (2009) and Smith (2000). Lundvall (2001) has also written extensively about ‘learning failures’ and Tomer (1999) discusses a rationale for industrial policy based on developing the capabilities of the learning firm.

⁵⁰ Here, Tassey is referring primarily to several SE Asian economies, but also to some European economies.

⁵¹ Here, Tassey means the USA.

⁵² Quoted from Starbuck (n.d.). It is also consistent with the argument in Swann (2006, Chapter 12) that we learn far more from *real* experiments in the *real* economy than from the modern interpretation of ‘experimental economics’, where the experiments are lab-based and the participants act out *induced* (rather than actual) preferences.

collaboration between the private sector and the government with the aim of uncovering where the most significant obstacles to restructuring lie and what type of interventions are most likely to remove them.”⁵³

⁵³ This suggests that the form of any policy will evolve over time as different challenges are resolved.

5) Assessment of Current Activities and Future Options

Now we turn to the issue of identifying and assessing relevant policy options and initiatives. There are two broad approaches we could take to this. One of these is to explore all aspects of the simple model (Figure 2) and to speculate where market failure and system failure might be relevant. The second approach is to collect together (some of) those policy initiatives that have already been tried, and others that have been suggested, and to assess to what extent the market failure and system failure rationales support such initiatives.

For two reasons, we shall take the *second* approach here. First, the policy documents from BIS (2009), DIUS (2009), European Commission (2010a, 2010b), and a ‘brainstorming session’ held at BIS on 25th March 2010 (see footnote on cover page) have identified no shortage of policy ideas – more than enough for consideration in this ‘short’ report. Second, we agree with the sentiments in the quotation from Rodrik (2004) above: it is probably better for government to identify areas where policy is needed by discussion with interested stakeholders, rather than by an ‘ivory tower’ contemplation of where there may be hypothetical market and system failures.

5.1 Nine Areas of Policy

We first list here nine broad areas of current and/or possible future policy activity. Then, in the next sub-section, we assess whether there is a good case for such government intervention. In brief, the nine areas of activity are as follows:

a) Engagement of Stakeholders

Standardization has traditionally been an area in which business, and especially large businesses are dominant. At a practical level, some see no problem with this. These after all, are the participants with the necessary technological knowledge and the resources required in order to participate in standards setting. Others, however, see this as a distinct problem. For even if SMEs, consumers, regulators, governmental and non-governmental organisations lack such technological knowledge, they will surely be affected by the outcomes of the standardization process – sometimes in ways that business does not see in advance. The issues at stake are not just technological details: the standard often defines a pathway for the future and affects us all.

For that reason, it is often argued that there is a role for policy to engage a wider group of stakeholders in the standardisation process.⁵⁴ Sometimes this involves government expenditures to support the participation of diverse stakeholders in the standardisation process (e.g. by paying travel and other costs).

b) Process Reorganisation

Many still believe that traditional and formal standards-setting bodies offer the best forum to

⁵⁴ There is a large literature on this topic, including: Blind (2006), Fomin and de Vries (2009), Goerke and Holler (1995, 1998), Jakobs et al (1996, 1998a) Simons and de Vries (2006), de Vries (2006c), de Vries et al (2009) and Willemse et al (2006).

ensure the participation of the widest possible group of stakeholders in standardization and to ensure that the process is transparent and that the standards produced will gain widespread acceptance.

For some years, however, and especially in some high technology industries – such as telecommunications – standards setting by these formal bodies is seen by some as hopelessly time consuming and cumbersome. In these areas, a different norm has emerged, where smaller consortia (usually comprising big business interests) define standards. This has a clear advantage in terms of speed of development, but critics still believe that this process has its limitations – in view of the issues raised above.

Whatever one's opinion on these issues, it seems that we now must accept that this fragmentation of the standardization process into formal bodies and less formal consortia is a fact of life. But three areas of policy activity have received much discussion. First, is there anything more that can be done to speed up the traditional process so that standards reflecting the interests of a wide group of stakeholders can be achieved more quickly? Second, is there anything that can be done to ensure that different players in this fragmented system can learn from each other? And third, when should formal bodies recognise consortia standards as their own, and are there any beneficial conditions that the formal bodies could demand in return for such recognition? ⁵⁵

c) Updating the Stock of Standards

The rapid pace of technological change means that standards have a life cycle – just as products have a life cycle.⁵⁶ Moreover, it is generally recognised that out-of-date, rigid and inappropriate standards can jeopardise many or most of the beneficial economic effects described in earlier parts of our report. This suggests that it is important that the standards catalogue should be kept in good condition and up to date.⁵⁷

Unnecessary standards and outdated standards should be removed, because they get in the way. If necessary they should be replaced with an updated version. Swann (2000) described this activity as fulfilling the same function as pruning fruit trees and fruit bushes after fruiting – to get rid of useless wood and maximise future fruitfulness. But this activity does not happen of itself, and it is not clear whether this would happen satisfactorily without the intervention of a public agency.

d) Education about Standards

A widely view is that relatively few people understand the workings of standards and there is therefore a role for government to educate and inform. While some in large business know what standards are for and why they are important, it can hardly be disputed that few people outside that world really understand the significance of standards.⁵⁸ And yet it is believed that

⁵⁵ On the reorganisation of standards-setting, see Jakobs (2002, 2008c, 2009b, 2010) and Krechmer (2009).

⁵⁶ Blind (2007) examines some of the factors influencing the life cycle of a standard.

⁵⁷ That was a prominent theme in Swann (2000). This theme is discussed further in Blind (2007). The issues around standards change are discussed in Egyedi (2009) and Egyedi and Blind (2008). The issue of standards integrity is discussed in Egyedi and Hudson (2005a, 2005b).

⁵⁸ Few professional economists, for example, really grasp the full economic significance of standards.

standards will have a significant impact on the lives and prosperity of these same people – and that was why further stakeholder engagement in the standardization process is so important. Some have suggested that schools and universities (and other HEIs) have an unfulfilled role to provide a *general* education on such matters.

In addition to the general understanding of standards, many see an important role for public activity to promote the use of *specific* standards (relevant in a *specific* setting) and to disseminate the information therein. It is recognised that some national standards bodies (perhaps DIN is the most notable in this regard) have made standards an exceptionally powerful tool of disseminating technological knowledge.⁵⁹

e) Big Issues

While the main focus of interest in standardization has been on how to improve the workings of the economic model described in Figure 2 above, there is now equal interest in exploring how standards can be used to address some of the big issues facing society in the 21st Century, including climate change, sustainability, health and safety, waste, social inclusion and consumer needs.

Progress in this direction calls above all for *systems thinking*:⁶⁰ the ability to think of the economy as an immensely complex system, where beneficial activities in one part may lead to unexpected and undesirable side-effects in another part. In saying this, we do not imply that policy agencies have all the knowledge required to engage in system planning. But the essential point to note is that economic decision making which takes no account of systems properties will be highly susceptible to market and system failure.

Indeed, some believe that many of the challenges identified above have their roots in incompletely thought out innovation strategies of the past. So, for example, the microcomputer – the ultimate *clean* technology as it was seen in the late 1970s and early 1980s - is now a major cause of e-waste, perhaps the fast-growing area of waste. And the decision to switch from analogue broadcasting to digital – and thereby free up a substantial ‘digital dividend’ – will lead to the probable scrapping of 100 million otherwise viable analogue radios by 2015.

It is a big task, but it would be welcome indeed if standards could play their part in limiting such unfortunate side-effects.

f) Integration with Research and Innovation

A related theme is the growth of interest in developing mutual awareness and collaboration between the standardization, technology watch, foresight and research communities. While some from the research community are indeed involved in standards-setting activities, there is a widely

⁵⁹ There is a large recent literature on standards and education, including: Choi and de Vries (2010), Krechmer (2007b), de Vries (2005) and de Vries and Egyedi (2007).

