



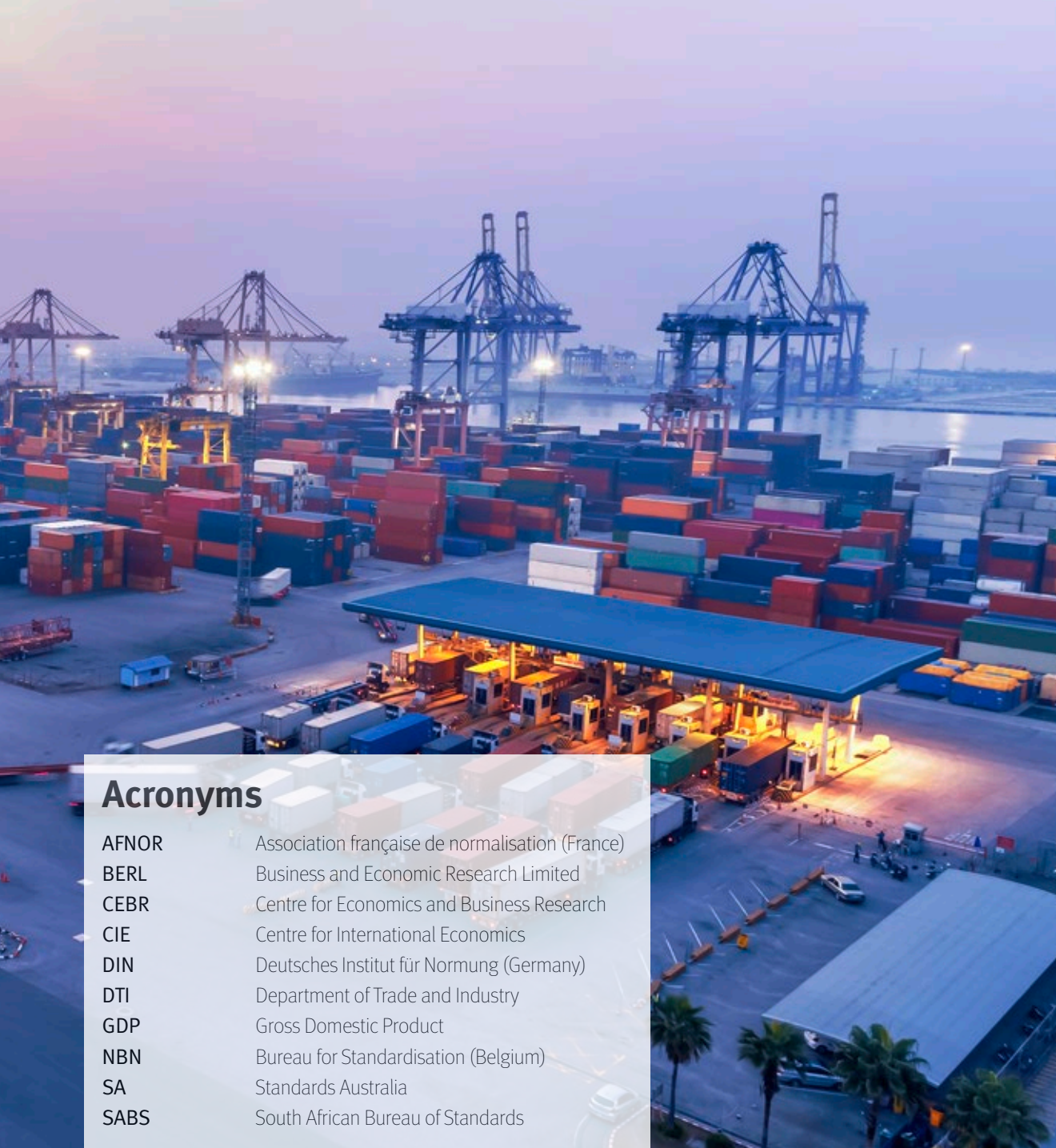
research

and innovation

Standards & economic growth:

ISO members' research on
the impact of standards on
their national economies

PAPERS



Acronyms

AFNOR	Association française de normalisation (France)
BERL	Business and Economic Research Limited
CEBR	Centre for Economics and Business Research
CIE	Centre for International Economics
DIN	Deutsches Institut für Normung (Germany)
DTI	Department of Trade and Industry
GDP	Gross Domestic Product
NBN	Bureau for Standardisation (Belgium)
SA	Standards Australia
SABS	South African Bureau of Standards

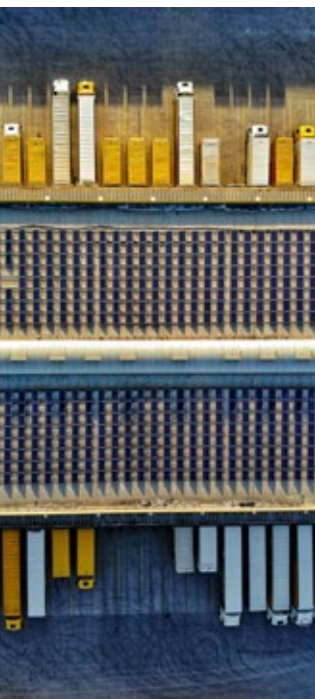
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Introduction

Very often, the notion that standards are beneficial to economies is taken as a given. Although it is easy to imagine the efficiencies created by standards at the company level and in trade relationships, these assumptions can be difficult to “prove”.

