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The Transaction Costs Perspective on Standards as a Source of Trade and Productivity Growth

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Abstract

This paper discusses the design, implementation and use of standards from the perspective of transaction costs economics. A proper design and implementation of standards may lead to a considerable reduction of transaction costs, which enhances trade and, consequently, economic welfare. A major example is the use of containers, which has drastically changed the worldwide transport infrastructure, and lowered the costs of transport of goods considerably. The example of containers also shows that network externalities play a major role in the use of standards, and that, on the other hand, worldwide standards with large sunk investment costs may lead to a lock-in. This may call for government intervention in the design and use of standards, and in the transition processes to new standards. The paper provides ample further examples of standards and on the role of the government, or clubs, with respect to these standards.

Keywords: standards, transaction costs, innovations, lock-ins, network externalities, international trade

JEL-codes: L15, L16, L17

The transaction costs perspective on standards as a source of trade and productivity growth

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1. Introduction

In 2006 the container celebrated its fiftieth birthday (see Box 1). The container is an excellent example of what we want to illustrate in this paper, namely that standards, especially when they are used world wide, can bring about a substantial reduction of transaction costs. In this way standards promote international trade and enhance productivity and welfare. Because of the effects on productivity, the use of standards like the container can be considered an important innovation. It is not so much a “high tech'” innovation, but it is rather the common acceptance of the standard and its surrounding infrastructure, that are essential for the productivity gains of such standards. Standards that reduce transaction costs fit well in the tradition of trading nations such as the Netherlands. In this country, as early as in the 17th century – the “Golden Age” - setting standards contributed to the high level of welfare. Rembrandt’s famous painting of the syndics - “De Staalmeesters” - is a testimony of this (picture 1). The syndics controlled and categorized the quality of “laken”, a fine woolen fabricate, so that it was unnecessary for traders to control for quality every time before a transaction could be made. This reduced transaction costs. Another example is the internationally accepted sea law of the Dutch lawyer Hugo de Groot (picture 2). Harmonization of the various existing rules has made trade over sea safer, and therefore reduced transaction costs.

Since then world trade flows have continued to grow, though with ups and downs, to their current scale. This growth, which resulted in a huge increase of GDP par capita in the industrialized world, accelerated in the past 50 years. The widespread use of containers resulted in a considerable reduction of transportation costs, among others through reduced costs of loading and unloading ships, trains and trucks. At the same time, formal trade barriers, such as import restrictions and tariffs, have been gradually removed to some extent. It implies that informal trade barriers, like differences in tax legislation, administrative and legal requirements, became an increasingly important part of transaction costs. The further development of standards can contribute to a further reduction of informal trade barriers, and hence to a reduction of the transaction costs that are a result of these barriers. In this way standardization can contribute to a further increase in trade and prosperity. It is also in line with the trend of increasing specialization and fragmentation of production processes throughout the world. Low transaction costs promote that different parts of the production chain are produced at locations where a comparative cost advantage exists. This outsourcing of parts of the production chain enforces the process of globalization and is facilitated by a further reduction of trade barriers. So at the micro level of single transactions, the costs associated with such a transaction are reduced. However, at the same time at the macro level,

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the role of transaction costs gains importance, because globalization through fragmentation of production will result in an ever increasing number of transactions. Data on the relative increase in trade flows confirm that the increase in world wide transactions is proportionally larger than the decrease in costs associated with each transaction. So the proportion of value creation through transactions as part of total value creation increases. It implies that transaction management and orchestrating of the value chain becomes more and more important. It is for that reason that innovation policy should focus more on innovations, such as standardization, that support international trade. For example good ICT facilities are needed to enable effective assessment of security aspects, a new trend in international trade. The increased demand for safety, as a consequence of international terrorism, functions as a new trade barrier. Standards can help to increase the safety of transport while at the same time reducing the costs of the safety measures that are needed.

Box 1: The container

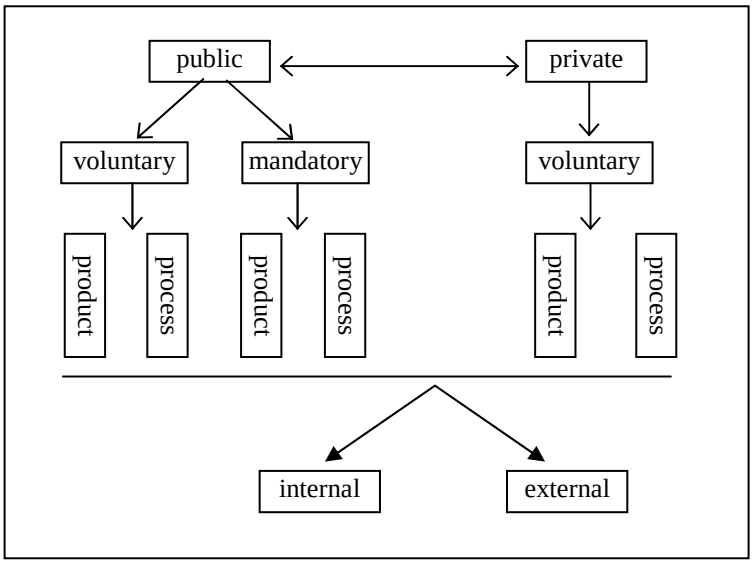
In April 1956 a harbor crane in the American city Newark loaded 58 aluminum containers in an old tanker. Five days later, the tanker was unloaded in Houston, where the containers were placed on 58 trucks, that would transport the containers to their final destinations. Since that moment, the container has conquered the world. Specialized ships can transport up to 13'000 containers at a time. This number is still rising gradually. Cranes in special build container ports can move 30 to 40 containers per hour, and sometimes process 10'000 containers a day. One container ship can be unloaded and loaded again in 24 hours (see Levinson, 2006). Thanks to the standard sizes that containers have, containers will fit on all appropriate ships and vessels, trains and trucks at any location on the world. A container is nothing more than an empty box of steel or aluminum, with a wooden floor and a large door at one side, about 7 feet wide and high, and slightly over 20 or 40 feet long. Clearly no big technological breakthrough. Still, the container managed to enable an enormous productivity gain in trade and transport. It has resulted in a global revolution in the way goods are shipped and transported. Without the container, globalization on a scale as we have seen during the last decades would have been very unlikely to occur. The whole infrastructure for the transport of goods is nowadays adapted to containers. In New York, the Chelsea Peers, that were reserved for the traditional loading and unloading of freighters, have been transformed to an entertainment center. Without the container, it would probably still have its old function. Alike, in Rotterdam parts of the old harbor area have new functions nowadays: the “Kop van Zuid” and the “Loydskwartier” have become residential areas, and are no longer used for loading and unloading general cargo.

