



European
Commission

ISSN 2443-8022 (online)

Market Functioning & Market Integration in EU Network Industries – Telecommunications, Energy & Transport

Martijn Brons, Fotios Kalantzis
and Lucia Vergano

DISCUSSION PAPER 111 | SEPTEMBER 2019

EUROPEAN ECONOMY



Economic and
Financial Affairs

European Economy Discussion Papers are written by the staff of the European Commission's Directorate-General for Economic and Financial Affairs, or by experts working in association with them, to inform discussion on economic policy and to stimulate debate.

The views expressed in this document are solely those of the author(s) and do not necessarily represent the official views of the European Commission.

Authorised for publication by Mary Veronica Tovšak Pleterski, Director for Investment, Growth and Structural Reforms.

LEGAL NOTICE

Neither the European Commission nor any person acting on behalf of the European Commission is responsible for the use that might be made of the information contained in this publication.

This paper exists in English only and can be downloaded from https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en.

Luxembourg: Publications Office of the European Union, 2019

PDF ISBN 978-92-79-77448-5 ISSN 2443-8022 doi:10.2765/861205 KC-BD-18-038-EN-N

© European Union, 2019

Non-commercial reproduction is authorised provided the source is acknowledged. For any use or reproduction of material that is not under the EU copyright, permission must be sought directly from the copyright holders.

Market Functioning and Market Integration in EU Network Industries – Telecommunications, Energy and Transport

Martijn Brons, Fotios Kalantzis and Lucia Vergano

Abstract

This paper provides a comparative assessment of market functioning and market integration in EU Member States in network industries, i.e. telecommunications, energy and transport sectors. The first section assesses Member States' progress in market opening and competition and highlights potential market distortions that can hinder the proper functioning of these markets. The analysis shows that over the last years overall improvements in the regulatory and competitive environment was achieved, especially in the telecommunications sector. However, additional efforts are needed, especially in some Member States. The second section empirically investigates whether any relevant price convergence across Member States took place in the EU network industries. Econometric results show that prices converged to the mean in all analysed subsectors. However, in some Member States country-specific factors prevented prices in each of the sectors from fully converging to the same level. The speed of convergence was higher in the transport and energy subsectors and lower in the telecommunications sector.

JEL Classification: C13, D47, L90.

Keywords: EU Single market, network industries, competition, price convergence, applied econometrics.

Acknowledgements: We would like to thank our colleagues in DG ECFIN B.4. i.e. Arnaud Mercier for his contribution to the analysis of the competition in the energy sector, as well as Andrea Mairate and Åsa Johannesson Linden for their supervision of the paper. Furthermore, we would like to thank Anne van Bruggen (DG ECFIN B) and Mary Veronica Tovsak Pleterski (Director, DG ECFIN B) for their useful comments; Duncan Van Limbergen (DG ECFIN B.1) for his review; Jana Jabukova (DG CNECT B.3), Emanuela Agozzino (DG CNECT, B.4), Anna Armengol Torio and Balazs Zorenyi (DG CNECT F.4), Augustijn van Haasteren (DG ENER B.2), Elisabetta Garofalo, Carla Pace and Jan Scherp (DG MOVE C.3), Pekka Hietanen and Reijo Puumalainen (DG MOVE E.1), Paolo Bolsi and Jakub Koniecki (DG MOVE A.3) for their useful comments and support with data collection.

The approach taken in this report is without prejudice to EU competition rules.

Contact: Martijn Brons, European Commission, Directorate-General for Economic and Financial Affairs, martijn.brons@ec.europa.eu. Fotios Kalantzis, European Investment Bank, f.kalantzis@eib.org. Lucia Vergano, European Commission, Directorate-General for Economic and Financial Affairs, lucia.vergano@ec.europa.eu.

ABBREVIATIONS

Countries

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EA	Euro Area
EC	European Commission
EE	Estonia
EL	Greece
EU	European Union
EU12	Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and United Kingdom
EU15	EU12 plus Austria, Finland and Sweden
ES	Spain
FI	Finland
FR	France
HU	Hungary
IE	Ireland
IT	Italia
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	the Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	the United Kingdom

Telecommunications

5G	Fifth Generation
BB	Broadband
BEREC	Body of European Regulators for Electronic Communications
DSL	Digital Subscriber Lines
DSM	Digital Single Market
HSPA	High Speed Packet Access
LLU	Local Loop Unbundling
NGA	Next Generation Access
NRA	National Regulatory Authority
VDSL	Very High Bit Rate Digital Subscriber Lines
RSPP	Radio Spectrum Policy Programme

Transport

IM	Infrastructure Manager
RU	Railway Undertaking

Other abbreviations

CPL	Comparative Price Level
EMU	European Monetary Union
GDP	Gross Domestic Product
HICP	Harmonised Indices of Consumer Prices
LOOP	Law of One Price
PLI	Price Level Indices
PPP	Purchasing Power Parity
PSO	Public Service Obligation

Graph/table unit

%	Percentage
Bn	Billion
GHz	Giga-Hertz
MHz	Mega-Hertz
MWh	Mega-Watt Hour
PKM	Passenger Kilometres Percentage Point
TKM	Tonne Kilometres
VKM	Vehicle Kilometers

Currencies

EUR	Euro
-----	------

CONTENTS

Executive summary	9
Introduction	11
1. Assessing developments in market functioning and regulatory environment in telecommunications, energy and transport	13
1.1. Introduction	13
1.2. EU policy in network industries	15
1.3. Telecommunications	17
1.4. Electricity and natural gas	23
1.5. Transport	27
1.5.1. Rail	27
1.5.2. Road	29
1.5.3. Aviation	30
1.6. Conclusions	33
2. Assessing the degree of convergence in EU network industries: evidence from the telecommunications, energy and transport sectors	35
2.1. Introduction	35
2.2. Literature review	37
2.2.1. Methodologies	37
2.2.2. Empirical findings	37
2.3. Price trends in EU network industries	39
2.3.1. Evolution of price levels in EU network industries	39
2.3.2. Cross country price variation in EU network industries	40
2.4. Empirical analysis	47
2.4.1. Testing for σ -convergence	47
2.4.2. Testing for β -convergence	49
2.5. Conclusions	53
Final remarks	55
References	57
Annex A – Detailed econometric results	63