ISO members have provided economic analysis that seeks to show, in real terms, the economic benefits of standards. These studies make state-of-the-art knowledge about the economic impacts of standards widely available and help to demonstrate how standards are a critical part of an economy’s knowledge system.



Hereafter, we outline the roles that standards play in an economy and summarize the findings from 13 studies conducted by ISO members in the following countries:

- Australia (2 studies)
- Belgium
- Canada (2 studies)
- France
- Germany (2 studies)
- New Zealand
- South Africa
- Nordic countries: Denmark, Sweden, Norway, Finland, Iceland
- United Kingdom (2 studies)

Broadly, each of these studies found that growth in the country’s stock of standards¹⁾ was linked to economic growth. Through economic modelling, the studies examine the correlation between these two variables.

1) The “stock of standards” is defined across the studies as the “sum of all published standards up to the end of a specific year minus the sum of standards that has been withdrawn up to the end of that year” (NBN, 2020). This refers to standards published nationally or to regional/international standards adopted at the national level as in the case of European harmonized standards.

Research context

Broader research on economic impacts of standards

This summary refers only to research conducted by (or for) ISO members. However, their research draws extensively on scholarly research on economic growth and standardization.

Variation in standards types and functions

The overall “stock of standards” in any given country will include a range of different standards types, all of which can be expected to have different types of impacts that may relate to economic growth. For example:

- Compatibility/interface standards may promote trade, improve knowledge dissemination and contribute to network externalities (where the value or utility of a product/service increases as more people use it).
- Minimum quality/safety standards may promote trade, increase consumer confidence (including by reducing information asymmetries) and lower search costs associated with procurement and purchasing.
- Variety-reducing standards may increase market efficiency by allowing larger, more efficient scales of production.
- Information/measurement standards may improve knowledge dissemination, increase consumer confidence and contribute to marketplace efficiency.

These individual impact types are not considered here – rather, the studies focus on the total volume of standards that are active and the change in that volume over time.



Standards as one of multiple factors

Standards are an important part of a multifaceted system of technology development and knowledge diffusion. They do not “operate alone” in terms of their contribution to economic growth, but are likely interdependent with other factors. For this reason, the Department of Trade and Industry (DTI, 2005) suggests, “they should not be considered independent of other factors integral to technical change”.

Purpose of standards

As noted by economic research consultancy BERL (2011) and others, individual standards are not generally developed for the purpose of furthering economic growth. Instead, standards have their own objectives and contribute to society in many ways. Nevertheless, being able to quantify the positive economic benefits of standards can offer support for the case for standards overall.

Standards can distil knowledge, provide a common language for discussion, underpin markets and help solve some externality problems. (CIE, Australia)



Conceptual basis

Economic growth

Economic growth theory generally suggests that the output of an economy, commonly measured as gross domestic product (GDP), is the result of the value generated by two kinds of “inputs”:

- Capital: fixed resources used to create products and services, like machinery and the buildings in which products are manufactured
- Labour: outputs produced by people working