This paper discusses the relationship between standards and transaction costs, and its importance for the strategic decisions both in the private and in the public sector. The next section gives a taxonomy of standards illustrated by some examples. Section 3 discusses the reduction of transaction costs that standardization and more specifically the chosen examples can bring about. An important question is how the welfare gains that are a result of decreased transaction costs are shared between the different stakeholders. This is the subject of section 4 which discusses how in a setting of different stakeholders, unifying standards are designed and implemented. Here, an important question is what economic incentives play a role in such processes. Some standards obtain the character of a public good, as the usage of standards cannot be restricted to those who contributed to its development and implementation, or because it is not in the public interest to restrict the usage of the standard. On the other hand, an existing standard can lead to an unwarranted monopoly situation due to economies of scale and network externalities inherent to the use of standards. Against this background, section 5 reviews the role that the government can play in this context. Section 6 summarizes the main findings of this study, and concludes.

2. Types of standards: a classification

Figure 1 summarizes how various types of standards and their role in the economy can be classified. The following definition encompasses more or less these roles in the economy: “a standard is the specification of the characteristics of goods and services that provides information on the quality of these goods and services and/or enhances their interoperability”. This section elaborates the classification of figure 1 based on the characteristics of the various types of standards. This classification necessarily is somewhat fuzzy as the characteristics may differ in different circumstances, which makes a clear separation of roles impossible.

Figure 1: Classification of standards



Classification of standards: an overview
The first distinction made in figure 1 is between public and private standards. This classification refers to the way standards originate. Is the *market* responsible for their development, or was it a *government* initiative? The government has the ability to make the standards *mandatory* through the introduction of legislation. This is in contrast to *voluntary* standards.

The following distinction of figure 1 is that between standards that are related to products and those related to production processes. *Product standards* are requirements with respect to some characteristics of the product itself, *process standards* are standards that prescribe how certain steps in the production process should take place. A problem is that often the question whether a product meets a standard can only be answered by an inspection of the production process. This can be very costly or even impossible for products that are not produced domestically.

The third categorization of figure 1 is based on the difference between *internal and external* standards. Internal standards are subject to the control of companies that set them, external standards are to be considered as given for individual companies. The remainder of this section provides a more detailed analysis of the classification in figure 1.

Quality standards and product differentiation

The extent of (product) differentiation is of importance for standards that prescribe the quality and specification of products and services. Economic theory distinguishes two main types of differentiation: vertical and horizontal differentiation. Vertical product differentiation has an ordinal character. To give an example: Rembrandt's syndics controlled the quality of the "laken" based on a list of characteristics, where a higher quality was assigned to products with superior characteristics. Horizontal product differentiation has no ordinal ordering, and is solely based on the individual taste of consumers. Therefore standards may have influence on the extent of product differentiation, where a more stringent standardization leads to reduced possibilities of product variation for the consumer.

A p*rivate standard* is a standard which primarily focuses on the interests of the private stakeholders that develop the standards. These stakeholders will only take the interests of consumers into account to the extent that it benefits their own interests.

Private standards can develop in different ways. For example, an individual firm may decide to share certain characteristics with other firms. The private standard can also originally be an internal standard (see later) that is adopted later on by other players in the market. An example is the bar code in the Netherlands. It was Albert Heijn, the Dutch branch of the multinational grocery company Ahold, that started to use this within its own supermarkets and logistics, and forced all its suppliers and business connections to make use of their standardized barcode system.

Alternatively, a group of firms can decide to develop a standard together. Firms often have shared interests, when they belong to the same industry and/or have the same suppliers and customers. When the standard can be used freely by third parties, it is called an "open standard". It is important to note that (in contrast to popular belief) is not the fact that the standard has no particular owner that makes it to an open standard, but merely that it can be used freely. There may be confusion with "open source", where the standard cannot only be used freely, but where it can also be changed to the desires of individual users. An open source standard is, because of this flexibility, less "standard", which results in a better correspondence with the specific demands of customers and allows for a larger product differentiation.

In other occasions, that is when a standard is owned by a collective of private organizations, one can speak of a *club good* (see also box 2). Here, the use of the standard is non-rival, but others (non members) can be excluded from using the standard. In that case, the standard does not have the full character of a collective good (which should be non rival and non excludable). A good example of such a club good is SWIFT. SWIFT is a collective of financial institutions that develops products for its members that deal with financial communication. In order to enable the communication and interactions in a safe and trustful manner, SWIFT has developed several standards in use for such communication. Franchising is another interesting example of a standard as club good. Through franchising existing product formulas and networks can be used (which results. for example, in economies of scale in purchases, logistics, and marketing), so that costs can be reduced. At the same time, the consumers information costs are being substantially reduced (a hamburger of McDonald's in Moscow is the same as in Amsterdam, so that the customer knows what he is up to), which results in a competitive advantage and therefore makes it very profitable for entrepreneurs to join such a formula.

There are also other economic incentives and interests that can stimulate actors to develop a standard together. For example, consumer interest organizations can develop a standard to compare the quality of different kind's products and services. Something similar holds for a trade union that tries to get good working conditions or safety standards introduced for their members. A lot of standards related to the ICT sector and the coordination between software and hardware have their roots in the private domain.

Box 2: XBRL

A recent example of a standard that has been developed as a club good is the eXtensible Business Reporting Language (XBRL). XBRL is a standard which registers corporate records – e.g. all kinds of bookkeeping and financial data - in a unified manner, and which presents them to different stakeholders. XBRL is comparable with the example of the container from box 1. XBRL transports financial information in the same way as the container transports goods in a standardized way. The standard enables different stakeholders to make digital financial and non financial data from their back office compatible for external usage. The external stakeholder can subsequently use the data in their own system, and extract the information according to the specification that they need. It is like a computer language, where the syntax has been standardized, while at the same time providing every user with he possibility to give an own interpretation to the semantics and use it in a way that suits their interests best (Dreyer and Wallis, 2006). Tax statements are also made less complex, since collecting financial data has become more straightforward. It thus improves the effectiveness and efficiency of collecting data, increases access to the information, and thereby results in a substantial reduction of costs for both the sender and the recipient of the information. There is no longer a need to make independent data collections for different usages. The receiver also knows for certain that the data has been calculated and reported using the appropriate definitions. The use of XBRL as standard has been promoted by a consortium of private actors (with at this time over 400 members). In the Netherlands the government (tax authorities, Central Bureau of Statistics,) has, in quite an early stage, supported the initiative to get XBRL more widespread and implemented as a standard for corporate financial statements (see also XBRL Nederland, 2006; Het Nederlands Taxonomieproject, 2006). XBRL is a good example of a standard that originated in the market, while the government joined the initiative later on. This path is regularly followed in the development of standards (this is also often the case when a new drug is introduced), and it enables a good balance of private and public interests.