LIST OF TABLES

1.3.1. Market functioning and regulatory environment in the telecommunications sector	21
1.3.2. Progress in market functioning and regulatory environment in the telecommunications sector	22
1.4.1. Market functioning and regulatory environment in the energy sector	25
1.4.2. Progress in market functioning and regulatory environment in the energy sector (total progress over the considered period)	26
1.5.1. Market functioning and regulatory environment in transport sectors	31
1.5.2. Progress in market functioning and regulatory environment in transport sectors (total progress over the considered period)	32
1.6.1. Progress in market functioning and competition in the telecommunications sector	33
1.6.2. Progress in market functioning and competition in the energy sector	33
1.6.3. Progress in market functioning and competition in the transport sector	34
2.3.1. Variation in price indices for the different network sectors (coefficient of variation 1999/2007 and 2017)	40
2.4.1. Results of the estimations of σ -convergence for the energy, transport and telecommunications sectors	47
A.1. Results of unit-root test estimations for the energy and transport sectors (1999-2017)	63
A.2. Results of unit-root test estimations for the energy and transport sectors (1999-2006)	64
A.3. Results of unit-root test estimations for the energy, transport and telecommunication sectors (2007-2017)	65

LIST OF GRAPHS

2.3.1. Evolution of price trends in network industries (1999-2016)	39
2.3.2. Electricity price indices in EU Member States in 1999 and 2017 (EU=100)	41
2.3.3. Natural gas price indices in EU Member States in 1999 and 2017 (EU=100)	42
2.3.4. Passenger rail transport price indices in EU Member States in 1999 and 2017 (EU=100)	42
2.3.5. Passenger aviation price indices in EU Member States in 1999 and 2017 (EU=100)	43
2.3.6. Wired telephone price indices in EU Member States in 2007 and 2017 (EU=100)	43
2.3.7. Wireless telephone price indices in EU Member States in 2007 and 2017 (EU=100)	44
2.3.8. Internet access price indices in EU Member States in 2007 and 2017 (EU=100)	44
2.3.9. Bundled telecom service price indices in EU Member States in 2007 and 2017 (EU=100)	45
2.4.1. Evolution of the coefficient of variation and fitted line representing σ -convergence for different sectors	48
2.4.2. Estimated β -coefficients by subsector/service in different time periods	50
2.4.3. Long-run systematic differences in price indices between Member States (1999-2017)	51

LIST OF BOXES

1.4.1. Indicators assessing competition in energy markets	24
1.5.1. Indicators assessing competition in transport markets	29
2.4.1. σ -CONVERGENCE	48
2.4.2. β -CONVERGENCE	52

EXECUTIVE SUMMARY

This paper investigates recent developments in market functioning and market integration in EU network industries. Network industries are economically relevant *per se*, but also as they provide services which are inputs for the rest of the economy. Their market functioning is therefore key for EU growth and competitiveness, but is affected by some specific sectorial features. Notably, some segments of network industries are natural monopolies. A regulatory authority is needed to both promote competition and safeguard consumers' access rights to services with a public/universal nature. In fact, EU market regulation policy in these industries has mainly been targeted towards ensuring competition in the provision of the service, regulating access to infrastructure and creating an integrated EU market.

The first section of this paper builds on previous work published by the European Commission (2014a). It provides a comparative assessment of the state of play and progress in market functioning and regulatory environment in EU network industries (telecommunications, energy and transport sectors) registered roughly during 2012-18⁽¹⁾. The analysis is based on a set of selected indicators allowing to identify potential market distortions and regulatory inefficiencies that can preclude the proper functioning of these markets.

Overall progress across countries was expected due to the liberalisation of network industries and the deepening of the EU Single Market. However, results show a rather heterogeneous picture by sector and by country. In the telecommunications sector, market opening has been overall more pronounced. In the energy and transport markets, some improvements have been achieved in both the regulatory environment and competition, but there is still scope for further progress. In many Member States relatively high levels of market concentration still persist. Countries which more recently joined the EU exhibit a somewhat weaker overall performance. This might reflect structural differences in the economy and the regulatory environment across Member States, but also a different degree of integration in the common market.

The second section of the paper empirically analyses whether, and possibly to what extent, convergence in consumer prices occurred between 1999 and 2017 in specific subsectors of the considered network industries. In agreement with the Law of One Price theory, market integration is expected to have brought along a reduction in price differentials for similar products and services across countries. An econometric analysis is carried out to verify whether price convergence to the mean indeed occurred across EU countries. Results suggest that overall price convergence took place in network industries. In the transport and energy sub-sectors covered in the analysis, the speed of convergence was found to be comparatively high, and increasing over time. Results for the telecommunications sector were less conclusive although beta-convergence² was found to be present in the various services. However, a proper identification of the drivers of price convergence would be needed to establish the existence of any positive correlation between the developments in market functioning/integration and price convergence.

From a policy perspective, the analysis shows that some progress in the market functioning of EU network industries has been achieved. However, further efforts are still needed to strengthen the process and lead to more homogeneous market functioning and regulation across Member States.

⁽¹⁾ The precise period under consideration differs across sectors and subsectors according to data availability.

⁽²⁾ See page 52 for an explanation of the concept of beta-convergence.⁴

INTRODUCTION

Network industries provide services, which are essential for the whole productive system. The quality of such services ultimately affects the well-functioning of the internal market and hence the standard of living of EU citizens, EU growth and competitiveness. The market functioning of network industries is therefore relevant for the economy as a whole, which can benefit from increases in efficiency.