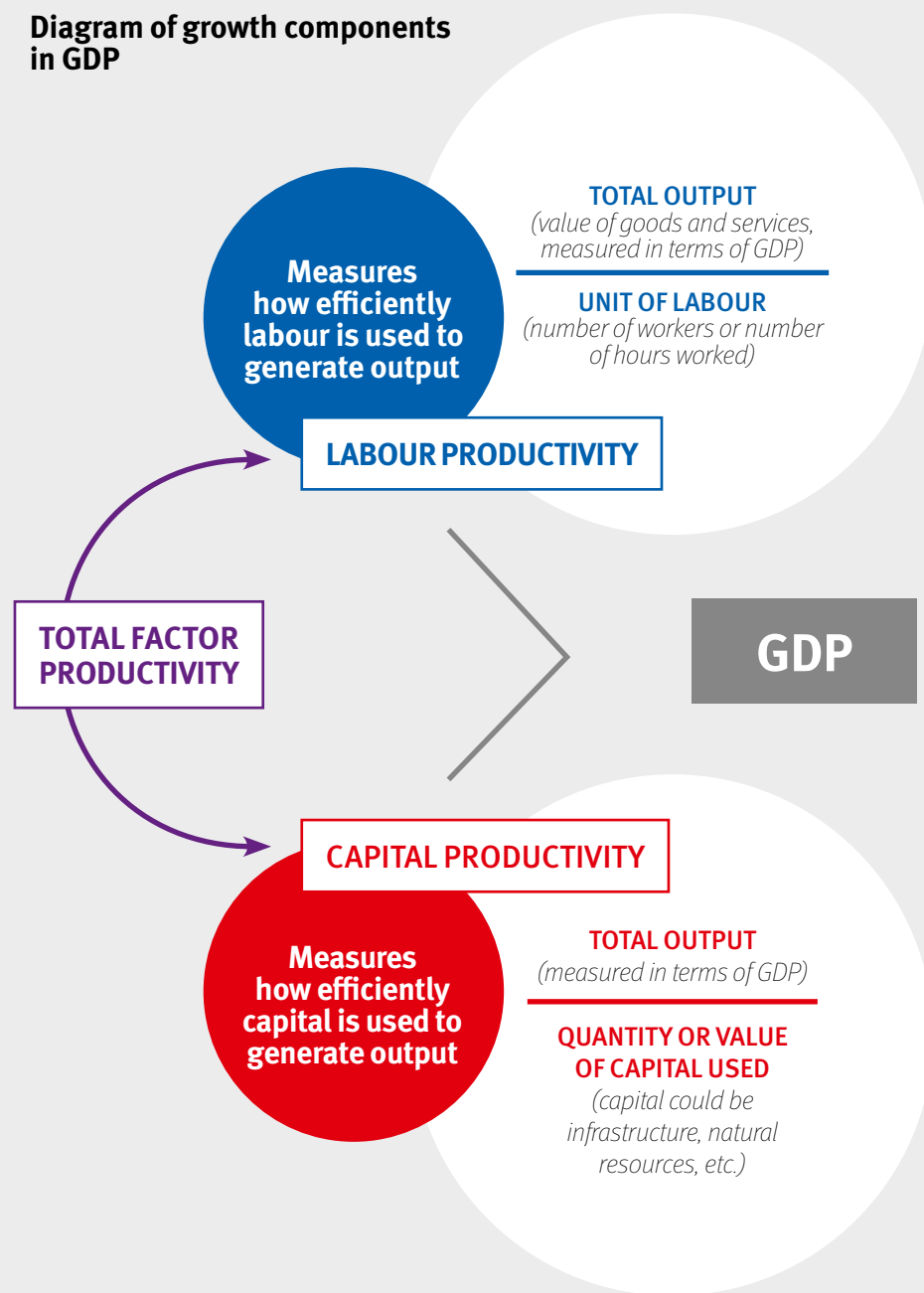
Once a certain level of economic development (or productivity) is reached, any further inputs in the form of capital and labour will create less value than they would have previously. This is the effect known as “diminishing returns”. Also relevant is that labour and capital are naturally limited – labour by the size of the working-age population and capital by the various resources available to an economy.

A way to continue economic growth beyond this point is to make the use of capital and labour more efficient. This results in more value being created using the same resources (of labour and capital).

This is widely believed to be done through inputs in the form of technological change and dissemination of information in the economy. This “technology/knowledge” input forms a third input category: total factor productivity (TFP) (also called multi-factor productivity or MFP).

TFP does not work alone; it increases the efficiency with which capital and labour are used. Instead of generating value itself, it enhances the value generated by the existing two inputs: labour and capital.

Diagram of growth components in GDP



A number of things contribute to TFP. Some widely theorized components are:

- Dissemination of information about new technologies within the economy
- Research and development (R&D) activities leading to new technologies and improved knowledge in the economy
- Availability of new technologies, including from foreign sources
- Improvement in education of the labour force