⁶⁰ This is discussed further in Nelson and Stolterman (2003).

held view that it would be good to strengthen such links and involve more researchers and innovators in standardization.⁶¹

g) Access to Standards and Pricing

A recurrent issue alongside that of promoting standards - topic (e) above, is the issue of access to standards – and the pricing of standards. Sometimes, standards are made available for free. But for many standards bodies, charging for their standards publications is an essential revenue stream – without which they cannot raise enough revenue to fund their activities.

Some have suggested that the pricing of standards, even at relatively modest levels, deters some marginal users of standards from buying and reinforces the uneven engagement in standardization described in topic (a) above. In addition to the issue of pricing standards, there is also the issue of the cost of certification and accreditation. Some suggest that the real reason for a reluctance to engage with standards is not so much the cost of the standard per se, but the cost of conformity assessment and certification.

h) Coordination of Different Government Activities

The EXPRESS Report says that, “Better coordination of and between Directorates General with the ESOs, including at early stages in policy development, is needed for standardization to deliver the greatest benefits for the economy, society and public policy.” Several others have argued that standards set by different agencies sometimes conflict or get in the way of each other. So, for example, in the area of waste management, Health and Safety standards may conflict with environmental standards. To resolve this calls for more systems thinking (see topic f above) and, in this particular case, ‘joined-up government’. The DIUS (2009) report on *The UK Government Public Policy Interest in Standardisation*, notes that:

“DIUS leads on standardisation policy for the UK Government and represents the Government in European and international policy debates related to general standardisation policy. However, other government departments may be involved in policy specific discussions which have a bearing on standardisation. DIUS also oversees and manages the cross-Whitehall officials group on standardisation.”

The TSF Committee (Taking Standards Forward) is a cross-Government initiative that aims to achieve this improved coordination of government activities. Its purpose is to “reach a Whitehall-wide consensus on a common, unified, and inclusive policy for standardisation in support of the economy as a whole”, and “to support and deliver a standardisation infrastructure which supports innovation, facilitates fair competition, promotes European and international trade, and protects consumers, health, and the environment.” (BIS, 2009)

BIS (2009) lists four specific objectives:

- i) To provide cross-Government expertise to promote, develop, and deliver standardisation policies that support effective government and economic development.

⁶¹ See Blind and Gauch (2007a, 2007b, 2009), Gauch (2006, 2007), Iversen et al (2006) and Jakobs (2008a, 2008b).

- ii) To influence and maximise the effectiveness of European and international standardisation policies, whilst ensuring UK leadership and influence in development of international policies and practice.
- iii) To ensure effective operation of the UK standardisation infrastructure, especially ensuring that Government support, financial or otherwise, maximises public benefit.
- iv) To advocate the effective and appropriate use of standardisation across Government and promote public interest in standardisation generally.

i) Better Regulation through Standards

Finally, many have suggested that standards have a role to play in achieve better regulation - with a lighter touch.⁶² One possibility is that those who (voluntarily) adopt standards could be entitled to a lighter regulatory regime. One extreme version of this could be that those who comply with standards are entitled to ‘bar the inspector from the door’. In this scenario, standards become a substitute for regulatory inspection. The costs and benefits of this to the individual company are rather like those considered in the recent studies for NWML: do you check the product and process before going to the market or do you face these checks when you are at the market?

5.2 Economic Rationale for these Policy Activities

Now we turn to examine the economic rationale for such policy activities. For the first seven of these, we assess whether there is a good case for government intervention, based on the market failure or system failure rationales. For the next one, the market failure rationale does not seem relevant, but we assess whether there is a good case for government activity based on the system failure rationale. For the final one, the case for such government activity lies elsewhere.

For further references on themes in the nine sub-sections that follow, the reader is referred back to the references in Section 5.1.

a) Engagement of Stakeholders

We noted above the widely-held view that too few stakeholders get involved in standardization. To what extent is there a *market failure* here? Let us consider each of the sources of market failure in turn: scale economies, asymmetric information, externalities and coordination.

There certainly are scale economies to participation in standards-setting. It is an expensive and time-consuming business, and for the most part, only large businesses and government agencies specialising in standards issues can afford such a division of labour that enables one individual to spend so much of his/her time attending such standards-setting meetings. For smaller businesses, where job descriptions are broader, the fixed cost of participation may simply seem too high to justify. The same may apply to researchers, consumers and others. So, yes, scale economies are part of the *explanation* of why relatively few stakeholders engage. *But does that imply a market failure?* Probably not, on its own, but when combined with other factors (see below) the existence of these scale economies does exacerbate the problem of market failure.

⁶² See, for example, den Butter and Hudson (2008).

Asymmetric information is also present here. Standards professionals from large businesses are well informed about the significance of standards for their own business while many other stakeholders are much less aware of this. Indeed, many people seem blissfully unaware of how standards affect them. They perceive standards, perhaps, as a technical matter of relevance to the internal workings of a product or service, but which need not concern them. But that is wrong, since standards are - as Krechmer (1996a) puts it so succinctly – “the foundations of the future”.⁶³ Because of this asymmetric information, these other stakeholders under-estimate the significance of standards to their interests and that will lead some to opt out when they really should have taken part in the process.

Externalities are also an issue here. It might well be in the interests of many consumers if a particular consumer could afford the cost of participation in standards-setting. But only a fraction of the benefits from such participation are actually enjoyed by the participant consumer. Most of the benefits would accrue as positive externalities to many other consumers. This is of course a classic setting in which market failure is found: even if the social benefits of participation exceed the social cost, the private cost of participation to one participant exceeds his/her private benefit. This is indeed an area in which free-riding is natural: it is not cost effective for me to participate in standards-setting but it is better for me to hope that someone else will do so.

In such cases, it is in theory possible for a group of consumers to band together to internalise these externalities. This is usually called the club good solution. Certainly, some consumer pressure groups have had considerable success at doing this.⁶⁴ But in general, the coordination costs are very substantial and that makes the club good solution impractical in many cases.

In short, the combination of asymmetric information, externalities and coordination costs mean that market failure is highly relevant to the issue of stakeholder under-representation in standards-setting. And in the face of these three causes of market failure, the fact of scale economies makes the problem even worse.

And to what extent is there a *system failure* here? Once again, let us consider each of the sources of system failure in turn: infrastructure failures, institutional failures, interaction failures, transition failures, and capability and learning failures – noting, once again, that some would not admit these as a true example of systems failure.

In the 1990s, while use of the internet was still in its early stages, some suggested that the growth of the internet would make it easier for a wide variety of stakeholders to participate online in standardization. It is debateable whether that has happened in quite the way that was anticipated. But such an argument is consistent with the infrastructure failure perspective. Today, if there are still barriers to participation in standardization that are due to the cost of online participation, it seems that this is less an issue of infrastructure failure than an issue of institutional failure.

What sorts of institutional failure could be relevant here? It could be that some *hard* institutional failures are found – for example, bureaucratic reasons which get in the way of coordinating a

⁶³ In a similar way, Jakobs (2006b) writes of “Today’s standards – tomorrow’s networks”.

⁶⁴ CAMRA (The Campaign for Real Ale) is perhaps the most famous example of all.

‘club good’ solution. But, on the whole, it seems more likely that *soft* institutional failures are at the root of the problem: the lack of a supportive climate for co-operation and risk-bearing, the and the lack of open-ness to change.

Interaction failures seem especially relevant. Strong network failures, where existing inward-looking networks are too strong, seem inevitable. There still seems a pervasive attitude amongst some standardisers in big business that this is their agenda, alone, and other stakeholders would just get in the way. This view is understandable if the only function of standards is to act as carriers of expert knowledge. But, to the extent that today’s standards shape future markets, which is a legitimate interest of many stakeholders, then this inward-looking attitude can be problematic. The other side of the coin is weak network failure, where networks cutting across the broad community of stakeholders are too weak.