In some segments of the networks, normally the infrastructure, the existence of high fixed costs creates natural monopolies. This justifies a sectorial regulation, guaranteeing the access to the market, fair competition and ensuring incentives for companies to invest.

To improve the functioning of markets in these sectors, the EU has pursued a three-pronged strategy: i) introducing competition in the segments of network industries which are not natural monopolies; ii) regulating the access to the network infrastructure and the conditions under which services are provided and iii) transforming fragmented national markets into a larger, more efficient, integrated EU market.

Liberalisation of network industries was expected to induce consumer prices to move closer to production costs, bringing along a more efficient allocation of resources, preventing rent-seeking positions and ensuring a broader supply of goods and services of increased quality to citizens and businesses. Furthermore, market integration was expected to bring along economies of scale and scope. Moreover, the reduction in price-cost margins due to more intense competition was expected to entail more homogeneous price levels for the same kind of services.

Two previous papers (European Commission 2013 and 2014) highlighted significant variation until 2014 in the degree of competition and market conditions across countries and across network industries, as well as a high dispersion in prices and market concentration. Moreover, from these analyses network industries showed a low degree of market integration, due to delayed regulation and implementation, and weak enforcement at national level.

Nevertheless, since changes in network industries require a long adaptation time and further policy measures have been taken in the meanwhile to advance the completion of the common market, the situation is likely to have evolved.

The objective of this paper is twofold. First, to provide a comparative assessment of the current state of play and recent developments in market functioning and the regulatory environment in selected network industries (telecommunications, energy and transport sectors). This assessment, which is the focus of Section 1, aims to identify potential market distortions and regulatory inefficiencies that can still hinder the proper functioning of these markets. This “horizontal” analysis is based on common comparable indicators across all Member States and builds on the first part of the paper on market functioning in network industries published by the Commission in 2014. The approach taken for this analysis is without prejudice to EU competition rules.

Second, to empirically analyse whether and, if possible, to what extent price convergence occurred within the same network industries in the recent past. This analysis builds on the theoretical concept of the Law of One Price (LOOP), which postulates that in the absence of natural and regulatory barriers the potential for arbitrage strategies should underpin the equalisation over time of prices of identical goods and services across countries as a result of a harmonised regulation and more integrated markets.

1. ASSESSING DEVELOPMENTS IN MARKET FUNCTIONING AND REGULATORY ENVIRONMENT IN TELECOMMUNICATIONS, ENERGY AND TRANSPORT

1.1. INTRODUCTION

Network industries are crucial for the economy. They are economically very relevant not only *per se*, but also as providers of important services and key inputs to the rest of the economy. Moreover, two specific features characterise these industries. First, the intrinsic co-existence of competitive and regulated segments due to the presence of natural monopolies, sunk costs and economies of scale in some specific segments. This justified major regulatory reforms over the past two decades to promote competition and safeguard consumers' rights. Second, the public/universal nature of the services provided which requires state intervention. This usually takes the form of price regulation and state-ownership of the infrastructure that can however lead to inefficient or distortive outcomes.

Market functioning in network industries has developed through time, although with a path and speed reflecting the specificities of each sector. In recent years, network industries all benefited from some measures undertaken as part of the Single Market Strategy to improve the performance of economic actors in the EU. Nevertheless, further efforts might still be necessary in order to improve market functioning. In fact, the degree of competition seems to vary greatly across Member States despite the presence of extensive EU legislation. In some sectors such as transport the degree of market opening even varies across modes, which could hinder inter-modal connectivity and fair competition between modes.⁽³⁾ This could prevent Member States from reaping the benefits of the liberalisation of these sectors (e.g. more competition leading to higher service quality and/or lower service costs), as could be possible in a genuinely integrated internal market.

This section reviews and updates the paper on market functioning in network industries published by European Commission (2014a), where an assessment of competition developments was presented on the basis of a set of indicators. The network industries covered are telecommunications, energy (electricity and natural gas) and transport (rail, road and air).

⁽³⁾ For example, the comparatively late opening of the rail freight market during a long period placed this sector at a disadvantage vis-a-vis the road freight sector.

1.2. EU POLICY IN NETWORK INDUSTRIES

The EU strategy to improve the functioning of markets in network industries has pursued the threefold objective of strengthening competition in service provision, regulating the access to infrastructure and promoting the creation of a larger, more efficient, integrated EU market. This has involved specific measures for each sector.

EU policies fostering the creation of a single market in the **telecommunications sector** date back to 1980-90s. Since then, a progressive liberalisation of telecommunications markets, traditionally state monopolies, has been realised. A number of legislative measures and packages have been enacted to open up markets, promote competition, free up economic bottlenecks and enable access to key inputs (Directive 88/301/EEC, Directive 90/388/EEC, the 1995 Telecom reform package, Directive 96/19/EC, the 2000 Telecom reform package and Directive 2002/21). In 2009, the Body of European Regulators for Electronic Communications (BEREC) was created to ensure a consistent application of the EU regulatory framework for electronic communications. More recently, a number of specific initiatives have been undertaken to improve the market functioning under the Digital Single Market (DSM) Strategy adopted in 2015. These include: the promotion of the free movement of persons, services and capital (COM/2016/587 final and Regulation (EU) 2016/2286); the promotion of access and exercise of online activities under conditions of fair competition (Regulation (EU) 2015/2120); the new guidelines on market analysis and the assessment of significant market power (Communication C/2018/2374), and the new Electronic communications code (Directive 2018/1972).