Standards and economic growth

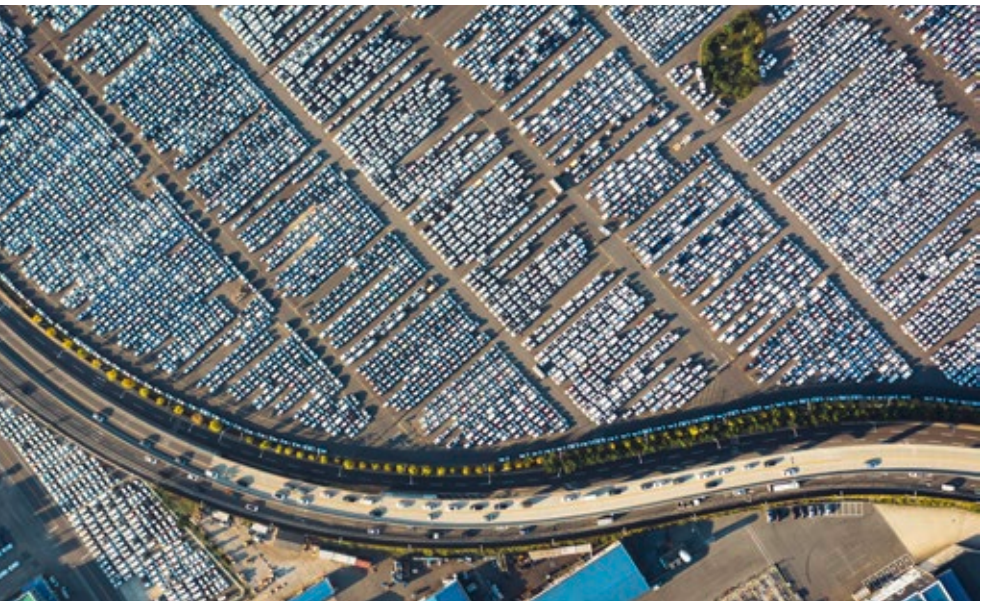
Standards are thought to contribute to economic growth by serving as a component of TFP. That is, standards contribute to the overall “knowledge stock” in an economy, and therefore improve the efficiency of use of capital or labour (or both).

Standards also have impacts on other outcomes that directly relate to economic productivity (but are not explicitly measured here), such as **international trade** and innovation.

The economic impact studies presented here focus on the contribution of standards to economic growth via TFP. Some also offer insights at the company level about the impacts of standards on quality, efficiency, trade and other factors.

The results of research and knowledge creation find their maximum economic value when they spread through the economy. Standards, as a source of codified knowledge, are an important vehicle for this dissemination process...

(DTI, UK)



Methodology overview

Each of the studies used a similar methodology based on a modelling approach developed for the German Institute for Standardization (DIN) in 2000. The studies are based on the **Cobb-Douglas function**, which allows researchers to establish the contribution made by each of the three components outlined above (labour, capital and total factor productivity) to economic growth.

Each study selects a measure of each of the components:

- Labour is generally measured by aspects of employment like number of people employed or number of hours worked.
- Capital is measured by national estimates of total capital, like the gross fixed capital formation.

These estimates are usually produced as part of the **national accounts** system.

- Economic growth is generally measured either by GDP or by a measure of labour productivity, such as output per hour worked.
- Standards are measured by the stock of standards, which is the number of standards (national standards or international standards that have been nationally adopted) that are “active” in an economy at a set time (in these studies, usually a calendar year). This number is generated by subtracting the number of “withdrawn” or retired standards from the number of standards that are published or added to the catalogue.

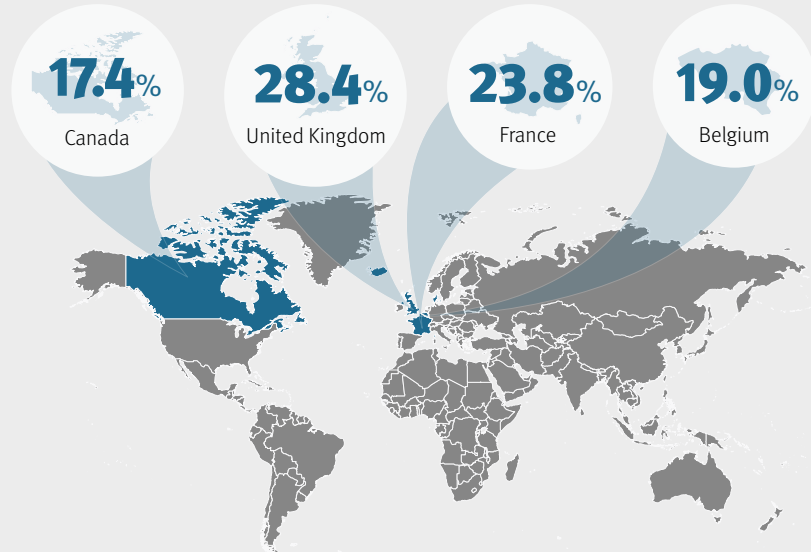
A comprehensive list of data sources used in each study is provided in **Annex A²⁾**.

2) Some researchers include an adjustment in order to account for other things that might contribute to TFP/MFP, such as patents, recessions, research or development activities. For example, DIN (2011) included patent applications in its model. This additional data is not included in this summary but is available in the individual member publications.