Transition failures seem relevant, because in the face of the institutional and interaction failures described above, it seems inevitable that standards-setting bodies (and consortia too) are to some degree locked-in to an old business model and changing that is hard. And the last category, capability and learning failures, seem pervasive. We have already discussed how most stakeholders have a limited knowledge of how standards affect them. And equally, those who think they understand the issues only too well often have an incomplete view: they understand how standards affect their business but don’t understand the broader social and economic effects. In short, both the market failure and the system failure rational seem to give strong support to government activities to broaden stakeholder engagement in the standards-setting process.

Despite this, some commentators still doubt whether this under-representation of stakeholders in standardization really matters all that much in practice. Some argue that standards are technical issues that *do not affect* the consumer. Others argue that the consumer is not competent to comment on issues of standardization, or is unable to articulate his/her needs. Either way, it is argued that consumer involvement in the standardization process (or government involvement on behalf of the consumer) achieves nothing except to slow down the process. We have argued above that we consider the first argument is wrong. The second argument is true only if we take a very narrow view of what standards do.

A third argument we sometimes hear is that standardisers from big business will take account of stakeholder interests. This argument won’t do. Here we need to remind ourselves of an essential insight in Adam Smith’s *Wealth of Nations*: “It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest.”⁶⁵ It is “not from benevolence” that the producer takes account of customer needs. It is because the producer in a competitive environment stands to gain market share if he takes better account of customer needs than do his rivals, or stands to lose market share if he does not. Smith was at great pains to emphasise that it is the *force of competition* that encourages the producer to do this, and which aligns the interests of the enlightened producer with those of the empowered consumer. One must not jump from that observation to the conclusion that producer and consumer interests are the same. They plainly are not. When consumers are not so empowered, or when there is no competition, then their interests may be in opposition to those of the producer.

⁶⁵ The quote is from Book One, Chapter II (Smith 1776/1904, p.16)

It may well be that having too many stakeholders involved in standardization means that they ‘get in the way’, slow up the process and don't help producers. But if today's technological standards shape tomorrow's products and services and if the purpose of innovation is to satisfy real customer needs and thereby promote growth, then the customer has a legitimate interest in the direction of standardization and that has to be brought within the standardization process.⁶⁶ If it is left out, there must be a risk that one of the trajectories launched by producer led standardization will lead to innovations that are not in the consumer interest. Powerful consumers may be empowered to stop such trajectories, but weaker consumers cannot.

b) Process Reorganisation

We noted above the widely-held view that the standard-setting process needs to be reorganised – either to make it operate faster, or to engage a wider group of stakeholders. Now, an immediate question (though not one I consider here) is whether any such reorganisation will actually improve matters. But suppose that such reorganisation strategies exist, and it appears that they will have a net social benefit. Even then, the reorganisation may not take place because some players (at least) do not feel incentivised to cooperate with it.

Let us consider two such strategies: (i) a plan to reorganise standards-setting to engage more stakeholders; (ii) a plan to reorganise standards-setting to speed up the process. The outcomes are different in the two cases.

In the first case, participants in the current (relatively exclusive) standards-setting bodies are unenthusiastic about reorganisation. *Overtly* their objections may relate to a fear that broadening engagement will slow down the process, but *in reality* their objections stem from fear of losing of control over the outcome.

Which, if any, of the sources of market failure are relevant here: scale economies, asymmetric information, externalities or coordination? As we said before, scale economies are important in standards-setting, but it is not clear why these should cause this particular problem. But, as before, it is possible that if a market failure exists for other reasons, then the fact of the scale economies increases the tendency for large players to resist reorganisation. Asymmetric information does not seem to be an important factor explaining the resistance to reorganisation. Indeed, this resistance stems from very clear information about the risks and not from ignorance. Externalities, on the other hand, seem to lie at the heart of this. Even if reorganisation is a game with a positive benefit to the economy as a whole, there are some losers, and this is the root of the resistance to reorganisation. And coordination costs between the stakeholders who should benefit from reorganisation may also get in the way of such reorganisation.

In short, in this first case, reorganisation is a battle between, on the one side, a strong group of big business interests who prefer the status quo, and on the other side, a diffuse collection of stakeholders who should benefit from reorganisation but who face substantial coordination costs in fighting to ensure that reorganisation proceeds. And indeed, the fact that scale economies are so strong means that the first group stands to lose a lot from reorganisation. If the net effect of

⁶⁶ See Iversen et al (2004).

reorganisation is a positive social benefit, then there would be a case (founded on the market failure argument) for government activity to make good the coordination failures and thus help to push through a reorganisation.

Now let us turn to the second strategy for reorganisation. Suppose this is a plan to speed up the process – not by limiting stakeholder involvement, but by increasing the frequency of meetings. In this case, big business players will be relatively happy about the reorganisation. Thanks to the scale economies they enjoy, they are far better placed to manage this increased frequency of meetings, and will support the reorganisation plan. By contrast, this increased frequency of meetings is a large burden to the smaller participants, and they will be unhappy about the proposal. But as before, the high coordination costs faced by diffuse smaller stakeholders may make it too hard for them to block such reorganisation.

As in the first case, the sources of any market failure lie mostly with externalities and coordination costs. But in this second case, the key difference is that market failure does not act to *block* the reorganisation. If anything, the market failure will cause an *excess momentum* towards reorganisation, because the winners are in favour and the losers face coordination costs that make it hard for them to mount an effective resistance. Unless the net effect of reorganisation is a clear social benefit, then any case for government activity (founded on the market failure argument) would be to make good the coordination failures and empower diverse stakeholders to block reorganisation. This sounds very strange, certainly, but it is arguably an appropriate reaction to excess momentum.

Finally, which systems failures are relevant in this case? The main systemic problem here is the weakness of the institutions that bind together diverse stakeholders and mean that they face high coordination costs. This would imply a mixture of hard and soft institutional failures. It could also be argued that this group also suffer from weak network failure – which also increases coordination costs. In the first case (the reorganisation to increase stakeholder engagement) we could say that there is a transition failure – from the status quo to the new organisation. But in the second case (the reorganisation to speed up the process) there is no transition failure.

c) Updating the Stock of Standards

The 2000 version of this report made particular emphasis on the need to keep the standards stock in good condition and up to date. But why should that not happen anyway? Where are the market failures and system failures here?

Let us start with the possible sources of market failure. There are several asymmetries here which suggest that normal market activity will not necessarily ensure that this happens. First, there are important scale economies in the use of standards and related information asymmetries. Those who use standards a lot will easily be able to sort through a large number and separate those that are relevant from those that are not. By contrast, those who use standards very little may find a mass of standards somewhat bewildering and if some of the documents are outdated, they will face quite a burden in sorting out the relevant from the irrelevant. A proliferation of outdated standards has the same sort of effect here as it does in models of product proliferation and patent ‘thickets’. In those cases, the uninitiated are deterred by the proliferation of products or patents around them, and they decide not to enter the game, while the initiated can see through

the proliferation and are not deterred. In short, an outdated standard acts as an asymmetric barrier to entry: it deters the uninitiated but does not deter the initiated.

The initiated have little incentive to ‘clear up the mess’, because they themselves gain little from doing so, and will simply grant a positive externality to potential competitors. At the same time, the uninitiated are not equal to that task, because they have not been able to work it out for themselves. Moreover, even if the social benefits are large, it is unlikely to be in the interests of one player to ‘clear up the mess’ because they only capture a tiny share of the overall benefit. This could be an activity where a ‘club good’ solution would be possible, but as before, those who need the task to be done are that diffuse group of small and uninitiated stakeholders who would face substantial coordination costs in effecting a ‘club’ solution.

What sources of system failure may be relevant here? It could be said that there are infrastructure failures here – to the extent that the standards stock is part of the technology infrastructure that supports innovation. We could also say that there is a system failure attributable to hard and (especially) soft institutional failures. Interaction failures don’t appear particularly relevant here, but a tendency for the standards stock to be out of date and a system failure to put that right could be seen as a transition failure. Finally, there are certainly capability and learning failures here – related to the information asymmetries described before.