Public standards are standards imposed by the government. Public standards attempt to serve a public interest. Most public standards have a large and rather general scope. The design and implementation of these standards becomes complex so as to meet all interests the different stakeholders, which is even more difficult when some interests are opposite. Public standards therefore require a political choice where the interests of different stakeholders are being weighted against each other. As yet, public standards are often a follow up to earlier private standards, which have been adapted by the government to become public standards in order to bring them more and more in line with public interests (WTO, 2005, p.33). In this respect the government may define the general conditions to which private standards have to comply. Public standards may also take private standards as model for defining specific characteristics.

Voluntary or mandatory standards

Public standards can be both voluntary and mandatory. A private standard is always a voluntary standard, unless government made that standard a public standard. Yet the threat of the government to make a standard a mandatory one can sometimes be a reason for private parties to introduce their own standard that is somewhat in line with government demands while still serving their own interests better than in case of a mandatory public standard. Examples are various codes of conduct - rules of appropriate behavior for companies and their

employees – that are the result of both ethical considerations and pressure of the government and other interest groups (e.g. NGO's). For instance, Shell has introduced high ethical and ecological standards partially in reaction to pressure from governments, human right organizations and environmental protest groups. Several types of self regulation are based on similar "voluntary" standards. The trigger mechanism behind it is that the costs of a reputation loss when the requirements of the standard have not been met can be very high.

Process and product standards

There are a number of rationales for process standards: (i) they may have a direct influence on the product quality (for example hygienic standards), or quality of services (for example ISO-certification); (ii) they enhance production efficiency (for example in case of network externalities), or (iii) they internalize external effects (as with environmental standards) (WTO, 2005, p.35). Moreover ethical considerations can play a role in the restrictions set by a process standards, for example in the case of child labor.

Product standards specify the characteristics of the product. A technical specification enables different companies to make use of the same product as input, as these companies can adapt their own production processes and products to the specification of such standardized products. Because the container has standard sizes, or, in this perspective: its own technical specification, it is possible for other companies to develop their applications on the technological specification of the container. The example of the container shows how a technical specification can have a worldwide impact. This holds for all kinds of standards that prescribe universal sizes.

According to Thompson (1954) industrial historians have somewhat undervalued the importance of technological standards in the automotive industry. The automotive industry is an early example of the use of industry wide technological specifications. These standards where needed because car producers had to rely on suppliers, a reliance that was relatively strong as a consequence of the complex nature of automobiles. An early example of a standard adopted by the automobile industry is the design of screws. These technological specifications made large scale production possible so that economies of scale were exploited.

Internal and external standards

Internal and external standards relate to different types of transaction costs (see box 3). Internal standards are used in order to come to a better coordination and hence to less transaction costs with respect to activities within the firm. External standards play a role in market transactions. These different roles of internal and external standards are linked to the way Coase (1937) described the nature of the firm. According to the Coasean principle, a firm has its optimal size when marginal transaction costs that are a result of (vertical) coordination via the hierarchy are equal to marginal transaction costs that are a result of (horizontal) coordination via the market. Better internal standards enable a firm to become larger, whereas a relative improvement of external standards enhance the possibilities to make use of outsourcing, subcontracting or purchase through markets. That may reduce firm size.

Box 3: MSD

The Dutch plant of the multinational drugs company Merck, Sharpe & Dohme (MSD) provides an example of how internal and external standards can affect corporate management. MSD Netherlands delivers drugs of the mother company to customers and regions all over the world. The Dutch plant coordinates the logistics, packs the drugs, and makes sure that all rules and legislative requirements have been met. Within MSD there used to exist an enormous diversity in packages. For example, different logos were used for the same product. A substantial part of this diversity was unnecessary. This unnecessary diversity can be considered an example of a suboptimal internal standard. As the company is, to some extent, free to make decisions on the shape, size and design of the package, it can reduces transaction costs by setting unified standards for its packaging. So the Dutch plant obtained cost reductions through more internal standardization and unification.

An external standard is ruled by mandatory requirements that have been imposed by third parties. This can be the government that made rules (in this case with respect to packaging of drugs), but it can also be a contract partner that has specifications according to the standard defined in the contract. Such external standards in package design play a major role in the case of MSD. MSD has to deal with many different prescriptions in various countries with respect to packaging and distribution of drugs. These differences relate to texts and codified signs on the package, to bar codes, and to medical descriptions and warnings on how to use the drugs which are to be included in the package. For example, it is prescribed that the medical descriptions are in the language(s) of the country where the drugs are used. Obviously it would be beneficial to a multinational like MSD that distributes its drugs all over the world, if it could promote some harmonization of government legislation in this respect. Such harmonization could also be beneficial to public health when the harmonized standards would imply the use of best practices with respect to information on drugs contained in the package.

Another example where external standards can bring about a reduction of transaction costs would be a standardization of qualifications of employees. When diplomas in, for example, India, China and East-European nations would provide the same and reliable information on the different levels of skills of their incumbent workers, it would reduce transaction costs for firms that are outsourcing parts of their production processes to these countries and regions.

3. The transaction costs economics of standards

The previous sections already mention how standards can contribute to the reduction of transaction costs (see Williamson, 1998; North, 1990, 1994). It holds both for specialization and coordination of tasks within firms and for transactions at the market. The more production processes are specialized and split up in various parts, the more coordination is needed and the more important it becomes to reduce transaction costs. On the other hand, a reduction in transaction costs, for example by making better use of standards, will promote a further fragmentation of the production process. It implies more transactions, cheaper production, and eventually increased consumption and welfare. An important reason why standards reduce transaction costs is that standards tend to reduce insecurity and information problems. In the literature, the best known effects of standards are network externalities and a reduction of switching costs (Blind, 2004). Standardization also increases the exportability of products, which facilitates the creation of economies of scale.

Typology of transaction costs

Transaction costs are all costs made in trade transactions, either as an exchange of property

rights in a market transaction, or as an exchange of responsibilities in a hierarchical situation. An entrepreneur who is able to keep his transaction costs low, will be more successful to offer an attractive product to the market, as this type of costs plays a considerable role in international trade. In principle two types of transaction costs can be distinguished: the "hard" or direct transaction costs and the "soft" or indirect transaction costs. The hard transaction costs relate to costs that are readily perceptible and quantifiable, such as transport charges, import levies and customs authorities tariffs. The soft transaction costs are much more difficult to observe and measure. One can think of all kinds of costs of making and checking contracts, information costs, costs because of cultural differences and communication failures, tacit knowledge on legal procedures, formation of trust and reputation, network building, costs associated with risks and with rules and regulation in order to reduce risks, security requirements etc.