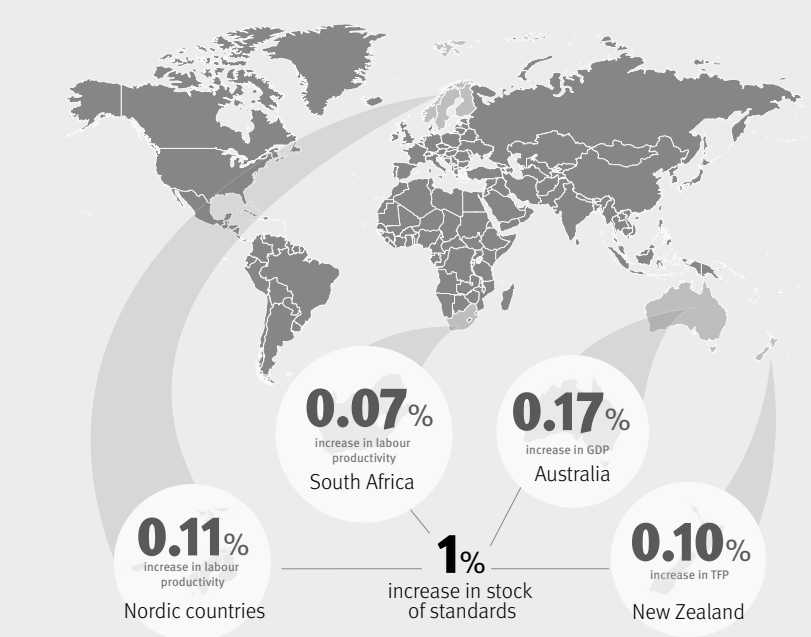


National findings

Percentage of GDP growth over the reference period associated with an increase in the stock of standards



Estimated GDP growth associated with a 1% increase in the stock of standards



Findings

Each study found that an increase in standards (most often the stock of standards) was correlated with a measure of economic growth. Using economic modelling, the researchers were able to suggest the amount of economic growth that could be explained by the increase in standards.

The following table (page 14) outlines the results identified by each country. Note that the studies used varying methodologies and data sources, so they are not directly comparable. This table, therefore, provides an overview of the results, but the individual country-level results cannot be compared with one another.



Summary of study findings by country

Country	Publication year	Period of analysis	Estimated economic function	Contribution of standards to growth in:		Projected impact of a 1% increase in standards	Contribution of standards to GDP growth
				GDP	Labour productivity		
				(expressed as a percentage)			
Australia	2006	1962-2003	TFP	–	–	0.17% increase in TFP	–
Australia	2012	1982-2010	LP	–	–	0.17% increase in GDP	–
Belgium	2020	1994-2018	LP and GDP	19%	19%	–	0.2%
Canada	2007	1981-2004	LP	9.0%	17.0%	0.356% increase in LP	0.24%
Canada	2021	1981-2019	LP and GDP	17.4%	38.4%	0.056% increase in LP	–
France	2009	1950-2007	GDP	23.8%	27.1%	0.12% increase in TFP	0.8%
Germany	2000	1961-1990	GDP	–	–	–	1%
Germany	2011	1960-2006	GDP	–	–	–	0.72%
New Zealand	2011	1978-2009	LP and TFP	–	–	0.10% increase in TFP	–
Nordic Countries	2018	1976-2016	LP	28%	39.5%	0.105% increase in LP	–
South Africa	2016	1972-2011	LP	–	–	0.07% increase in LP	–
UK	2005	1948-2002	LP	–	13.0%	0.05% increase in LP	–
UK	2015	1921-2013	LP	28.4%	37.4%	–	0.7%

TFP: Total Factor Productivity | **LP:** Labour Productivity | **GDP:** Gross Domestic Product

Note: This table offers a general overview of research findings for indicative purposes only. Countries cannot be directly compared because of variations in reference period, data sources and methodology.

Theorized mechanisms

While these studies suggest the magnitude of the impact of standards on an economy, they do not identify how standards are having such an effect. However, each of the studies points to potential mechanisms by which standards make these contributions to economic growth.

There was also a great deal of consensus among the studies, with most suggesting that standards perform the following functions that lead to economic growth. (Many of these theorized mechanisms are borne out by the micro-economic studies described in the section below.)

Disseminating information

Standards are widely believed to serve an information dissemination function within an economy, making state-of-the-art knowledge equally available to everyone. They are thought to do this in two ways:

- By codifying information about technologies, products and processes so that all manufacturers and service providers have access to the same information
- By facilitating the exchange and distillation of technological and other knowledge through the standards development process (CIE, 2006)

Contributing to efficiency in companies that use standards

Standards can reduce operational costs by establishing procedures that reduce expenses for repeated activities. In the case of management standards, they reduce the cost of “spreading ideas” within an organization.

Supporting market efficiency

Standards can support the efficiency of markets in multiple ways:

By preventing market failure

- It is theorized that free markets may not provide reliable “diffusion paths” for the spread of technology (DTI, 2005). Standards can prevent this market failure and increase the efficiency of markets by ensuring transmission of technological information.

By facilitating network externalities

- Network externalities are a network effect by which the value of a technology increases as the number of users increase. A classic example is the telephone. In today’s technology markets, interoperability standards ensure that technologies can interact, leading to increased value and greater market efficiency.