In the **energy sector**, the European Commission adopted a series of measures to radically reform the electricity and natural gas supply industry of its Member States, in order to build an internal market for electricity and natural gas. Between 1996 and 2009, four major directives (Directive 96/92/EC (electricity), Directive 98/30/EC (gas), Directive 2003/54/EC (electricity) and Directive 2003/55/EC (gas)) and a comprehensive “Third Legislative Package” (Directive 2009/72/EC, Directive 2009/73/EC Regulation 713/2009/EC and Regulation 714/2009/EC) were enacted to dismantle vertically integrated monopolies, liberalise the production and supply of electricity and natural gas, grant non-discriminatory third party access to networks and stimulate cross-border trade. To reinforce further the effectiveness of existing regulations and directives, in 2016 the EC has adopted the "Clean Energy for All Europeans" package (COM/2016/860 final). This translates into legislative and non-legislative proposals the Energy Union Strategy launched by the Commission in 2015. Among other objectives, the strategy aims to facilitate further market integration through better regional cooperation and greater harmonisation of general principles and rules of the energy markets.

The development in the transport sector differs by mode. In the **railway sector**, the EU promoted competition between rail operators over the same rail infrastructure. The legislative framework is based *inter alia* on four railway packages, adopted between 2001 and 2016. The key elements of this framework are: (i) market opening in the freight and international passenger markets; (ii) functional separation and independence of the infrastructure manager from the railway operators; (iii) interoperability of national rail networks; (iv) independence of regulators. The transposition of the railways packages should translate into increased competition in the freight and passenger segments and independent infrastructure managers. In 2016, the Fourth Railway Package (the market pillar of which consists of Regulation (EU) 2016/2338, Directive 2016/2370/EU, Regulation (EU) 2016/2337) was adopted to improve the governance of rail infrastructure and operation, open the market for domestic passenger rail transport, introduce mandatory competitive tendering for Public Service Obligations (PSO)⁴ contracts from 2019 and a new role for the European Railway Agency. The adoption completed the Single EU Rail Area.

⁽⁴⁾ In the context of EU transport law, a PSO is an arrangement in which a governing body or other authority offers an auction for subsidies, thereby permitting the winning company a monopoly to operate a specified service of public transport for a specified period of time for the given subsidy. This is done in cases where there is not enough revenue for routes to be profitable in a free market, but where there is a socially desirable advantage in this transport being available

Cross-border traffic in **road freight transport** was liberalised between 1983 and 1998. In 2009, an EU regulation was introduced (Regulation 1072/2009) to increase the integration of the road transport market, improve the efficiency of road haulage operations and create a level playing field for operators by eliminating the uncertainties associated with the possible differing national interpretations of the applicable cabotage rules⁽⁵⁾. However, some important restrictions remained limiting the ability of road transport operators to optimise their operations and increase their efficiency. Moreover, the completion of an international transport operation is a pre-condition for cabotage, which *de facto* leads to restrictions on some types of operations⁽⁶⁾. In 2017, the Commission put forward a proposal to amend Regulation 1072/2009 to improve the effectiveness of the regulation *inter alia* by simplifying cabotage rules.

The **air transport** sector was liberalised by three legislative packages. In 1987, the first package (Regulations 3975/87/EEC and 3976/87/EEC, Directive 87/601/EEC) reduced fare restrictions and gave airlines some flexibility to share seat capacity. In 1990, the second package (Regulations EEC 2342/90, 2343/90, 2344/90) allowed European airlines to carry an unlimited amount of passengers and cargo between their home country and other EU countries. Fare and capacity restrictions were further reduced. The third liberalisation package (Regulations EEC 2407/92, 2408/92 and 2409/92⁽⁷⁾) gave to EU airlines in 1993 the freedom to provide services within the EU and to set fares, and in 1997 to provide cabotage. In the Single EU Market, EU airlines have practically unlimited flexibility to determine their routes, capacity, schedules and fares. Moreover, they also have access to the necessary resources and services in airports.

The next three subsections will review the current state of play of market functioning in the considered sectors based on a set of selected indicators.

⁽⁵⁾ The new rules entitle any operator to carry out up to three cabotage operations within a period of seven days after the full completion of an international transport operation whereby one or more of these three cabotage operations may be carried out in other Member States (one per Member State within three days from the empty entry into the territory of that Member State).

⁽⁶⁾ A haulier registered in one Member State cannot, even occasionally, carry out a domestic transport operation in another member State unless it has completed an international transport operation during the previous seven days. Or, as another example, a haulier who is in the process of carrying out an international transport operation with a partially loaded truck is not currently allowed to utilise the spare capacity of its vehicle by carrying out a cabotage operation while doing the international transport as the full unloading of the truck after the completion of the international transport is a pre-condition for cabotage.

⁽⁷⁾ Now replaced by Regulation (EC) 1008/2008.

1.3. TELECOMMUNICATIONS

Telecommunication markets have evolved since the 1998 "First Telecoms Package" was launched. Liberalisation has brought about benefits in terms of prices, competition and convergence of new technologies. According to previous analyses (European Commission, 2013 and 2014) differences among Member States persisted until 2014 in price performance, market structure, consumer's choice and implementation of the relevant regulatory framework. Such differences were much more pronounced than in the energy and transport sector. Therefore, it was concluded that a fully fledged European internal market for telecommunications seemed far from having been achieved.

In 2015, the EU DSM strategy was adopted by the Commission (COM/2015/0192 final) to create a common digital market by removing barriers, promoting innovation and further improving the environment for investment. As part of the strategy, many initiatives have been undertaken to foster a better connected and competitive continent and a free and safe flow of data⁽⁸⁾.

This section is based on a set of selected indicators mainly from the European Commission's Digital Scoreboard 2018⁽⁹⁾. It provides an up-to-date assessment of the functioning of telecommunications market in the EU and the evolution of Member States' relative positions⁽¹⁰⁾. The choice of the "monitoring indicators" is based on a previous assessment exercise (European Commission, 2014), but some modifications have been introduced to capture the latest developments in market conditions⁽¹¹⁾.