In short, all four of the sources of market failure are relevant here (scale economies, asymmetric information, externalities and coordination) and many of the sources of systems failure are found too. As a result, there is a strong case for government activity to keep the stock of standards up to date and in good order, and this case rests on both the market failure and system failure rationales.

d) Education about Standards and Promotion of Standards

Some are sceptical about whether there is still a need now to invest more public money in educating *companies* how to use standards. Have these companies not learnt already what they need to know about the value of standards to their business? And if so, and they choose to make little use of standards, why should government presume this is the wrong decision? And equally, why is it necessary to invest more public money to promote the use of particular standards throughout the UK’s businesses? Don’t these businesses already know the value of standards for their business? And why should government presume to know better than the business what is the right use of standards? On the other hand, the case for investing public money in educating consumers and public sector service providers about standards appears to be much stronger.

To explain the above assertions, let us go back to the four principal sources of market failure. How relevant are they in these cases?

We have said several times before that the use of standards is subject to economies of scale. Perhaps the most important form of these economies of scale is a *learning curve*: those who have already learned the usefulness of standards find it is easier to find value in the next standard they use. Does the existence of this learning curve imply a market failure? That is debateable, but when such dynamic scale economies exist it is highly likely that a relatively small piece of ‘pump priming’ investment can help to bring the new user of standards far enough down a learning

curve that his/her use of standards thereafter becomes self-sustaining.⁶⁷ This is probably still relevant for ordinary consumers, public-sector users of standards and perhaps some other stakeholders.

What of asymmetric information? Again, it is clear that most economic agents start with limited information about the value of standards, while a few have a good understanding of the issue. But it is not clear that this asymmetric information leads to the traditional form of market failure associated with asymmetric information.

What of externalities? If a company does not use standards and loses business as a result, does that create externalities? Yes, it will permit 'business stealing' externalities whereby other, wiser, firms win new business. However, it is hardly the business of public policy to address externalities of that sort which are after all part and parcel of competition in free markets. But does it create any other externalities – which might affect consumers or third parties? This is obviously a possibility when a company does not make use of health and safety standards or environmental standards. But in that case, government policy would usually reinforce standards with regulation so that non-adopters cannot legitimately sell their products in the market. The most relevant externality here is where (say) the public sector agency's failure to make the best use of standards creates a negative externality to consumers and other stakeholders. Whereas market competition might address this problem in the case of a non-adopting company, that check does not work in this case as the public sector is a monopolist for many of its activities.

Finally, could coordination problems contribute to a market failure here? The answers seems to be similar to an answer that has surfaced several times above. Coordination problems are not the root cause of the market failure. But if market failure happens for other reasons, and some form of coordinated effort is required to educate and promote, then the high coordination costs amongst diffuse stakeholders will mean that a 'club good' solution is impractical. The worse the problem of coordination costs, the greater the case for government activity to resolve the market failure.

What now of the issue of possible system failure in the context of education about standards and the promotion of standards? Here it is easier to find several weak links. It is reasonable to argue that there are some institutional failures (or at least institutional 'weaknesses') in education about standards. These are both hard and soft. While standardisation courses, standardisation faculty and even standardisation departments are to be found in Germany and the Netherlands, these are almost unheard of in the UK. Moreover, in many of the 'core' academic subjects, standardisation is treated as something of a 'Cinderella' subject, and it is hard to introduce such subjects onto a curriculum dominated by the 'core' of the discipline. These institutional failures probably also reflect strong and weak network failures. Members of the 'core' have excessively strong network ties within the 'core' and tend to neglect the 'periphery'. Equally, the 'periphery' often distance themselves from the 'core' as a survival strategy. And, most obviously, there are as a result, significant capability and learning failures in education about standards.

In short, the system failure arguments for education and promotion look moderately strong, but the market failure arguments look weaker – though they may still be relevant for the education of

⁶⁷ The use of the term 'self-sustaining' here follows its use in nuclear reactions.

consumers, public sector staff and other stakeholders, and the promotion of standards to these stakeholders.

e) 'Big Issues'

A lot of recent attention has been given to the possible role that standards could play in helping to resolve 'big issues' facing society in the 21st Century, including climate change, sustainability, health and safety, waste, social inclusion and consumer needs.

What do we mean by a 'big issue'? We mean a social, economic or environmental problem that is having or will soon have substantial and widespread effects on our lives, and for which we are, as a society, unprepared. We are unprepared for three reasons. First, the 'big issue' has only recently been perceived as a problem. Second, we have only just realised that our social and economic system as it currently stands is not dealing with the problem. Third, and perhaps worst of all, we perceive, though imperfectly, that current social, economic and technological priorities may actually be making the problem worse, or may even lie at the very root of the problem.⁶⁸

This means that big issues call above all for 'systems thinking' - that is, thinking that spans the current boundaries of the division of labour within which we all work. Indeed, the emergence of 'big issues' suggest that the existing division of labour is incapable of dealing with this particular problem and some organisation, institutional and/or policy change is required to address the problem. In a sense, the fact that 'systems thinking' is a lost art is a reflection of the apparently unstoppable trend towards a further division of labour.

Some commentators make gentle fun of the division of labour in some organisations and the 'silo' mentality that results. However, we need to remember that a division of labour will always tend to emerge in a competitive economy, because as Adam Smith stressed in the earliest days of economics, the division of labour enhances productivity. The form of division of labour that emerges and dominates will be one where the lack of communication across boundaries is generally unproblematic – at least at the start.

Markets work best within an existing division of labour. Traders are then clear about their daily routines, and the identity and character of those with whom they trade, and this helps to reduce the transaction costs they face. But when a 'big issue' emerges that cannot be handled within this division of labour, a market solution is hard to manage because it calls for transactions and coordination across traditional boundaries. These are fraught with difficulties and high transaction costs and as a result a solution is not found because of market failure. It is in this context that government activity becomes so important.

So let us turn now to the four sources of market failure identified above. Which of these are relevant to this case?

⁶⁸ An example of the last of these would be the recognition that Moore's Law – so often praised as the engine of growth in the computer industry - lies at the root of the growing and (currently unmanageable) problem of e-waste – see Swann (2009d).

At one level, economies of scale could be said to lie at the root of this, because with no economies of scale, the division of labour would be far less pronounced, and 'big issues' which called for systems thinking would be much easier to handle. As to asymmetric information, the problem behind the 'big issue' is not so much *asymmetric information* as a lack of any information. Sometimes the pioneers who first perceive these 'big issues', while all others are unaware of them, are dismissed as 'cranks' or 'activists'.

Of the four sources of market failure, perhaps externalities are the most important of all. When a 'big issue' arises, one of the first manifestations of it may be pervasive and unmanageable externalities from one economic activity which previously had little or no effect on the third party who now suffers the externality. So for example, e-waste emerged as a 'big issue' when obsolete computers were shipped to less developed countries for 'recycling'. The cottage industries that grew to process this waste gave no attention whatever to any health and safety or environmental considerations, and subjected the poor of these countries to substantial negative externalities.

And fourth, coordination problems are clearly relevant here. Indeed, it is precisely because a coordinated 'club good' solution to 'big issues' is too hard to broker, that government activity is required.

In short, markets organised around an existing division of labour are ill equipped to deal with 'big issues' that arise because of the internal contradictions within that division of labour. In that sense there is a pervasive *market failure* in dealing with the 'big issue'.

What of system failures here? The 'big issue' can be seen as the result of several system failures. When an existing division of labour becomes unworkable, then we perceive a variety of hard and soft institutional failures. The institutions we need to manage a 'big issue' and bring it under control do not exist or are hopelessly weak. These institutional failures may in turn stem from various interaction failures. After all, the division of labour *encourages* some forms of communication (within a workgroup) and *discourages* communication that cuts across the division of labour. So, almost by definition, whenever an existing division of labour becomes unworkable and a 'big issue' emerges, then we perceive strong network failures (too much communication *within* a narrow group) and weak communication failures (too little, or *no* communication *between* groups). These problems can also manifest themselves as capability and learning failures.