These transaction costs can also be regarded as *frictions in (international) trade* which are the cause that the optimal trade equilibrium from a purely neoclassical perspective is not reached in practice. In fact there is much less trade than in a frictionless economy (Trefler, 1995, p.1029). Obviously standardization in international trade, and trade innovations like the container, contributed to the increase of trade flows. To what extent is unfortunately difficult to quantify. The theory of these frictions is comparable to the description of search frictions in labour economics, which give rise to dynamic unemployment equilibria (see e.g. Mortensen and Pissarides, 1994). In a similar way as a match at the labour market transaction costs can materialize before, during and after the transaction itself: the contact phase, the contract phase and the control phase.

In the *contact* phase of a potential transaction, the buyer is looking for information about his preferred product (price and quality), potential suppliers, or, when the product does not yet exist, which producer could invent and/or produce it for him. The seller is trying to find a buyer for his product through marketing activities. Here transaction costs are mainly search and information costs, where transaction costs are caused by the inaccessibility or incompleteness of information (see also WRR, 2003). Here there is an obvious analogy with search costs in labour economics. A special feature of these transaction costs in the contact phase is that they are sunk costs and are made even when no transaction results from seeking contact.

The *contract* phase starts directly after the moment the potential trading partners have found each other and are inclined to make a deal. Here transaction costs are made in negotiating the terms of the contract. Parties have to decide on how to make a reasonable slit-up of the expected rents of the transaction and what to write down in the contract. As there will always be uncertainties about expected rents it is impossible to make complete contracts that cover all possible circumstances. Apart from this incompleteness of information, information can be difficult to verify and may be asymmetrical. This means that one contracting partner can observe if the contract has been fulfilled, while the other contracting partner lacks this ability

The phase of *control* consists of the monitoring and enforcement of the contract. Both involve high transaction costs, especially at large distances. Monitoring means that business partners check whether the other party is doing what he promised to do. If the check turns out that this is not the case, the next step is enforcement of the contract. The most common solution for enforcement is to start a legal procedure. Especially in international trading relationships, this is often a troublesome affair. It takes time and money in large quantities and foreigners often

feel being mistreated by prejudiced national courts when they file a claim against a national company.

Standards and market failure

A telephone would not have any value for a consumer as a means of communication if he or she would be the only user of a telephone. The higher the market penetration of telephones, the higher is the value of the telephone for the consumers that own a telephone. This is the essence of *network externalities*. The value of the product is closely related to the size of the network. A standard can contribute to the development of a network that is large enough (Gandal and Shy, 2001, p. 363). Network externalities that arise when the size of the network grows are direct network externalities. Indirect network externalities arise when the number of complementary products that is available increases. An example of an indirect network externality is the combination of computers and software. As more software becomes available, the value of the computer for the user increases. This is best illustrated by the moment that the first operating system became available for the PC: it was especially after that time that the PC became a success. When standardized operating systems were unavailable, only highly skilled professionals could use computers. Both internal and external network externalities are causes of market failure, which results in underinvestment, in case there is no intervention from the government to repair the market failure. In case of indirect network externalities, a standard can contribute to the reduction of market failure, because it makes different products compatible (WTO, 2005, p. 36).

Apart from a coordination problem two other forms of market failure can arise as a result of network externalities: *excess inertia* and *excess momentum*. Excess inertia occurs at the supply side of the market, when the introduction of new techniques is delayed. In such circumstances firms are reluctant to bring their own technology in the market, since they take for granted that the technology of the market leader will be dominant and become standard. Excess momentum appears when buyers choose an inferior technique as standard. These two coordination problems are to be regarded as disadvantages of standardization. Another problem is that in the case of a private standard a monopoly position can be obtained. Here Microsoft's monopoly on the market for operating systems is a well known example. All software has to be compatible with the Windows operating system. Because Microsoft refused to make the source code of its operating system public, it was difficult for other producers to develop compatible software, so that Microsoft could gradually monopolize the entire software market.

A further aspect in this context is incomplete information. High transaction costs bring about incomplete information when the transaction costs of acquiring the information that is needed are higher than the (expected) gains in cost reduction, or profits, that the additional information yields. Obvious this argumentation shows that incomplete information does not exclude rational behavior. Asymmetric information, which is a form of incomplete information, relates to a situation where the buyer cannot observe the quality or specific characteristics of products. In his famous article on signaling problems with asymmetric information, Akerlof (1970) gives the example of the second hand car salesman. The buyer does not know the quality of car, so that, as a consequence, the bad cars (to speak in Akerlof's terms, the “lemons”) are crowding the good cars (“peaces”) out of the market. In this case, asymmetrical information reduces the supply of good quality products.

Mandatory standards can result in the removal from the market of all products that do not

comply with the minimum standard. This results (if the standard is set high enough) in sufficient quality of supplied goods. Voluntary standards in combination with labeling can provide buyers with sufficient information on quality differences in a situation where both low and high quality products are supplied. Negative labels can be made mandatory by the government for producers of goods that do not comply with a standard. Positive labeling is used by firms to enable the consumer to distinguish (often more expensive) products that comply with high standards. Therefore, standards can reduce, or even take away, the problem of asymmetric information identified by Akerlof. By making information more symmetric and less incomplete, standards reduce the transaction costs as they enable more and better transactions.

From the perspective of information, the economic analysis distinguishes three product types: (i) symmetric information products; (ii) experience products; and (iii) asymmetric information products. Symmetric products contain the information that is needed in advance in a way that is observable by the customer. In the case of experience products, the characteristics can be observed when using it. Asymmetric information products do not give the possibility to observe all relevant characteristics, not even after years of usage. Standards designed to solve the problem of incomplete information should focus on experience products and asymmetric information products. The above examples of labeling show that a standard enables the consumer to access information that he could not have obtained otherwise. Safety characteristics are an example of such information.

Standards as transaction costs reducing device

Standardization decreases search and information costs, that are both part of the transaction costs. When product specifications are standardized and know to trading partners, the bargaining process will cover only the price and conditions of delivery. When the product has not been standardized, bargaining will also be needed with respect to the specifications of the product. This leaves room for additional information costs, since the buyer does not avail of all information needed. An example is the technical specification of parts for the automotive industry referred to previously. After standards were introduced, it was no longer necessary to search for a supplier that could produce the parts that were needed in a specific situation. Search costs decreased and using external suppliers became more profitable. Apart from search costs, contracting costs were also reduced. Contracts between the producer and its suppliers did no longer have to be specified extensively. Clearly this also reduced enforcement costs. In the early automotive industry, individual producers did not have much market power, so that the benefits of standardization were entirely passed on to the consumer. Box 4 discusses two other practical examples.