The objective of the current exercise is to provide an overview of the telecommunications market conditions and identify situations where further assessment might be needed. Therefore, the set of selected indicators has to be considered as a basis for further country-specific in-depth economic analysis. Table 1.3.1 describes the competition conditions and market functioning in the telecommunications sector in 2017 (or 2018, depending on data availability), while Table 1.3.2 shows the progress achieved during the last five available years (for most indicators, 2013-17).

⁽⁸⁾ The Strategy encompasses *inter alia* the Communication on Connectivity for a Competitive Digital Single Market – towards a European Gigabit Society (COM/2016/0587 final); the Communication on the Action Plan on 5G for Europe (COM/2016/0588 final); the Regulation promoting Internet connectivity in local communities and public spaces (COM/2016/0589 final); the VAT DSM Package (12/2016) for cross-border e-commerce, adopted by the Council on November 2017 (Directive 14126/17); a regulation to ban unjustified geo-blocking, adopted by the Council in February 2018 and applied from December 2018 (2016/0152/COD).

⁽⁹⁾ Digital progress in EU MSs are often analysed through the Digital Economy and Society Index (DESI). DESI 2018 indicators refer to 2017 data. However, since it builds on output and outcome indicators, a different set of indicators was used for this paper.

⁽¹⁰⁾ This assessment does not reflect the full effects of the implementation of the DSM Strategy.

⁽¹¹⁾ For instance, with respect to European Commission (2014a) the regulatory environment indicators "Framework transposed" and "NRA's independence" have been removed, as these provide qualitative indications based on which it is not possible to derive unambiguous conclusions about Member States' compliance. The indicator "800MHz spectrum assigned" has no longer been taken into account since it is no longer relevant. This indicator previously captured Member States' progress in assigning and putting into use the digital dividend deriving from the allocation of the 800 MHz radio frequency spectrum to mobile operators following the transition from analogue to digital broadcasting. The so-called "second digital dividend" currently concerns the 700 MHz radio frequency spectrum, one of the three "pioneer2 frequency bands identified for the 5G technology deployment, which has been allocated to mobile use by the Decision (EU) 2017/899 of the European Parliament and of the Council. Member States need to comply with this decision by 2020. Since so far only Finland, France and Germany have completed the relevant authorisation procedure, the corresponding indicator is not so informative and therefore has not been included. Finally, the "Full LLU wholesale access charge" indicator for fixed broadband is no longer included in the assessment framework since this access charge has lost its relevance in encouraging the competition in the retail broadband access market.

Box 1.3.1: INDICATORS ASSESSING TELECOMMUNICATIONS

The assessment of telecommunications is based on the following indicators:

- *Regulatory environment indicators*, including: i) an overview of the effective competition as emerged from the 2014 Commission's Recommendation in relation to Article 7 and Article 7a of the Electronic Communications Framework Directive - 2002/21/EC ⁽¹⁾ and ii) the share of all harmonised bands assigned, given the Member States' commitment to identify at least 1200 MHz of suitable spectrum to wireless broadband by 2015.
- *Mobile communications indicators*, including: i) the market share of the leading operator; ii) the mobile voice termination rates ⁽²⁾; iii) the mobile broadband penetration; iv) the share of households living in areas served by the 4th Generation (4G) mobile broadband, a technology extending and improving the performance of existing 3rd Generation (3G) mobile telecommunication ⁽³⁾.
- *Fixed broadband indicators*, including: i) the fixed broadband incumbent's market share; ii) the fixed voice termination rates; iii) the share of Digital Subscriber Lines (DSL) (including Very High Bit Rate Digital Subscriber Lines - VDSL) in total broadband lines and, among them, the share of full local loop unbundling (LLU) and shared access ⁽⁴⁾; iv) the fixed broadband penetration; v) the penetration and coverage of Next Generation Access (NGA); vi) the rural standard fixed and NGA broadband coverage.

As reported in Tables 1.3.1 and 1.3.2, coloured labels are assigned to all Member States for each indicator, based on the following approach: "green labels" indicate the best performances and "yellow labels" intermediate performances, while "red labels" are assigned to the worst performances.

-
- ⁽¹⁾ Every three years National Regulatory Authorities (NRAs) analyse national circumstances in order to verify whether retail market failures incompatible with competitive markets exist. In case they are not, the corresponding wholesale market can be deregulated. The objective of *ex ante* regulation is ultimately to produce benefits for end users by making retail markets effectively competitive on a sustainable basis.
- ⁽²⁾ Voice termination rates are the charges one operator has to pay to another for terminating calls on its network. In general, each operator has a significant market power position for termination in its network. Therefore, termination rates are *ex ante* regulated, in both the mobile and fixed market. When voice termination rates are higher than efficient costs, substantial transfers take place between fixed and mobile markets and consumers. If operators have asymmetric market shares, significant payments can take place from smaller to larger competitors. High voice termination rates tend to be related to high retail prices for originating calls and correspondingly lower usage rates, thus decreasing consumer welfare.
- ⁽³⁾ The 4G of mobile telecommunications technology in addition to the mobile voice and other services supported by 3G, provides higher data throughput and therefore better support for mobile broadband Internet access, for example from laptops with Universal Serial Bus (USB) wireless modems, to smartphones and other mobile devices.
- ⁽⁴⁾ These two indicators are somehow inversely related, to the extent that the share of DSL provides an indication of the level of inter-platform competition, while the share of LLU/shared access among DSL an indication of the extent of intra-platform competition.

Overall, although significant differences can still be traced among Member States, especially with regard to some indicators (e.g. mobile penetration rate and Next Generation Access - NGA - coverage⁽¹²⁾), especially in rural areas), some progress towards deepening the EU DSM has been registered.

⁽¹²⁾ Next Generation Access (NGA) are access networks wholly or in part consisting of optical elements and capable of delivering broadband access services with enhanced characteristics (such as higher throughput) as compared to those provided over already existing copper networks.