In short, the systems failure perspective gives many reasons why an existing division of labour will be unable to manage its way out of a 'big issue' without government activity.

In conclusion, of course, we should say this. We have said little so far about the role of standards in solving the 'big issue'. It may be that standards can help to manage 'big issues' of this sort. Or it may be that regulation, rather than just standards, is required. But if standards are to work in this way, we would argue that they must be standards driven by a process in which government and government agencies give proper account to all stakeholder interests. They cannot be 'business driven' standards because those are the product of the division of labour which was unable to manage the 'big issue' in the first place.

f) Integration with Research and Innovation

While a modification of the standardization process to integrate those involved in foresight, research and innovation is not as ambitious as the use of standards to manage the ‘big issue’ problems described above, the challenges are similar – though on a smaller scale.

Such integration involves communication across the traditional boundaries in the division of labour. The following sources of market failure seem most important, and for the same reasons as described in (e): economics of scale, externalities and coordination problems. And the following sources of system failure seem most important here, and (again) for the same reasons as before: institutional failures, interaction failures and learning failures.

g) Access to Standards and Pricing

As we said above, some have suggested that the pricing of standards, even at relatively modest levels,⁶⁹ deters some marginal users of standards from buying and reinforces the uneven engagement in standardization described above. How important is this in practice? Suppose also that standards are all sold online, so that the marginal cost of supplying an additional copy is zero. Suppose also that market demand follows the following demand function:

$$X = \alpha P^{-\beta}$$

In the region of the revenue-maximizing price (P^*), we assume that $\beta \approx 1$,⁷⁰ and that above that price, $\beta < 1$. Assume that at the revenue-maximizing price, X^* copies of the standard are sold. Then we can show (see Technical Appendix) that the ratio of the value lost by pricing marginal users out of the market (deadweight loss) to the revenue recovered by the standards-seller, is given by:

$$\frac{\text{Deadweight Loss}}{X^* P^*} = \frac{\beta}{1 - \beta} \quad \text{where } 0 < \beta < 1$$

Consider three examples. (i) If $\beta = 0.9$, then this ratio takes the value 9; the amount of value lost is *well in excess* of the amount recovered. (ii) If $\beta = 0.5$, then this ratio takes the value 1; the amount of value lost is *approximately equal* to the amount recovered. (iii) If $\beta = 0.1$, then this ratio takes the value 1/9; the amount of value lost is *small* in comparison to the amount recovered. In short, unless the price elasticity is small, the amount lost by pricing marginal standards users out of the market is a significant loss.

For this reasons, many commentators are asking whether it would be better to consider a move towards making standards available without charge – or perhaps considering a system of price discrimination for standards, where the full standard is sold at the regular price but a cut down version is available without charge.

⁶⁹ To take one example at random: BS 25999-2:2007, the standard for business continuity management, is currently (5th April, 2010) priced at £100.

⁷⁰ The rationale for this assumption is simply that the revenue maximizer will seek a point on the demand curve where the price elasticity is minus one (see appendix).

The price discriminatory scheme looks attractive. For this is, after all, a well-recognised problem in many areas of business – including tickets for airline travel, tariffs for mobile phone use, and so on. If a product or service is produced by a process with a large fixed cost but zero marginal cost, then it is well known that a single profit (and revenue) maximizing price will be some way above marginal cost, and hence that trading at this price only will mean that a large number of sale opportunities may be lost. For this reason, many sellers offer slightly differentiated products or services: those customers prepared to pay a higher price typically buy the high quality product while those prepared to pay only a low price buy the lower quality product (or cut down version). As a general rule (Swann 2009c, p. 80-81), the larger the number of different versions offered at different prices, the more revenue and value can be extracted from the market.

How might the price discrimination scheme work in the context of standards? A very simple implementation would be where the standards body charges the full price for the technical version of standard, with all the technical details, but sells a cut down version for a low price – or perhaps even gives this away *for free*. The difference between the two versions may not simply involve how much content is included. The low price (or free) version may also be written in a more accessible style for ‘marginal’ users – that is, new users who are unfamiliar with the technical language used in full-length standards.

To what extent is there a market failure or system failure rationale for this? The reason why there is market failure if standards are sold at one price only (the revenue maximizing price) is that price is above marginal cost, and so some would-be users who would be willing to pay at or above marginal cost are excluded from seeing the document, and this involves a loss of welfare. This problem may be exacerbated in a context where those unfamiliar with standards have incomplete information, and are uncertain about the value that they can gain from the standard, and do not buy because they are risk averse. The reasons for system failure stem from infrastructure and institutional failures which mean that standards are sold at one price only which means an inevitable (and unnecessary) welfare loss.⁷¹

h) Coordination of Different Government Activities

As we said at the start of this sub-section, the market failure argument doesn’t apply to this policy. This is for the simple reason that these activities are *already* public sector activities which we don’t expect the market to provide. It is, however, relevant to ask whether there is a good rationale based on system failure arguments for such activities. That is what we shall do here.

The problems of ensuring a proper coordination of the different activities of different government agencies are similar to the problems described above in the context of ‘big issues’. If the activities of different government departments and agencies lack coordination, it is again the result of a division of labour that is no longer ideal for purpose. When that happens, then we

⁷¹ In addition to the issue of pricing standards, there is also the issue of the cost of certification and accreditation. Some suggest that the real reason for a reluctance to engage with standards is not so much the cost of the standard *per se*, but the cost of conformity assessment and certification. This is a big and important area indeed, but lies outside the specification for this present project.

perceive a variety of hard and soft institutional failures. The institutional routines we need to ensure coordination do not exist or are too weak. These institutional failures may in term stem from various interaction failures. As we said, the division of labour *encourages* some forms of communication (within a workgroup) and *discourages* communication that cuts across the division of labour. So, almost by definition, whenever we encounter such coordination problems, then we perceive strong network failures (too much communication in a narrow group) and weak communication failures (too little, or *no* communication between groups). These problems can also manifest themselves as capability and learning failures.

In short, the systems failure rationale suggests a variety of reasons why we may expect inconsistent standards activities when there are coordination problems across different areas of government. This is an area which requires some careful systems thinking by government.

i) Better Regulation through Standards

As we said at the start of this sub-section, it doesn't really make sense to ask whether the market failure or system failure arguments justify this policy option. For the very fact of regulation implies that there is already market failure and/or system failure here, so the issue is different. Is there a better way to achieve the objectives of regulation – by the altogether 'lighter touch' of voluntary standardization.

One possibility is that those who (voluntarily) adopt standards could be entitled to a lighter regulatory regime. One extreme version of this could be that those who comply with standards are entitled to 'bar the inspector from the door'. In this scenario, standards become a substitute for regulatory inspection and legal action. The costs and benefits of this to the individual company are rather like those considered in the recent studies for NWML: do you check the product and process before going to the market or do you face these checks when you are at the market?

A balanced assessment of the pros and cons here are not to be found in the market failure or system failure analyses presented above. It is already assumed that one or other of these is relevant – and that is why there is regulation in the first place.

Conclusion

In conclusion, we can summarise the relevance of the possible sources of market failure and systems failure in a simple table. As stated before, the market failure argument is not relevant to policy (h) and neither is relevant to policy (i).

Table 2 shows for each policy which of the sources of market failure and system failure may apply in that case. As explained in the key to Table 2, we distinguish between those cases where there is a clear argument that the factor may be relevant and other cases where the argument is more equivocal. From a perusal of this table, it seems clear that policies (a) Engagement of Stakeholders, (c) Updating Stock, (e) 'Big Issues', (f) Integration with Research and (g) Access and Pricing find especially strong support. There is also strong support for (h) Government Coordination, but more moderate support for the other two policies: (b) Process Reorganisation and (d) Education and Promotion.