Box 4: How standards can reduce transaction costs in practice

In the case of the eXtensible Business Reporting Language (XBRL) there are many types of transaction costs that are reduced. Administration will become less complex with XBRL. Companies using the standard can also reduce costs, since their internal control and reporting has become less complicated. Control by tax authorities will also be less time consuming, and thus less costly. The translation of the financial data from the backoffice system to a tax statement, warranted by the tax office, is no longer a complex process as it can be fully codified. For firms, it becomes much easier to serve different stakeholders with the information that they need, enabled by the right taxonomy and a simple push on the button. All sorts of reporting can take place more efficient, both in terms of time and money. Additionally, daughter firms and branches can be managed more efficient, since it is no longer needed to use complex internal reporting systems.
These costs reductions from the use of XBRL are in part a consequence of economies of scale and also of

network externalities. For instance, it brings about considerable cost reductions for firms when external actors develop their own taxonomies that can be implemented in all systems of the firms where these external actors need information from. Reliability can also increase, since information has to be imported in the system only once. Obviously, this development is going to reduce accountant costs. Management can also obtain more tailor-made strategic information, thus improving the quality of the decision making process. This results once again in a reduction of transaction costs, partially because the firm can make a better risk assessment.

At MSD an internal standard has been developed, to reduce packing costs, by – for example – using one package for a group of regions. Standardized packages can also improve the visibility of the firm and through this marketing device enhance reputation and reduce transaction costs. In other words, it reduces the information costs. The firm itself will mainly benefit from the standardization by lower labor costs and a more efficient inventory management. That is why the Dutch plant of MSD, in spite of relatively high labor costs in the Netherlands, has succeeded to remain efficient in the world wide distribution of drugs. In order to keep this position, R&D investments are needed to optimize standards that comply with the existing framework of legislation and regulation (which is very demanding in this specific case of drug packages). Because of this increased importance of R&D financing, a shift from variable costs towards sunk costs is taking place. Since MSD is critically assessing its own internal standards, it will also try to realize optimal external standards when interacting with governments. In this case of drugs packages, it appeared that governments were open to discussion for improvement and harmonization of standards. That is because also for governments, common arrangements in the form of standardized rules and regulations of what drug packages should contain, can be efficient. It ensures that the registration of drugs in one country will be transmissible to other countries and also that the rules and regulations are upgraded to best practices. Other producers can also benefit from these standardization efforts. That is way it is relevant to have these externalities of these standardization processes internalized in club goods or through governments.

Standards and trust

Trust is an important mechanism that enables the reduction of transaction costs, especially in the frequent cases of incomplete and/or asymmetric information. In such cases, contracts can never be complete, and trust will always play a role somewhere in the transaction process (Den Butter and Mosch, 2003; Mosch, 2004). Standards may very much contribute to such formation of trust. The example of Rembrandt's syndics shows that quality standards for "laken" will only lead to lower transaction costs when all stakeholders trust the expertise and independence of the controlling authority. A painting, made by a well known painter, that shows the distinguished gentlemen, can help to establish trust. This example illustrates the close relation between standards and trust. The reputation and reliability of the quality labels have to be build up slowly, because the formation of a trustworthy reputation will need some time. Explaining the standard and what it stands for to its users on the one hand, as well as adequate supervision, and careful development of a reputation of trust and reliability on the other hand, are needed to make the label to a success. Here the saying is that trust comes by foot, but may ride away on horse back. There is an analogy with the fiduciary character of money. When everybody can be sure that his or her coins and notes are universally accepted as means of payment, and when it is almost impossible to bring false money into circulation, money transactions can take place at low information costs. It is for that reason that central banks put great efforts in reducing opportunities to falsify money. Bank notes are printed on special paper and use high tech printing techniques with hidden features and holograms, in order to fight counterfeit (see e.g. Williams and Anderson, 2007). The Dutch central bank has also used marketing campaigns to show the public how they can detect false banknotes, thereby making the job very difficult for falsifiers. Similar methods are needed to make traders and consumers familiar with all kinds of (other) standards. The familiarity increases trust. In that way, brand names play also a role as standards, and can represent a high value for firms. For that reason familiar and established brand names were used to enhance trust in

internet trade.

4. Investing in standardization

This section deals with incentives for the development of standards. It is from the way standards affect the economy that can be derived why standards are used and developed. Even though standards are often developed in reaction to market incentives, as has been already argued above, market failures are present in other cases. This will result in too many or too little (or no) standards. The next section discusses more extensively how market failure can be an argument to legitimize government intervention.

Incentives to standardize: standardization and the market
Standards play an important role in the ever increasing fragmentation of production, and the related process of globalization. Here the chain of causality goes in two directions. On the one hand the reduction of transaction costs through standardization creates possibilities for an increased division of labor and more specialization. On the other hand more specialization and the reduction of other types of transaction costs that globalization brings about, e.g. through economies of scale and better exploitation of comparative advantages in factor endowments, will enhance the need for world wide standards. These cost reductions associated with fragmentation of production (outsourcing) and standardization will usually not only benefit producers, but by lowering product prices, will eventually also benefit the consumer. How welfare gains of standardization are shared between producers and consumers depends largely on the extent that producers are able to exclude others from using the standard. If, under the neoclassical assumption of perfect competition, excluding competitors is impossible, every gain in productivity will eventually be passed on to the consumer.

Box 5: Standards and the chip market

The chip market provides an interesting example of how standards affect the profit sharing between different players in markets. Intel plays an important role in setting standards in the chip market. These standards to a large extent exclude other producers from using that standard, especially since other producers (in the chip market this is especially AMD, which stands for Advanced Micro Devices) always have a technological lag relative to Intel, and can only start developing their own product after enough information about the newest generation Intel chips has become available. On the market for other computer parts there is much more competition. It is important for Intel that its chips have excellent compatibility with these parts, which means that Intel has to provide producers with information in an early stage of development, thus enabling the newest generation of processors to be compatible with available motherboards. Other chip producers can, based on this information, only reconstruct what the design of the newest processor looks like (reverse engineering), while it is relatively easy for producers of motherboards to make a design that has good compatibility with the Intel processors. This enables Intel (which almost has a monopoly) to keep its profits high, while the producers of other parts (that are faced with almost perfect competition) have no or compared with Intel only very small profits.

The presence of standards results in more competition, because inter-compatibility of intermediate products and parts reduces switching costs (being part of total transaction costs). Joining such a standard reduces the dependence on specific suppliers (or on dominant customers). This increased competition will, generally and on the long run, benefit the consumer. However, if other producers cannot use the standard, the owner will have the possibility to acquire a monopoly position (see box 5).

In some markets network externalities (see the previous section) play an important role. Standards can be warranted in such markets, but there are also pitfalls from the perspective of the functioning of these markets. For example, the GSM telephones in Europe – where only one standards was used- became an almost instant success, while it never reached the same level of market penetration in the United States (WTO, 2005). It illustrates that under specific circumstances (in Europe) different producers have a strong incentive to cooperate. At the same time, the case of the US makes clear that this cooperation does not always take place. It can be that network externalities result in different players (both producers and consumers) waiting until the market has chosen for a standard. Especially in the ICT sector this inter-compatibility is of great importance. When a standard has reached a certain critical mass, it is very likely to become (almost) *the* standard and will crowd out other possible standards.