By reducing production costs and increasing company productivity

- Standards reduce the cost of identifying product specifications, quality levels, etc. By using standards over time and across the production and supply chains, productivity is increased because less money is spent finding information, adapting to new components or developing component/product specifications.

Facilitating innovation

Standards are thought to support innovation by establishing the playing field for technologies on which new products and services can be built. CIE (2006) suggests that this may contribute to the “routinization” of innovation practice that is characteristic of modern economies.

The timing of a standard may impact on this value contribution in that a standard introduced too early in the course of a technology’s development may have the effect of “locking in” a sub-optimal technology. Conversely, a standard introduced too late can result in high costs for adoption and transitioning to the requirements set out in the standard.



Other research findings

To further explore the relationship between standards and national economies, a number of the studies looked in detail at experiences at the company level and impacts of standards in specific sectors.

Company surveys

Surveys conducted in the Nordic countries (Menon Economics, 2018) and Belgium (NBN, 2020) found that the main benefits of using standards observed at the company level were:

- Improved market access
- Better quality of the products/services they produce
- Reduced risk and improved risk management

A survey of French companies showed similar results but identified five additional benefits of using standards:

- Improved interaction with public R&D institutions
- Company value enhancement (this benefit was also related to companies’ participation in standards development)
- Dissemination of innovation
- Improved compliance with competition rules
- Increased opportunities for international exchanges, in particular a rise in exports

Related to these findings, in a survey conducted in the United Kingdom, 84 % of respondents reported that using standards had “contributed to enhancing the status of their company”. The Centre for Economics and Business Research (CEBR) surveyed 527 companies across seven sectors in the UK. The survey examined the impact of standards on, among other things, company turnover, labour productivity, exports, innovation, supply chain relationships, overall productivity and competitiveness. It also asked about the companies’ experiences of participating in standards development.

Of the companies surveyed, 48 % reported a net benefit from standardization (although there was some variation by sector). Generally, companies found the use of standards to be associated with increased revenue (between 1.7 % and 5.7 % across all sectors surveyed), increased labour productivity (measured as gross value added) and increased exports (impact varied by overall trade volume). In the sectors of information communication technology and food & drinks manufacturing, a majority of respondents reported that standards increase productivity, while views were more mixed in the aerospace & defence and the construction manufacturing & services sectors.



The information contained within [standards] is the technological benchmark for innovation, safety, interoperability and trade [...]. It is in this way that standards are a key mechanism for the diffusion of technological knowledge and therefore a key component of productivity.

(SA, Australia)

In terms of innovation, opinions differed. While 54 % of respondents reported that standards can facilitate technology transfer and make innovations more accessible, 59 % said they caused the companies to lag behind technological development. These findings are in line with the broader literature on the mixed impacts of standards on innovation.

Most of the companies that participated in the survey were not involved in standards development activities, but those that were reported they were more likely to reap the benefits of standardization. A commonly held reason for this was that participation in standards development “facilitated the anticipation of future market rules and emerging themes in their industry”.

The Belgian survey also considered participation in the standards development process. Respondents concluded that being able to influence the content of standards and having access to industry information and networks are important drivers for participation in standardization. The study highlights the standards development process as an important mechanism for diffusion of information, likely with its own impacts on economic productivity.

Sectoral case studies: Australia

The study conducted by CIE for Standards Australia included case study research on the economic impact of standards in specific industries.

Sale of minerals

The researchers looked at the impact of selected standards on the mining sector as a whole. Standards for sampling procedures set out how a company should identify the mineral content of ores and concentrates. By producing tests with a high degree of precision and minimum bias, companies are able to assure their customers of the purity of the ore/concentrate and command a price that reflects the quality of their product.

The researchers calculated the increase in the sale of minerals that could be associated with the use of standards for sampling procedures. They found the standards could result in an estimated trade growth worth USD 58 million (based on 2004-2005 prices) if adopted across the whole mining sector in Australia.

Water and electricity

A range of standards serving diverse functions is available for the water and electrical industries. This case study considered the combined impact of all relevant standards on two factors related to the production of water and electricity for communities:

- Input costs: costs associated with providing water/electricity to households and businesses (e.g. networks of pipes and wiring, digging of trenches and tunnels, infrastructure and systems management)
- Access/use costs: costs associated with users accessing and using water/electricity

By considering the relevant standards as part of an economy-wide model, the researchers reported an estimated benefit of USD 1.9 billion per year for the economy. In other words, if the available standards were used across the water and electricity industries, GDP would be USD 1.9 billion higher than it is without standards.