Table 2
Sources of Market Failure and System Failure Relevant to Policy Initiatives

	Market Failure				System failure						
	Scale Economies	Asymmetric Information	Externalities	Coordination	Infrastructure	Institutional		Interaction		Transition	Capability/ Learning
						Hard	Soft	Strong	Weak		
(a) Engagement of Stakeholders	(√)	√	√	√		(√)	√	√	√	√	√
(b) Process Reorganisation			√	√		√	√		√	(√)	
(c) Updating Stock	√	√	√	√	√	√	√			√	√
(d) Education and Promotion	(√)		(√)	(√)		√	√	√	√		√
(e) Big Issues	√	(√)	√	√		√	√	√	√		√
(f) Integration with Research	√	(√)	√	√		√	√	√	√		√
(g) Access and Pricing	√	(√)			√	√	√				
(h) Government Coordination	n/a	n/a	n/a	n/a		√	√	√	√		√

Key: √: Yes, this factor is relevant in this context.
 (√): A qualified ‘yes’, this factor may sometimes be relevant in this context.
 Blank: We have not found a convincing case that this factor is relevant.
 n/a: *Prima Facie*, this factor is not relevant in this case.

5.3 An ‘Ideal Model’ for Policy

As we said at the start of this report, we are defining the ‘ideal model’ for policy by those policy initiatives that have a strong economic rationale. These are summarised in Table 3. This lists for each policy option the strength of the market failure and system failure rationale for such a policy.

Table 3
An ‘Ideal Model’ for Policy

		<i>PERSPECTIVE</i>	
		Market Failure	System Failure
POLICY OPTION	(a) Engagement of Stakeholders	Strong justification for policy	Strong justification for policy
	(c) Updating Stock	Strong justification for policy	Strong justification for policy
	(e) ‘Big Issues’	Especially strong justification for policy	Especially strong justification for policy
	(f) Integration with Research	Strong justification for policy	Strong justification for policy
	(g) Access and Pricing	Strong justification for policy – though based on a few factors	Strong justification for policy – though based on a few factors
	(h) Government Coordination	n/a	Strong justification for policy

We have marked as “especially strong” the case for a policy to use standards to address ‘big issues’, because the stakes are so high. This above all, is the area that needs to be developed as a priority.

6) Case Studies of Good Practice⁷²

This final component of our report will examine some practical examples of standards activities and policy towards standardisation which relate to six of the policy initiatives discussed above.⁷³

The discussion will be in two sub-sections. In Section 6.1 we discuss areas that are relatively well-developed. In Section 6.2 we discuss areas that are currently under-developed and, according to our assessment above, are areas where further activity is a priority.

6.1 Three Well-Developed Areas of Activity

a) Engagement of Stakeholders

This was one of the central aims of the National Standardisation Strategic Framework (NSSF). It left a legacy of BSI documents and policies. The BSI website stresses the aim to involve a wide variety of stakeholders:

“BSI actively seeks to bring together all those with significant interest in particular projects. Representations are sought from many spheres including: consumer organizations; professional institutions; certification, testing and inspection bodies; educational establishments; research organizations; UK notified bodies; enforcement bodies and government departments. BSI also works with trade associations or equivalent organizations as a means of representing most standards users in business. This enables a wide measure of consultation and support in standards work.”⁷⁴

“It is a requirement of BSI’s bye-laws that all national committees are representative of the interests of users, manufacturers, government departments and other bodies concerned with their work.”⁷⁵

The ‘standard for standards’,⁷⁶ BS0-1:2005 sets out the BSI principles for the composition of standards committees (Section 4.3.2):

“The composition of Policy and Strategy Committees shall be individuals appointed by SPSC to be broadly representative of stakeholder interests and who shall act independently of any trade or other organizations or interest groups.

⁷² I am grateful to Daniel Mansfield of BSI who provided many references and links for this section.

⁷³ Three of the initiatives are not discussed in detail here: process reorganisation, coordination of different government activities, and better regulation through standards. The first did not emerge from Section 5 as a top priority for policy. The second is being addressed by the TSF committee – see Section 5.1 (h). The case for the third lies outside the scope of the perspectives discussed in Section 4; BSI (n.d.) has already discussed some work on this.

⁷⁴ <http://www.bsigroup.com/en/Standards-and-Publications/How-to-get-involved/>

⁷⁵ <http://www.bsigroup.com/en/Standards-and-Publications/How-to-get-involved/Become-a-committee-member/>

⁷⁶ BS 0 is the ‘Standard for Standards’. The revised version, which came into effect in 2006, describes the way BSI produces standards: <http://www.bsigroup.com/en/Standards-and-Publications/About-BSI-British-Standards/How-we-produce-British-Standards/>

The composition of Technical Committees and Subcommittees shall be organizations representative of the interests in the standardization of products (including services) or processes within the committee's terms of reference. BSI shall endeavour to carry out an analysis of all those it considers might have substantial interest in, or who might be significantly affected by, a particular standards project with a view to encouraging their representation. As far as possible, BSI shall ensure that its committees are representative of the interests concerned. Prior to the commencement of work of a Technical Committee or Subcommittee, its members shall be asked whether they know of any other organizations with a direct interest that should also be represented.

NOTE 1 However, the need to secure a balanced representation should not lead to committees that are so large as to be unmanageable.

NOTE 2 The composition of a Technical Committee or Subcommittee should be a standing item on every meeting agenda.

The primary means of representing business interests shall be through trade associations or their equivalent organizations. Exceptionally, representation from individual companies shall be permitted when BSI deems that the scope of the Technical Committee or Subcommittee requires this in order to undertake its work. BSI shall endeavour to ensure that the balance of representation between trade associations and individual companies meets the requirements of fairness of representation.

Where the scope of a Technical Committee or Subcommittee so requires, representation shall be sought from consumer organizations, professional institutions and organizations with interests in testing, inspection and certification. Where it is believed by SPSC that a standard could be used to support legislation or impact on consumer protection, health and safety, human rights or environmental matters, representation from the relevant government department(s) shall be sought ...”

But it is clearly unrealistic for many consumers to get involved in standards-setting on a day-to-day basis. For that reason, BSI has established a Consumer and Public Interest Unit (CPIU):

“All standards affect the public directly or indirectly, even though most are produced to serve the immediate needs of business and industry. Many, though, have a direct and beneficial impact on the general public. These include ‘traditional’ consumer related standards such as those for domestic appliances, or signs and symbols, as well as those newer types of standard for sustainability, social responsibility or services. BSI is committed to trying to ensure that representation on its technical committees and access to the standards-making process is as wide as possible and maintains a Consumer and Public Interest Unit (CPIU), responsible for co-ordinating the participation of those stakeholders who would not otherwise normally be involved at a day-to-day level, e.g. consumers and individual specialists in subjects such as child safety or ergonomics. The objective is to influence the content of standards to reflect

the needs and proper expectations of the general public with regard to factors such as safety and security, labelling, accessibility, fairness and redress.”⁷⁷

b) Updating Stock of Standards

The need to keep the standards stock up to date and relevant is well enshrined in BSI policies and practice. In BS0-1:2005, Section 5.6 describes the policy for maintenance of standards:

“BSI shall ensure that every standard is under the responsibility of a Technical Committee. Each Technical Committee shall maintain standards for which it is responsible, to ensure that those standards are up to date with current practice and free from material error ... To ensure standards of national origin are up to date with current practice, every one shall be reviewed by the Technical Committee responsible, at least every five years ... Following review of a standard of national origin the relevant committee shall decide on the action to be taken from the following options: confirmation of standard, editorial changes, technical changes, full revision, obsolescence or withdrawal if no longer current.”

Five years is intended as the outside limit (or occasionally seven years in IEC) and standards are reviewed beforehand if required.⁷⁸

c) Education and Promotion

While much past BSI activity has been directed at educating business about the benefits of standards, we argued in Section 5 that the greater market failures lie in the lack of understanding about standards amongst consumers and in government. For that reason, we shall focus here on BSI activities to educate these two groups.