An important incentive for firms to develop a standard can be the so called *first-mover advantages*. The designer of the standard has a time advantage on his competitors when entering the market, which will usually give him the opportunity to maintain a large market share on the longer term. He also has a knowledge advantage. The presence of network externalities is usually amplified by the non rival nature of standards. Every additional user is increasing the utility of all other users, while this does not come at the cost of all other users having to share the good with the new user.

Economies of scale and network externalities make a preference for international standards over local standards plausible. Obviously global standards give the opportunity to realize even more economies of scale, now that there is not only the advantage of national compatibility but also that of international compatibility. This is becoming increasingly important in the globalizing world of today.

The possibility to obtain the exclusive right to use a standard – by using patents and copyrights – is also an incentive to develop standards. When the standard is protected by copyrights or patents, it gives the owners the possibility to financially exploit their invention, and to exercise market power. The next section further discuses this relation between patents and standards. The possibility to exclude others from using the standard decreases the opportunities for free riders. Especially in a situation of network externalities, the possibility to exclude others plays an important role. Here, producers and users have a strong economic incentive to use one and the same standard, as soon as it has become the dominant standard in the market. Therefore, the monetary value of this standard will be very large for its owner. This is the problem of “the winner takes it all”.

When free rider behavior becomes possible, and first mover advantages become smaller, producers will take a more passive approach in the development and implementation of a new standard. In that case, it pays to wait until another producer has introduced a standard, and adopts that standard. The producer that developed the standard will bear all the development costs, while the benefits of the standard are the same for all players on the market. This will result in a clear competitive disadvantage for the innovating firm. In situations like this, it can take a considerably time before a standard is introduced in the market.

Section 3 discussed that so called asymmetric information products have characteristics that cannot even be observed after the products have been used. Large players in a market (with well known brands) can communicate these characteristics by building a good reputation, yet small players often lack this possibility. In such a situation the producers of products with a

relatively high quality have a strong incentive to join a quality standard. Whether it pays off to introduce a new standard depends on the extent to which existing standards are present and on the costs that are needed to introduce such a standard (for example marketing costs to get the general public familiarized with the standard). It is striking that in most industries there is only one quality standard. Producers that meet the minimum requirements of this standard would often also meet the requirements of a higher quality standard. There are several reasons why in such cases it is not profitable for these producers to come with their own standard. First, the costs of the new standard would have to be shared between a smaller number of firms. Second, the consumer can only respond to a limited amount of information, which means that every additional standard necessitates even larger marketing costs, and will also increase the information costs for the consumer.

These arguments illustrate again that the possibility to exclude others from using a standard plays an essential role. A quality standard makes little sense when products of inferior quality cannot be excluded from making use of the standard (for instance when producers pretend that they comply with the quality standard in their marketing campaigns).

How are standards set?
Sometimes, an existing technology somewhat fortuitously becomes a standard. In cases like this, the standard has an ad-hoc character. The standard is just there, without the pretension or plan to make it a standard. Standards which are developed as club goods may rather soon become profitable, since the costs can be shared while the club can still exercise some market power. In many other cases, however, a lot of coordination is needed to come to a standard. This is especially true for public standards, as in such cases it less likely that the benefits of developing the standard are large enough for only one or a few producers who are to develop and implement the standard. Yet, from the perspective of social welfare the development of such public standard could be warranted when the welfare gains of all stakeholders would exceed the costs of the development of the standard. In such a case there is a role for the government.

Standardization agencies, like the German DIN or CELENEC in Europe, constitute another important institutional arrangement through which standards can be developed. In the Netherlands the ECP.NL platform plays such a role with regard to ICT. A large number of standards, with a more or less official character have been developed this way. The development of standards by standardization agencies often takes place via a trajectory of consultation of and discussion with different stakeholders. That is because consensus formation and creating support for the use of the standard is essential. In order to get patents and copyrights recognized as a standard, standardizing organizations usually demand that they can be used at no cost or at relative low costs. This is relevant in case these standards were originally excludable as a private good or club good. In case of complete exclusion, there will be potential users that do not use the standard (for example when the price set by the owner is to high, or access to the standard has been denied to them completely), while the marginal revenues of using the standard would still be larger then the marginal costs for them. This is inefficient from a welfare point of view. When the designer of the standard has the possibility to ask a certain price from users of the standard (in order to stimulate the development of new standards), a trade-off occurs. A choice has to be made between efficient usage of existing standards on the one hand, and speeding up the development of new and improved standards on the other hand. Here, an open standard (see section 2), that can be used by everyone freely, is the best solution. Sometimes, when the owner can exclude others from using the standard, it

can turn into a “the winner takes it all” situation. The mentioned dominant positions of Microsoft and Intel in the computer world are good examples of that. On the other hand, standardizing agencies have an incentive to produce as many standards as possible, which could result in over standardization. Further research should reveal whether this is the case.

Farell (1996) modeled the process of political negotiation that takes place when standardizing organizations adopt a new standard. He considers a situation where several producers want to have a high quality standard implemented. When these stakeholders have large vested interests, it can be very profitable for them to get their own standard adopted, even if there is a better standard available (note that the concept of competitive advantages does not take efficiency gains that are equal for all companies into account). The willingness to wait plays an important role here. Since a high degree of consensus is needed to get the standard implemented, a stakeholder that can wait for a long time (and therefore has a strong bargaining position) has a strong incentive not to agree with a proposed standard that is of high quality but very different from its own standard. This stakeholder hopes that a fast implementation of a standard will be of such importance for the other stakeholders that they will eventually agree with an inferior standard. An interesting conclusion of Farell is, however, that the player with the best standard will usually have the largest preparedness to wait. Therefore he argues that the negotiation process is mainly a process of screening, where the different stakeholders rank each others preparedness to wait. This eventually results in an *ex ante* standard of high quality, but can be very time consuming. ICT improvements have somewhat increased the speed at which new standards are adopted by standardizing agencies, but it did have almost no effect on the screening process where the players explore each others preparedness to wait. The time that is needed get a new standard implemented is still over three years (IEC). This is an improvement compared with the situation 10 years ago, when, according to the annual report of 1995, more than 5 years where needed. Yet the process is still very slow. Especially when existing interests are large (usually when there are multiple stakeholders with large market shares), it can be efficient to increase the speed of the process, even if this comes at the cost of adoption of a suboptimal standard (Farell, 1996).

When setting a standard, the interests of the end users (often consumers) usually obtain less attention than those of the producers. The interests of individual producers are often very large, so that even for one producer it can be profitable to contribute actively to the development of a standard. Additionally, the number of producers is often somewhat limited, which makes it easy to get a standard introduced in a coordinated action. The users of the standard are often a large mass where the individual interests related to the standard are only very small. However, when their number is sufficiently large enough (as is often the case) their combined interest can easily be larger than that of the producers.