Company-level case studies: Belgium

An NBN (2020) review of case studies carried out across 12 Belgian companies found that the benefits of standards at the company level are numerous. They include:

- Facilitating dialogue and transactions with customers and suppliers (participants believed this lowered transaction costs, improving the company's financial performance)
- Creating a level playing field in competitive markets
- Improving product quality and safety
- Facilitating global trade and supporting competitiveness in global markets
- Supporting R&D, innovation and the commercialization of innovative products and services

Moreover, respondents found that participation in standards development is crucial for larger companies because it allows them to anticipate potential market developments and maintain strong industry networks. In the case of smaller companies, two general approaches seemed to emerge: small to medium-sized enterprises either take a reactive stance to standards, shifting their processes where necessary, or they seek to influence the standards development process through their engagement with larger companies.



Stakeholder interviews: Canada

The Conference Board of Canada (2007) interviewed 15 people across the private sector, government and standards bodies. Interview topics included participation in the standards development process, the strategic importance of standards and the relationship between standards and innovation, trade and operational costs.

Interviewees described standards as creating both “a demand for higher quality and technically superior products” and a level playing field on which companies are able to produce high-quality product while “following the same rules”. They also highlighted the value of national standards systems in coordinating standards development activities and bearing the costs of standards development. They spoke about the role of standards in opening up international markets and emphasized, in particular, the importance of international and harmonized standards for facilitating global trade.

On the subject of cost savings, the interviewees described mixed impacts. On one hand, product standards can lead to cost savings by reducing transaction and research costs; they described this impact as being most beneficial when production volume is high. Conversely, standards can have a negative effect on profits if companies are “locked in” to obsolete technologies and are unable to innovate and/or benefit from newer technologies. When discussing management standards, interviewees described the potential for ISO 9000 to reduce costs by increasing efficiency and reducing waste.

Stakeholder interviews: United Kingdom

To complement the survey results outlined above, CEBR conducted interviews with 13 sector representatives across the same seven sectors as the survey. Interviews covered topics such as the standards used in the sector (and how they are used), the strategic importance of standards for the sector and the costs and benefits they bring.

Broadly, the interviewees across multiple sectors reported that standards:

- Contribute to more efficient processes
- Ensure higher-quality products (even more so when established as a requirement in supply chains)
- Reduce defects and waste in the production cycle
- Improve access to global supply chains and new markets
- Improve companies' reputation and convey important quality information to consumers

Analysis of the Community Innovation Survey³⁾: United Kingdom

As part of their 2005 study, the DTI conducted analysis on the United Kingdom's Community Innovation Survey (undertaken by the Office for National Statistics). By comparing survey responses across questions relating to innovation and information sources, they identified that respondents saw standards as both constraining innovation and providing information. They found that companies that were active in innovation were most likely to value the information provision role of standards.

3) Community Innovation Survey: series of surveys performed by national statistical offices throughout the European Union and in Norway and Iceland, designed to provide information on the innovativeness of different sectors and regions.



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“**The Economic Benefits of Standardization**”, 2011
- Liao, D (Standards Council of Canada)
“**Every Standard Counts – How Standardization Boosts the Canadian Economy**”, 2021
- Menon Economics
“**The Influence of Standards on the Nordic Economies**”, 2018
- NBN and the Vrije Universiteit Brussel
“The Impact of Standards on the Belgian Economy 2020”, 2020
- South African Bureau of Standards (SABS)
“Economic Impact of Standards”, 2013
- Standards Australia (SA)
“**The Economic Benefits of Standardisation**”, 2012

Note: This reference list includes hyperlinks to the publications where they are freely available online. These links are correct as of 26 April 2021.



Annex A

Data types and sources

The data types and sources used in each study are outlined below, grouped by the four main components of the equation:

$$\text{labour productivity} + \text{capital productivity} + \text{TFP} = \text{GDP}$$

The information presented hereafter does not include adjustments applied to the data and any control variables added beyond the basic equation. Publications missing from the following tables did not have data sources clearly stated.

Data used to estimate labour

Country	Measure of labour	Data source
Australia (2012)	Number of employed persons	Data source not stated, but this information is available from the Australian Bureau of Statistics' National Labour Force Survey
Belgium	Employment (not further defined)	Organisation for Economic Co-operation and Development (OECD)
Canada (2007)	Index of labour productivity in the aggregate business sector	Statistics Canada
Canada (2021)	Total hours worked in the labour market in Canada	Statistics Canada
France	Total working population	National Accounts data
Germany (2011)	Number of employed persons subject to social security contributions, excluding those working in the agriculture and forestry sector, in property services, or in domestic services	German Federal Statistical Office
New Zealand	Number of employed persons	Data source not specified, but this information is available from Statistics New Zealand
Nordic countries	Number of employed persons	Country-level data accessed from OECD.Stat
United Kingdom (2005)	Employment (not further defined)	Office for National Statistics
United Kingdom (2015)	Number of employed persons (16+)	Office for National Statistics
South Africa	Ratio of capital to labour	South African Reserve Bank