Consumers

Education of consumers about the value of standardisation is the job of the BSI has Consumer and Public Interest Unit (see above). As part of their consumer education activities, they publish a number of case studies:⁷⁹

Matta Products: The case study explains how Matta Products used BS 1177 to reduce the number of serious injuries, by reducing the chances of children hurting themselves when falling from play equipment in children's play areas.

Manchester United: The case study explains how the football club have used BS 8300:2001 to give more supporters with disabilities access to live football and improve the match day experience.

⁷⁷ <http://www.bsigroup.com/en/Standards-and-Publications/How-to-get-involved/Become-a-consumer-representative/>

⁷⁸ IEC standards state in the foreword the ‘review cycle’ for a standard, i.e. the date of the next review (typically 2, 5 or 7 years). In ISO and CEN, five years is the default, so no ‘review cycle’ is specified. Similar (but shorter) review cycles exist for interim documents such as the PAS, the Draft for Development, and the Technical Specification.

⁷⁹ <http://www.bsigroup.com/en/Standards-and-Publications/How-we-can-help-you/Consumers/Consumer-case-studies/>

Brent River Park: The case study explains how Brent Council used ISO 14001 to help them regenerate Brent River Park for the local community, making the park more accessible, more useful, and safer.

They also publish a summary of the *Top 10 Standards that Matter to Consumers*.⁸⁰ These are:

- Accessible buildings (BS 8300)
- Accessibility of hotels (PAS 88)
- Fire safety (BS 9999)
- Safety of toys (BS EN 71)
- Personal data protection (BS 10012)
- Internet safety for children (PAS 74)
- Environmental labelling (BS EN ISO 14021)
- Customer service (BS 8477)
- Vehicle body repair (PAS 125)
- Adventurous activities (BS 8848)

Public Sector

A large part of the work of BSI is concerned with educating the public sector about the value of standards. Two examples from the BSI website⁸¹ illustrate initiatives which resonate with several of the priorities identified in Section 5.

“The Cabinet Office's Code of Practice on Consultation sets out standards for all departments to follow, helping to raise the quality and quantity of consultation carried out by government. Effective consultation is central to the Government's better regulation agenda. Engaging stakeholders and the general public helps find alternatives to legislation and identify potential consequences before proposals become law.”

“The use of standards by the Met Office is allowing the department to save resources and control its environmental impact. The Prime Minister has stated that every Government department must contribute to the goal of sustainable development. The Met Office has fulfilled this duty in its implementation of ISO 14001. It offers compelling evidence that introducing a standard can simultaneously yield environmental and financial benefits.”

The BSI publication, *The Standards Solution for Government* describes several aspects of the BSI efforts to describe the relevance of standards to the public sector:⁸²

“... it isn't just private enterprises that profit from standards. They also make a significant contribution to the success of local, regional and central government organizations. Standards are an excellent way of encouraging a 'lighter-touch'

⁸⁰ <http://www.bsigroup.com/upload/Standards & Publications/Consumers/Top-10-Standards.pdf>

⁸¹ <http://www.bsigroup.com/en/Standards-and-Publications/How-we-can-help-you/Government/Government-case-studies/>

⁸² http://www.bsigroup.com/upload/Standards%20&%20Publications/Government/The_Standards_Solution_for_Government.pdf

approach to regulation. By complementing legislation, standards provide a convenient and effective means by which all stakeholders can fulfil their responsibilities. By working with standards, government can make its procurement processes more efficient through eliminating waste, driving down costs and maximizing value for money. Standards also increase efficiency across departments and organizations that adopt common purchasing processes.

A collaborative approach to standardization provides a unique framework for sharing knowledge. This reduces the costs and risks associated with innovation, as well as guaranteeing quality, safety and accessibility. The public sector can benefit from innovation just as much as the private sector. With managers under continual pressure to deliver on departmental and organizational objectives, standardization forms part of the solution. The message is loud and clear – standards are good for government.”

This is supported by various other publications that elaborate on specific ways in which standards can help to improve the work of government: ⁸³

- *Enabling Lighter Touch Regulation*
- *Improving the Efficiency of Public Procurement*
- *BSI Guidance for Government Representatives*
- *Home Office* (a document demonstrating how the Home Office has uses standards to help achieve its objectives)

And others, which while originally directed at business, are also relevant to government:

- *Sustainability - The Role of Standards*
- *Innovation - The Role of Standards*
- *Business Continuity Management and risk - The Role of Standards*

6.2 Three Under-Developed Areas of Activity

a) ‘Big Issues’

The use of standards to help manage ‘big issues’ (such as environmental issues) may be an under-developed area in general, but nonetheless BSI has a track record of activity in this area.

The BSI publication, *Sustainability: The Role of Standards* ⁸⁴ describes the magnitude and complexity of the sustainability challenge, and how standards can help in this:

“Trade has expanded across the globe rapidly since the 1970s, obscuring and lengthening supply chains. At the same time, the drive for further growth in developing and mature economies has intensified commercialization and resource

⁸³ <http://www.bsigroup.com/en/Standards-and-Publications/How-we-can-help-you/Government/Publications/>

⁸⁴ <http://www.bsigroup.com/upload/Standards%20&%20Publications/Government/Publications/SustainabilityROS.pdf>

pressure. Managers can no longer afford to ignore the crescendo of demands for transparency and social responsibility that have ensued, led by the sustainability movement.

Those that grapple with this issue are overwhelmed by the complexity and depth generated by the need to manage problems previously viewed as irrelevant to business or outside its direct control. The transparency expected from sustainable businesses entails rigorous definitions of where a supply chain begins and ends, and clarity on how its environmental and social impacts are measured. A sustainable business also has to redefine the values at its heart.

Standards play a crucial role in this new world. They focus on motivating management to develop more sustainable processes, products and services. They inform purchasing decisions by giving customers confidence that their suppliers have attained benchmark levels of sustainability. And finally, they play a crucial, fundamental role in encouraging innovation.”

BSI has also carried out various ‘trials’ of standards in development, notably in energy management and sustainable events management.

The BSI website provides various case studies of energy management case studies.⁸⁵ These illustrate the use of BS EN 16001, the standard for *Energy Management Systems: Requirements with Guidance for Use*.

“BS EN 16001 provides a road map to help organizations improve energy efficiency, reduce greenhouse gas (GHG) emissions and drive down energy costs. It is a best practice document that will allow businesses to implement their own energy management systems and to get an appreciation of their own energy usage. It explains what steps they need to take and who they need to get involved in their businesses to help. The standard applies to all energy-related activities under the control of an organization. For example, it takes account of the power used by machinery and the energy needed to heat office buildings. These ‘energy aspects’ represent elements of an organization’s activities, goods or services that can affect energy use. The standard can also be used to turn energy into a key performance indicator alongside such elements as unit cost and customer satisfaction.”

The case studies relate to City of London Corporation, N D Metering Solutions, Robert Wiseman Dairies, SKF Limited and Virgin Trains.

The BSI website also provides various case studies of sustainable events management.⁸⁶ These illustrate the use of BS 8901:2009, offering a *Specification for a Sustainability Management System for Events*. BS 8901 provides requirements for planning and managing sustainable events of all sizes and types. It encompasses the entire range of events ranging from large scale conferences and unique events such as the London 2012 Olympic and Paralympic Games to

⁸⁵ <http://shop.bsigroup.com/en/Browse-by-Sector/Energy--Utilities/Energy-management-and-efficiency/BS-EN-16001-case-studies/>

⁸⁶ <http://www.bsigroup.com/en/BSIGroup/Standards-and-Publications/Industry-Sectors/Environment/BS-8901-case-studies/>

music festivals and air shows. BS 8901 is applicable throughout the sector supply chain encompassing venues, organizing companies and industry contracting firms and is aimed at event organizers, venues and organizations and/or individuals in the supply chain. It provides guidance for managing the environmental, financial and social risks and impacts of event management.