The welfare economics of standards

By reducing transaction costs standards generally have a positive effect on the economy and enhance social welfare. This is especially true when standards are voluntary and can be used (almost) freely by all market players. An example is the open source standards that are often developed by the users themselves (a well known example is the operating system Linux). An intriguing question from the economic perspective is about the incentives for the contributors to these freely available open sources (Lerner and Tirole, 2000, 2004; Von Krogh and Von Hippel, 2003; Gutsche, 2005; Maurer and Scotchmer, 2006). These open standards seem to give much opportunity for free riders, and there are no direct revenues for the contributors to the standard. However, it appears that informal hierarchies between the contributors build up,

where only a limited number of key programmers obtain the power to decide which additions are included in the system. Joining such a group of experts may increase the prospect to find a (well) payed job related to the open standard. Apart from that, intrinsic motivation often plays an important role for the contributors to open source standards.

Standards may also have a negative effect on the economy and be welfare diminishing. This is especially the case when they are used worldwide and there is a large existing infrastructure with high sunk costs. In such cases, the existing standard can make further innovation almost impossible. This has to do with the high transition costs (that are also part of transaction costs) of switching to a new and better standard. A well known example is the QWERTY keyboard, introduced in the late 19th century to prevent typing machines from jamming. In this era of computers it would be possible to switch to a keyboard design that maximizes typing speed. However, the costs of such a change are very high, since everyone would have to learn typing all over again.

Large network externalities can be a major cause of these *"lock-in"* effects. Here, the costs of being the first one to switch to a new standard, which is not compatible with the old one, can be extremely high. This will block innovation until the revenues of the new standard have become very high. A good example are fuel engines. The whole infrastructure, with roads, automotive industry, gas stations and everyone that has learned how to drive such a car, makes it almost impossible to abandon this standard in favor of another. The economics of these kinds of technological transitions have been extensively studied, especially with respect to new standards and technologies that are more efficient in energy use and therefore enhance environmental quality (see for example Den Butter and Hofkes, 2006).

Obviously there is a relation between standards and innovations: several studies found a positive relationship (WRR, 2003). A study of the DIN (2000) of the effects of standards on the German economy concludes that the impact of standards on the growth of the economy exceeds that of other types of innovation. However, standards can also be harmful to innovation so that the relationship becomes negative. Standardization can for example decrease the speed at which other major innovations are being developed. Innovations that require a standard which is not (yet) used world wide with sufficient network externalities, will be costly to develop as the revenues from the innovations will be low, at least on the short run. Also, the "winner takes it all" effects tend to increase the risks of innovators. The chance that in the end the technology of another developer becomes the standard is large in such cases. If so, there will be no revenues at all but only the sunk development costs. As a higher rate of return is demanded from investment opportunities with the same expected return but a higher risk, this risk premium implies a lower net present value of investments in new technologies. External effects may, however, sometimes result in additional revenues, that can be collected by the owner of the standard. This might also result in higher revenues of products that are compatible with the standard. Blind (2004) finds that industries with a high R&D intensity are characterized by a relatively low number of existing standards. It therefore seems that causality exists in two directions here: innovating industries do not standardize as much as other industries, and strongly standardized industries innovate less. Some other studies find, however, that there is not necessarily a causal relation between standardization and R&D expenditures (Blind, 2004).

The increased risks when the innovations are dependent on standards, appear to be an important reason for firms to join collective standardization projects. In this way, the risks of

R&D projects can be substantially reduced (DIN, 2000). Additionally, empirical evidence shows that other forces than standards are of far more importance as barriers for innovation (DIN, 2000). Moreover, as soon as innovations have become implemented as standards, these new technologies find their way to the production process and to the end users at a much higher speed than when standards play no role in the innovations. This may (more than) compensate the risk premium and consequent decrease in investments in innovations. Especially standardizing agencies play an important role in this respect. When new technologies are well specified in a standard, and for all stakeholders available at no or low costs, the diffusion of the new technology will accelerate (WTO, 2005; Blind, 2004). All in all, standardization seems to bring about a reduction in investments in new technologies, but at the same time in a better usage and broader application of the new technologies. Since this last effect is of far more importance than the first, the relation with innovation is (strongly) positive after all.

5. Standards and the government

The previous argumentation shows that leaving the development of standards entirely to the market can sometimes result in solutions that are suboptimal from the perspective of social welfare. The existence of market failure is a necessary – though certainly not sufficient – condition for government intervention. This section contains a more extensive review of the various aspects of market failure and of the role that the government can play in that case. First, asymmetric information and network externalities as sources of market failure are discussed. Subsequently, this section considers the role of the government in making the use of standards excludable, by protecting intellectual property rights.

Asymmetric information

In some cases, asymmetric information, where the producer usually has better access to information then his buyers, can result in inefficiencies. This is a clear case of market failure, since the assumption of full information is no longer met. When asymmetric information results in the inability of consumers to include some relevant aspects of the product in their buying decision, it is possible that only products that score low on these aspects are offered on the market, since they cost less (WTO, 2005). This can be undesirable, and therefore, albeit under conditions, can be a legitimatized ground for government intervention.

The government can take several measures to repair these market failures. One possibility is to force the producers to label their products. Another possibility to intervene is a complete ban on products that do not comply with a certain minimum level of quality. The latter is often inefficient, since there may also be demand for lower quality products. For instance, some consumers might not derive any utility from the fact that a good has been produced in an ecologically responsible manner.

Apart from internalizing negative externalities, it is especially through reducing information problems that the government can benefit society. It can be done by the introduction of a quality label that provides the user with information on several relevant aspects. Such a multidimensional quality label facilitates the supply of products with various quality levels. This system aims at promoting product differentiation which enhances consumer welfare. Although such a standard does no longer imply a unified set of minimum requirements that all products should comply with, it can still be regarded a standard. Joining this type of standard can be voluntary or mandatory. It is very likely that producers that have a low score on certain

dimensions will not voluntarily join the standard, in the hope that consumers will expect an average quality of the product in the absence of information. This can be undesirable. Therefore, the EU-energy label, for example, is mandatory and must be used by all producers.

Definitions with a subjective character pose another type of asymmetric information problem. For example, the definition of chocolate has been specified in a standard that prescribes, amongst other things, a minimum percentage of cacao. Producers are not allowed to label products that do not comply with the standard definition of chocolate as "chocolate". Such (mandatory) standards are desirable from a social welfare point of view, since they reduce the opportunities to misuse asymmetric information. In this way they reduce the chances of miscommunication and as a consequence the information costs for consumers. It is, however, important that the standard is closely related to popular definitions of the products that are covered by them. In other words, it is important that what is defined as "chocolate" in the minimum standard, is in line with what is generally considered to be chocolate.