Concerning regulatory environment, national circumstances⁽¹³⁾ justified the removal of regulation of markets for local and central access to telecommunication networks (i.e. for local loop unbundling and bitstream access) in only six countries (Bulgaria, Denmark, Estonia, Portugal, Romania and Slovakia), while in the others National Regulatory Authorities (NRAs) still identified retail market failures incompatible with competitive markets⁽¹⁴⁾. Considerable discrepancies exist in terms of assignment of radio spectrum to mobile operators. While Germany has already assigned all the harmonised spectrum bands⁽¹⁵⁾, Luxembourg assigned only around 50% and three countries (Bulgaria, Cyprus and Croatia) have assigned less than 50% of them. It is worth noting that spectrum demand - and hence its offer - depends on the size of the market and the geographical characteristics of the country. In some Member States lack of progress is justified by country-specific circumstances provided in the acquis (e.g. Bulgaria and Cyprus) or lack of spectrum demand by operators. The European Commission monitors developments in countries where cross-border coordination problems persist.

In the mobile market, during the last five years the market share of the leading operator increased quite substantially in some countries and was on average around 35%. Despite the lack of a binding approach at EU level, the voice termination rates⁽¹⁶⁾ dropped by more than 60%, down to 0,94 Eurocents/minute. Diverging national approaches to strike a balance between addressing the interests of end-users (i.e. lower termination rates) and those of national operators (i.e. higher termination rates) represent a barrier to the internal market. To promote efficiency and sustainable competition, the Commission supports the adoption by the end of 2020 of a single maximum voice termination rate applying Union-wide. The mobile broadband penetration strongly increased (by around 57% on average) up to about 90 subscriptions per hundred inhabitants. The coverage for the 4th Generation (4G) of mobile broadband improved, even in rural areas, but with a high degree of heterogeneity across countries.

In fixed broadband markets, the incumbents' market shares have only slightly decreased, remaining around 40%. The voice termination rates decreased in almost all countries and more substantially than the mobile market, staying below 0,10 Eurocents/minute in the majority of the Member States. The Commission supports the adoption by the end of 2020 of a single maximum voice termination rate applying Union-wide also for fixed services. The shares of subscriptions to Digital Subscriber Lines (DSL)⁽¹⁷⁾ slightly dropped (down to around 40%). In countries where for historical reasons it is still high (Greece, Italy and France), it is associated with a high share of Local Loop Unbundling (LLU)⁽¹⁸⁾/shared access. As LLU is the most advanced way for other operators to access the incumbent's DSL network, a high share of LLU subscriptions can be considered as a good proxy for the accessibility to the incumbent's DSL network. Overall, the indicators point to a consolidated gradual improvement in both

⁽¹³⁾ Every NRA has to make its own analysis in the national circumstances every three years. If no retail markets failures are identified, the corresponding wholesale market are deregulated. Markets were proposed as susceptible for *ex ante* regulation under the 2014 recommendation on relevant markets. The objective of *ex ante* regulation is ultimately to produce benefits for end users by making retail markets effectively competitive on a sustainable basis.

⁽¹⁴⁾ These markets are: voice call termination on fixed network; voice call termination on mobile networks; wholesale local access; wholesale central access; whole sale high quality access.

⁽¹⁵⁾ The RSPP set a 1200 MHz target for identifying spectrum suitable for wireless broadband, but so far only 1090 MHz have been harmonised (cut-off date: 30/04/2018).

⁽¹⁶⁾ Voice termination rates are the charges a telecommunications operator need to pay to another one for ending calls in the network of the latter.

⁽¹⁷⁾ A technology transporting high-bandwidth data over a simple telephone line that is directly connected to a modem.

⁽¹⁸⁾ A service whereby a telecommunication organisation provides (shared or fully) unbundled access to its [local loop](#) to another telecommunications organisation. The local loop identifies the physical twisted copper pair circuit connecting the network termination point at the subscriber's premises to the main distribution frame or equivalent facility in the fixed public telephone network.

intra-platform (i.e. between DSL firms) and inter-platform competitive conditions. Progress in the latter is reflected by an overall decline in the share of DSL. Concerning infrastructure, NGA coverage increased by almost 30% (up to around 80%) and in rural areas, although the digital divide is still important, registered a very substantial increase (up to around 47%). Fixed broadband penetration increased by around 15% (up to almost 34%), with an impressive contribution from NGA networks, whose penetration more than double (from almost 22% to almost 48%).

Overall, these market evolutions appear to signal a gradual progress in market functioning, although marked differences remain across countries and across markets, no least in terms of speed of improvement. Based on the considered indicators, it is possible to identify those Member States whose relative performance appears to be poorer than the others in the policy areas under scrutiny and where specific market conditions might deserve enhanced attention⁽¹⁹⁾. Cyprus, Croatia, and Luxembourg are the weakest performers in terms of regulatory environment; Cyprus and Croatia, followed by Bulgaria, Greece, Portugal, Romania, Slovenia and Slovakia in terms of mobile communications; Greece, France, Poland and Romania in terms of fixed broadband.

⁽¹⁹⁾ This is based on an elementary counting of the red labels assigned to performances below the cut-off defined for each of the selected indicators in each of the three broad telecommunications areas.