The case studies include: the European Meetings & Events Conference, EC&O Venues, Live Nation (the concert organiser), Lord's Cricket Ground, Manchester International Festival, Reeds Carpets (a major supplier of carpets to the events industry), the Google Zeitgeist Conference 2009, Olympia and Reed Exhibitions Limited.

b) Integration with Research

This is generally recognised to be an underdeveloped area. Indeed, even in the academic literature, there are only a few articles on this topic, all in the last few years – Blind and Gauch (2007a, 2007b, 2009), Gauch (2006, 2007), Iversen et al (2006) and Jakobs (2008a, 2008b, 2009a).⁸⁷

One of the first advances in this area has been the establishment of a joint group by CEN and CENELEC to address the relationship between standardisation and research. STAIR (STandards, Innovation and Research),⁸⁸ chaired by Prof. Blind, has produced its first report on the integrated approach to innovation, research, and standardization.⁸⁹ BSI played an important role in this.

c) Access and Pricing

Amongst academics, the theoretical case for making standards available to potential users at marginal cost (zero!) has been recognised for some time. This is, indeed, another instance of the general argument that when the marginal cost of making a public good available to another user is zero, then there are strong efficiency arguments for setting a zero price. Of course, that argument does not answer the pressing supplementary question: if standards are to be given away for free, how is the standards-setting institution to raise revenue to cover its costs? Because these two considerations point in such different directions, the discussion of pricing standards can get quite heated, as the two following quotations illustrate:

“the whole notion of charging for standards is profoundly stupid: it restricts their distribution and inhibits uptake, which defeats the whole point of providing a standard”⁹⁰

“proponents of free standards are forgetting one important fact: bridges have to be designed, constructed and maintained. Giving standards away free will eliminate the most significant source of funding for standards development.”⁹¹

⁸⁷ Having said that, the connection is anticipated in the remarkable paper by Krechmer (1996a).

⁸⁸ <http://www.cen.eu/cen/Services/Innovation/STAIR/Pages/default.aspx>

⁸⁹ <http://www.cen.eu/cen/Services/Innovation/STAIR/Documents/STAIRIntegratedApproachexamplefinal.pdf>

⁹⁰ <http://zoom.z3950.org/>

⁹¹ <http://www.techstreet.com/myth1.html>

One approach which tries to reconcile these two perspectives, as described in Section 5, is an application of price discrimination. This is already used to some extent.

For example, BSI Membership is divided into Bronze, Silver, and Gold levels,⁹² depending upon the size and type of organization. The membership subscriptions are priced in bands depending on the size of the organisation (employees and turnover) and the category or sector in which it is located:⁹³

- A) Sole traders, partnerships and consultants
- B) Industrial and commercial organizations
- C) Local authorities, police and fire services
- D) Educational, housing associations and healthcare establishments
- E) Associations, institutions and representative bodies
- F) Retailers
- G) Special industry (food, beverage, pharmaceutical and biotechnology)
- H) Non Departmental Government Bodies and other Sponsored Government Bodies

Members are entitled to a 50% discount on BS hardcopy standards, a 50% discount on the cost of subscription to British Standards Online, and discounts on foreign standards (40% off ISO standards, 10% off DIN, ASTM standards, etc.)⁹⁴

These schemes combine price discrimination by customer characteristics and quantity discounts. DIN also offers a quantity discount scheme for SMEs (*Normen-Flatrate* 25).⁹⁵ This lets the subscriber download 25 DIN Standards in PDF format within a 12 month period, and at a reduced price compared to individual sales.

It is possible that there is also scope for applying some of the other mechanisms of price discrimination and ‘innovative pricing’ to the pricing of standards. Jonason (2001) and Philips (1983) give an overview of many of these mechanisms, while Swann (2009, Chapter 6) gives a brief introduction. This is an area that BIS and BSI may wish to explore.

⁹² <http://www.bsigroup.com/en/Standards-and-Publications/Membership/Join-BSI-today/Membership-types/>

⁹³ <http://www.bsigroup.com/en/Standards-and-Publications/Membership/Join-BSI-today/Subscription-rates/>

⁹⁴ <http://www.bsigroup.com/en/Standards-and-Publications/Membership/Benefits-and-services/>

⁹⁵ <http://www.beuth.de/cmd?level=tpl-home&languageid=en>

Technical Appendix

Proof of Maths in Section 5.2 (g)

The main aim of this appendix is to prove the result asserted in Section 5.2 (g). But in addition, this appendix provides further insights into the rationale for the price discrimination or ‘innovative pricing’ schemes discussed in Sections 5.1 (g), 5.2 (g) and 6.2 (c).

Suppose that market demand follows the following demand function:

$$X = \alpha P^{-\beta} \quad (1)$$

Where X is the quantity demanded, P is the price, and α and β are parameters. By rearranging Equation (1), we can rewrite this as an equivalent *inverse* demand function relating the price at which a particular quantity will be sold in the market:

$$P = \gamma X^{-\delta} \quad (2)$$

Where $\delta = \frac{1}{\beta}$ and $\gamma = \alpha^{1/\beta}$.

In the region of the revenue-maximizing price (P_0), we shall assume that $\beta = 1$, and above that price, that $0 < \beta < 1$. This assumption is made to ensure a finite solution in Equation (8) below.

Why does the revenue maximizer seek a point on the demand curve where price elasticity is minus one ($\beta = 1$)? The reason is simple. Revenue is defined as price multiplied by quantity (PX), and using Equation (1) that can be written:

$$PX = \alpha P^{1-\beta} \quad (3)$$

To maximize revenue, we differentiate this expression with respect to P , and set the derivative equal to zero:

$$\frac{\partial PX}{\partial P} = \frac{\partial (\alpha P^{1-\beta})}{\partial P} = \alpha(1-\beta)P^{-\beta} = 0 \quad (4)$$

From this, it is clear that the value for β which solves Equation (4), and which therefore maximizes revenue, is where $\beta = 1$.

Now let us apply this model to the sale of standards. Assume that at the revenue-maximizing price (P_0), a total of X_0 copies of the standard are sold. Suppose also that standards are all sold online, so that the marginal cost of supplying an additional copy is zero (or trivially small).

If all standards are sold at a single price, and so some marginal users (who are willing to pay a positive price, but not as much as P^*), are priced out of the market. The potential revenue lost as a result of this is known in economics as the ‘deadweight loss’, and is given by the integral:

$$\text{Deadweight Loss} = \int_{X_0}^{\infty} \gamma X^{-\delta} dX = \left[\frac{\gamma}{1-\delta} X^{-\delta} \right]_{X_0}^{\infty} \quad (5)$$

Since $\delta = \frac{1}{\beta}$, it follows that if $\beta < 1$ then $\delta > 1$, and hence (5) simplifies to:

$$\text{Deadweight Loss} = \frac{\gamma}{\delta-1} X_0^{1-\delta} \quad (6)$$

On the other hand, the revenue recovered by the standards-seller who makes all his sales at a single price, is given by:

$$X_0 P_0 = \gamma X_0^{1-\delta} \quad (7)$$

Hence the ratio of the deadweight loss (Equation 6) to the revenue recovered (Equation 7) is:

$$\frac{\text{Deadweight Loss}}{\text{Revenue}} = \frac{1}{\delta-1} = \frac{\beta}{1-\beta} \quad (8)$$

Consider three examples. (i) If $\beta = 0.9$, then this ratio takes the value 9; the amount of value lost is *well in excess* of the amount recovered. (ii) If $\beta = 0.5$, then this ratio takes the value 1; the amount of value lost is *approximately equal* to the amount recovered. (iii) If $\beta = 0.1$, then this ratio takes the value 1/9; the amount of value lost is *small* in comparison to the amount recovered.

In short, unless the price elasticity is small, the amount lost by selling all standards at a single price, and hence pricing some standards users out of the market, is a significant loss. It follows that the revenues of standards organisation could be increased substantially by practicing the forms of price discrimination or innovative pricing described in Sections 5.1 (g), 5.2 (g) and 6.2 (c).

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