Exclusivity and the protection of intellectual property rights
When third parties cannot be excluded from using a new (improved) standard, it will less often become profitable to invest in the development of such a standard. On the other hand, a standard protected by copyrights or patents, provides the owners with the possibility to exercise market power. It raises the price of using the innovative standards and consequently yields an incentive to increase the supply of innovative standards, while their usage will at the same time decrease. Obviously there is a trade off in this situation. Farell (1995) shows that in the presence of network externalities a less than full protection is justified from the perspective of social welfare. Two types of inefficiencies accumulate here: (i) the individual that does not use the standard whereas his or her gain in utility of using the standard is higher than the marginal costs, and (ii) the decrease in the utility of the other users, caused by the non-participation of this additional user. Empirical evidence shows that the presence of patents is indeed an important motivation to standardize (Blind, 2004).

When several producers engage in the development of a new standard at the same time, as was the case with the development of the DVD-player and the VCR, in the end all producers will have to switch to the technology that succeeds in reaching a critical mass of users first. In such situations the contribution of individual producers does not really lie in the development of the standard as it is, but rather in developing it a little bit faster or better than the others. Here, the first producer who gets his or her finding patented is rewarded with all the revenues. Again: "the winner takes it all". The presence of strong network externalities makes it even possible that a standard that has been chosen somewhat arbitrarily (e.g. it is not outstanding with respect to quality compared with the other technologies that competed to become the standard), becomes protected by copyrights or patents anyway. Therefore, most standardizing agencies require that the standard that is adopted is available free or at a reasonable price.

Legislation by competition authorities, which prevents cartel formation, may exclude inventions that have become a standard, from the protection by property rights. This can happen in cases where this protection results in decreased market competition. Measures that have lately been taken against Microsoft are a well known example. At first sight it seems somewhat unfair, because it implies that findings that are "somewhat" useful are protected, while a finding that becomes "very" useful at a certain point in time, loses this protection. However, it is plausible that making such exceptions will benefit social welfare. Moreover, since the large profitability of these findings stems mainly from the fact that they have

become a standard, and not so much because of the exceptional quality of the innovation itself, it can be regarded as unjust that the owner of the standard obtains a monopoly. Blind (2004) points at the fact that a lot of useful standards have started as patented technologies – something that is clearly positive – while these same patents can (especially when the standard has become a success) substantially reduce technological progress afterwards since others are not allowed to develop it further, and since diffusion of the standard is limited. In that case "standing on shoulders", which is a major source of technological progress, is no longer possible.

Apart from the arguments above with respect to the externalities of standardization, the government can also standardize its own services. A special case relates to services provided to multinational organizations. These organizations often have to take all sorts of differences in rules and legislation that exist between different countries into account. It can bring about high transaction costs for them. Especially small countries with legislation that differs substantially from that of other nations, will make themselves less interesting for multinationals. For a small country like the Netherlands it is therefore important to take this aspect of international compatibility into account when reconsidering the design of the legal system. Harmonization and less complexity can enhance the ability of a nation to attract foreign investments. To keep such country attractive as a trade nation, it is important to be one of the first in designing and adopting new international standards, especially with respect to government services. An example is harmonization and reducing transaction costs with respect to customs regulation, where many changes already have been made through the WCO (World Customs Organization).

Finally, ineffective governance with respect to standardization can result in an increased negative effect of the lock-in effects discussed earlier. When the government very strongly supports a certain standard, and when it can be changed only through lengthy procedures, the introduction of a new and better standard will be much more difficult. This is once again a plea for a well designed standardization policy, that is preferably organized through standardizing agencies. These agencies can devote special attention to policies that attempt to reduce lock-in effects, by promoting and supporting the introduction and development of new and better standards. The government can subsequently play a helpful role as an early adopter.

6. Conclusions

This paper outlines what can be called: "the economics of standardization". By giving a number of examples, it describes the mechanisms through which standards have their impact on the economy. A major aspect is that standards are important means to reduce transaction costs. They may reduce uncertainties, risks and other information problems; they may exploit economies of scale and network externalities, and they may enhance coordination of production processes. Thanks to standards more transactions can take place, which is beneficial to social welfare.. It is striking that welfare economics has somewhat neglected this important role of standards in the literature.

There is a large diversity of standards, differing from standards that are used within a certain firm to standards that are used at a global level and have resulted in fundamental changes in transaction and trade technologies and infrastructure. The container is a good example of the latter. It is sometimes difficult to draw a line between what can be called a standard, legislation, institutionalization or technology. One could even say that a common language, or

a common value system within a society can also be considered as standards. At least, similar processes that reduce transaction costs play a role here. For example, empirical evidence shows that countries with similar legislation have relatively large bilateral trade flows (Den Butter and Mosch, 2002). From that perspective the International Bureau for Fiscal Documentation (IBFD) attempts to harmonize tax legislation of different countries throughout the world. Empirical research of Islam and Reshef (2006) shows that good and reliable institutions are even more important for international trade than harmonization of these institutions. Therefore, standards should also play an important role in controlling the quality and reliability of institutions.

There is also a definition problem with respect to what can be called a standard and what an innovation. Many of the examples of this paper show that standards can often be considered innovations themselves – again the container as an obvious example. Often, it is not so much the technological sophistication – it is a mistake to focus innovation policy exclusively on "high tech" – but organizational efforts that are in particular needed to get a new technological standard implemented and accepted by different stakeholders. The relation between innovations and standards has yet another dimension. On the one hand, the existence of a standard can result in a large number of other additional innovations within the system of the standard, that derive their value from the standard. On the other hand, because of high sunk costs, a standard can result in a lock-in situation, where innovations that do not comply with the dominant standard, no longer take place. This problem of the lock-in, and that of high transition costs of escaping from it, also occurs when a much better alternative for the old standards becomes available, that would improve social welfare on the long term. In that sense, standards can also harm welfare.

The extent to which the standard has the character of a public good appears essential for the way standards affect the economy. Often, a technology or specification becomes a standard after a dominant market player in the private sector has put efforts in getting it accepted within the market. In order to guard against free riders, and to earn back the investment and implementation costs of the standard, it should be made possible to exclude others from using the standard. However, exclusion of others from using the standard becomes undesirable from the perspective of social welfare, when the use of a standard brings about network externalities. In cases of market failure, incentives to invest in the development of standards can be too low. In such cases government intervention is needed. A similar argument holds for government support to escape from lock-in effects and to come to faster implementation of newer and better standards. It is difficult however, to organize this government intervention in an effective and efficient way.

This paper only provides a qualitative review of the way standards reduce transaction costs, and of the consequent welfare gains. Quantification of these welfare gains, but also of the costs of the introduction and implementation of standards, has barely taken place. This is a promising field for further research.

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Picture 1. The “syndics” by Rembrandt, setting standards for the quality of “laken”.

Picture 2. Hugo de Groot (Grotius), protagonist of internationally accepted sea law.