Table 1.3.1: Market functioning and regulatory environment in the telecommunications sector

	Regulatory environment		Mobile communications					Fixed communications									
	Effective competition ⁽¹⁾	Total assigned of harmonised spectrum	Market share of the leading operator ⁽¹⁾	Mobile termination rates (Euro cents) ⁽¹⁾	Mobile broadband penetration	4G Mobile broadband coverage	Rural 4G mobile broadband coverage	Incumbent's market share (excluding resale) ⁽¹⁾	Fixed termination rates (Euro cents) ⁽¹⁾	Share of DSL lines (VDSL included) ⁽¹⁾	LLU and shared access lines as a % of total DSL	Fixed BB penetration ⁽²⁾	NGA penetration ⁽³⁾	NGA coverage	Rural standard fixed BB coverage		NGA rural coverage
	Aug/18	Apr/18	2017	Jan/18	Jul/17	Jul/17	Jul/17	Jul/17	Jan/18	Jul/17	Jul/17	Jun/17	Jul/17	Jul/17	Jul/17	Jul/17	
AT	0	69.4%	38.4%	0.80	95.2	99.0%	92.7%	58.0%	0.11	64.2%	72.0%	29.0	27.2%	90.0%	94.0%	45.0%	AT
BE	0	67.0%	43.8%	0.99	72.6	100.0%	99.8%	46.5%	0.50	48.0%	9.4%	38.3	92.6%	99.0%	98.4%	91.5%	BE
BG	2	26.6%	39.0%	0.72	86.6	91.9%	59.3%	26.2%	0.08	10.7%	n.a	24.2	77.7%	74.6%	82.5%	25.0%	BG
CY	0	44.5%	54.4%	0.99	100.6	78.8%	77.8%	57.6%	0.10	79.6%	47.4%	33.8	12.0%	87.5%	100.0%	60.0%	CY
CZ	0	80.0%	41.6%	0.97	80.8	99.4%	95.8%	24.0%	0.13	29.3%	46.6%	30.2	54.4%	88.6%	95.1%	58.7%	CZ
DE	0	100.0%	38.0%	1.07	78.9	96.5%	87.9%	40.1%	0.10	74.8%	56.1%	39.6	45.2%	84.1%	89.1%	53.9%	DE
DK	1	56.3%	37.8%	0.60	129.5	100.0%	100.0%	52.4%	0.05	40.5%	52.1%	43.6	72.7%	94.6%	97.5%	65.5%	DK
EE	1	89.0%	44.7%	0.89	124.6	98.5%	98.5%	57.0%	0.10	34.8%	0.0%	32.7	72.7%	80.4%	72.9%	37.8%	EE
EL	0	67.5%	n.a.	0.96	59.1	97.1%	86.7%	45.7%	0.05	99.6%	99.3%	33.9	9.9%	49.6%	96.6%	13.7%	EL
ES	0	68.8%	29.8%	1.09	91.8	97.2%	87.0%	41.6%	0.08	41.6%	78.3%	30.5	60.2%	85.0%	92.8%	37.4%	ES
FI	0	76.1%	38.3%	1.25	146.3	99.6%	98.0%	n.a.	2.80	49.0%	n.a	31.0	67.7%	75.1%	84.0%	8.3%	FI
FR	0	63.3%	34.8%	0.74	86.8	98.0%	87.5%	39.7%	0.08	81.7%	85.7%	42.3	22.5%	51.9%	100.0%	37.3%	FR
HR	0	40.4%	45.9%	0.62	80.9	94.8%	76.5%	47.6%	0.10	75.6%	48.7%	25.7	45.1%	67.4%	97.3%	16.1%	HR
HU	0	61.0%	44.4%	0.55	49.1	99.2%	97.7%	40.7%	0.13	26.9%	12.6%	29.2	70.3%	82.0%	86.2%	50.5%	HU
IE	0	69.7%	38.4%	0.79	103.7	97.2%	91.6%	32.2%	0.07	67.3%	4.0%	30.0	68.5%	88.8%	93.9%	82.0%	IE
IT	0	64.8%	31.5%	0.98	85.6	98.7%	89.2%	45.5%	0.04	90.7%	71.6%	26.7	21.5%	86.8%	94.8%	39.2%	IT
LT	0	83.8%	42.6%	0.94	78.4	99.8%	99.4%	50.4%	0.13	18.8%	4.4%	27.8	71.7%	81.6%	86.5%	39.4%	LT
LU	0	50.5%	46.5%	0.89	125.9	98.6%	95.2%	66.1%	0.14	65.9%	74.4%	36.1	55.9%	94.6%	99.9%	94.5%	LU
LV	0	89.9%	38.4%	0.89	90.8	98.4%	94.4%	57.1%	0.10	24.5%	0.0%	26.3	76.6%	91.3%	82.4%	77.4%	LV
MT	0	60.4%	43.5%	0.40	93.2	99.9%	90.2%	49.1%	0.04	42.5%	0.0%	40.8	66.7%	100.0%	100.0%	99.9%	MT
NL	0	89.9%	39.8%	0.58	88.4	99.6%	99.4%	41.4%	0.14	38.7%	64.5%	43.7	84.1%	98.3%	100.0%	98.4%	NL
PL	0	90.6%	28.0%	1.01	143.9	98.5%	93.0%	28.8%	0.48	34.2%	17.4%	18.4	52.1%	66.7%	83.1%	40.6%	PL
PT	2	68.7%	45.9%	0.75	65.0	98.9%	92.4%	39.7%	0.06	23.9%	85.0%	33.6	76.0%	95.2%	98.3%	78.5%	PT
RO	1	72.9%	39.6%	0.96	81.7	93.6%	84.8%	23.2%	0.14	19.0%	17.5%	22.5	78.8%	74.0%	82.7%	38.6%	RO
SE	0	87.9%	44.7%	0.66	123.3	100.0%	100.0%	37.5%	0.07	26.6%	45.8%	39.4	76.4%	77.7%	87.2%	22.7%	SE
SI	0	56.9%	43.9%	1.14	65.9	98.6%	95.1%	35.2%	0.09	36.4%	37.1%	31.0	65.8%	83.2%	92.5%	53.9%	SI
SK	2	88.4%	34.0%	1.23	83.7	96.3%	87.1%	35.1%	0.12	36.3%	0.4%	25.7	48.3%	78.7%	91.1%	44.2%	SK
UK	0	82.9%	n.a.	0.56	89.8	99.5%	95.4%	36.7%	0.04	79.1%	77.3%	38.8	49.2%	93.9%	99.8%	82.4%	UK
EU28	n.a.	70.3%	35.4%	0.94	90.2	n.a.	n.a.	40.3%	n.a.	64.2%	72.8%	33.7	47.5%	80.1%	92.4%	46.9%	EU28
Median	-	69.1%	39.7%	0.89	87.6	98.6%	92.8%	41.4%	0.10	41.1%	47.0%	31.0	66.3%	84.6%	93.9%	47.8%	Median
Cut-off	-	56.8%	44.7%	1.0249	77.3	96.5%	86.9%	54.2%	0.1358	76.3%	-	26.2	41.5%	74.4%	83.8%	34.8%	Cut-off