Data used to estimate capital

Country	Measure of capital	Data source
Australia (2012)	Gross fixed capital formation	Data source not specified, but this information is available from the Australian Bureau of Statistics' National Accounts
Belgium	Net capital stock	Organisation for Economic Co-operation and Development (OECD)
Canada (2007)	Hyperbolic end-of-year net stock of non-residential capital for all industries	Statistics Canada

Canada (2021)	Stock of fixed non-residential capital from all industries at each year end	Statistics Canada
France	Total capital inputs	Source not specified
Germany (2011)	Gross fixed assets	German Federal Statistical Office
New Zealand	Labour and capital productivity index	Not stated
Nordic countries	Measure of capital not specified	Country-level data accessed from OECD.Stat
United Kingdom (2005)	Gross capital stock, excluding dwellings	Office for National Statistics
United Kingdom (2015)	Capital stock	Bank of England and Office for National Statistics
South Africa	Gross fixed capital formation	South African Reserve Bank

Data used to estimate economic growth/labour productivity as dependent variable

Country	Measure of economic growth	Data source
Australia (2006)	Total factor productivity	Productivity Commission
Australia (2012)	GDP	National Accounts data via the Australian Bureau of Statistics
Belgium	Labour productivity per person employed and per hour worked	Organisation for Economic Co-operation and Development (OECD)
Canada (2007)	GDP	Statistics Canada
Canada (2021)	GDP	Statistics Canada
France	GDP	Not stated
Germany (2011)	GDP	German Federal Statistical Office
New Zealand	GDP	Data source not specified, but this information is available from Statistics New Zealand
Nordic countries	GDP	Country-level data accessed from OECD.Stat
United Kingdom (2005)	Gross value added (at 2000 prices)	Office for National Statistics
United Kingdom (2015)	GDP	Bank of England and Office for National Statistics
South Africa	Labour productivity	Quantec (private economic consulting company)

Data on standards

Country	Measure of standards	Data source
Australia (2006)	Stock of standards	Standards Australia and SAI Global
Australia (2012)	Production rate of standards	Standards Australia
Belgium	Stock of standards	Belgian National Standards Bureau and European Committee for Electrotechnical Standardization
Canada (2007)	Stock of standards	Compiled by Standards Council of Canada using data from the Bureau de normalisation du Québec, Canadian General Standards Board, Canadian Standards Association and Underwriters Laboratories of Canada
Canada (2021)	Stock of standards	Compiled by Standards Council of Canada
France	Stock of standards	French Standards Association
Germany (2011)	Stock of standards	German Institute for Standardization and Perinorm global standards database
New Zealand	Stock of standards	Standards New Zealand
Nordic countries	Stock of standards	Menon Economics, Standards Norway, Swedish Standards Institute, Danish Standards Foundation, Finnish Standards Association, and Icelandic Standards
United Kingdom (2005)	Standards Catalogue Index	British Standards Institution and Perinorm global standards database
United Kingdom (2015)	Stock of standards	British Standards Online database
South Africa	Stock of standards	South African Bureau of Standards



Annex B

Variations on the shared methodology

All studies summarized in this paper used the methodology outlined above, with variations in data sources and definition of proxy measures according to national priorities, data availability, etc. Some of the studies considered additional topics within the economic growth equation.



Australia (Centre for International Economics)

CIE (2006) combined the stock of standards with a measure of R&D in the economy to create a single “knowledge stock” variable. When considering the impact of this knowledge stock variable on TFP, it found that a 1% increase in the total knowledge stock would lead to a 0.12% increase in TFP. This is consistent with the suggestion by DTI (2005) that standards operate in conjunction with other factors in their contribution to TFP.

Germany (DIN)

DIN (2011) included two additional measures of “technological knowledge generation and diffusion” in their model, alongside standards:

- Patents (innovative technology generated within Germany)
- Licence payments (for use of innovative technology developed in other countries)

Its analysis found that all three factors contributed to economic growth. Patents had a bigger impact on economic growth than either standards or licensed use of foreign technologies.

France (AFNOR), Belgium (NBN) and the Nordic countries (Menon Economics)

France, Belgium and the Nordic countries similarly included patents in their models. All three found that patents also have a significant impact on economic growth.

United Kingdom (Department of Trade and Industry)

DTI (2005) took the further step of quantifying the contribution of overall “technological change” to economic growth, finding that it contributes to a 1% growth of GDP per annum. It estimates that the contribution of standards to technological change is over 25%.

South Africa (SABS)

The South African study included economic openness as a component in the growth model, finding that it had a negative impact on labour productivity. This component may be of interest in other countries with increasingly globalized trade networks.

About ISO

ISO (International Organization for Standardization) is an independent, non-governmental international organization with a membership of 165* national standards bodies. Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market-relevant International Standards that support innovation and provide solutions to global challenges.

ISO has published more than 23 500* International Standards and related documents covering almost every industry, from technology to food safety, to agriculture and healthcare.

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