Notes: ⁽¹⁾Data reflect the number of markets in which the regulation was lifted by the National Regulatory Authorities as no retail market failures incompatible with competitive markets were identified. Red corresponds to 0, orange to 1 and green to 2 markets. Concerned markets are: called termination on fixed network; voiced call termination on mobile networks; wholesale local access; wholesale central access; whole sale high quality access. ⁽²⁾Data refer to number of subscriptions per 100 inhabitants. ⁽³⁾Data refer to NGA (FTTH, FTTB, VDSL, Cable Docsis 3.0 and other NGA) subscriptions as a % of total fixed broadband subscriptions. n.a. = not available data.

Equal or above the median (equal or below, if ⁽¹⁾).

Below the cut-off at 20th percentile (above 80th percentile, if ⁽¹⁾).

Otherwise.

Source: Digital scoreboard (2018)

Table 1.3.2: Progress in market functioning and regulatory environment in the telecommunications sector

	Mobile communications					Fixed communications										
	Market share of the leading operator ^{(1) (*)}	Mobile termination rates (Euro cents) ^{(1) (*)}	Mobile broadband penetration	4G Mobile broadband coverage	Rural 4G mobile broadband coverage	Incumbent's market share (excluding resale) ^{(1) (*)}	Fixed termination rates (Euro cents) ^{(1) (*)}	Share of DSL lines (VDSL included) ^{(1) (*)}	LLU and shared access lines as a % of total DSL	Fixed BB penetration	NGA penetration	NGA coverage ⁽²⁾	Rural standard fixed BB coverage ⁽²⁾	NGA rural coverage ^{(2) (3)}		
	2013-17	2013-18	2013-17	2013-17	2013-17	2013-17	2013-18	2013-17	2013-17	2013-17	2013-18	2013-17	2013-17	2013-17		
AT	-11.7%	-60.0%	51.8%	182.9%	32693.4%	1.5%	-84.6%	-4.3%	-8.9%	12.4%	132.3%	28.3%	-0.4%	118.5%	AT	
BE	12.7%	-16.1%	60.2%	119.5%	2430.6%	6.1%	6.4%	-4.0%	-28.4%	13.3%	58.6%	0.6%	-1.3%	22.2%	BE	
BG	-4.9%	-68.2%	100.5%	154.9%	217.2%	13.1%	-81.4%	-45.4%	n.a.	26.2%	54.8%	10.1%	16.8%	2788.4%	BG	
CY	-18.9%	-42.8%	145.4%	30.8%	n.a.	-14.2%	-69.6%	-4.5%	-47.3%	31.7%	825.5%	13.6%	0.0%	33.3%	CY	
CZ	3.0%	-40.7%	60.05%	729.1%	120.6%	-25.8%	-85.6%	-16.3%	51.3%	15.6%	44.3%	39.2%	5.6%	3002.0%	CZ	
DE	n.a.	-42.2%	80.1%	19.1%	33.4%	-8.8%	-66.7%	-8.8%	-32.3%	12.4%	231.2%	12.5%	2.4%	153.1%	DE	
DK	-7.5%	-44.0%	26.5%	35.6%	900.0%	-12.8%	-31.1%	-22.1%	-3.7%	8.0%	300.1%	14.5%	4.5%	400.8%	DK	
EE	3.2%	-39.5%	45.5%	15.8%	33.0%	-5.1%	-84.5%	-18.0%	-100.0%	16.9%	102.7%	28.4%	20.1%	244.9%	EE	
EL	n.a.	-24.5%	25.3%	77.1%	567.8%	4.3%	-75.1%	-0.2%	1.6%	34.3%	7194.1%	84.6%	0.3%	2901.2%	EL	
ES	-16.5%	-65.7%	57.3%	106.3%	3902.3%	-14.0%	-76.7%	-46.3%	-2.2%	21.4%	167.8%	31.1%	-1.6%	61.5%	ES	
FI	7.9%	-55.4%	30.2%	16.5%	315.9%	n.a.	16.7%	-23.2%	n.a.	1.4%	105.4%	4.1%	2.9%	12.0%	FI	
FR	-11.3%	-11.8%	96.2%	44.1%	692014.3%	-2.0%	-3.8%	-10.5%	1.6%	13.2%	227.8%	26.7%	1.6%	130.5%	FR	
HR	35.2%	-75.8%	27.2%	288.5%	1353.0%	-19.5%	-75.7%	-11.0%	225.0%	20.5%	2882.0%	102.5%	15.8%	36722.1%	HR	
HU	-4.5%	-78.0%	94.3%	153.4%	886.9%	-6.4%	-60.0%	-20.4%	-15.5%	24.5%	174.1%	8.4%	3.5%	72.9%	HU	
IE	-15.3%	-69.6%	60.02%	176.0%	3563.9%	-18.6%	-82.0%	4.9%	-2.9%	18.9%	149.1%	64.4%	0.4%	1146.5%	IE	
IT	-20.0%	-35.6%	57.9%	151.1%	12641.8%	-8.9%	-84.2%	-5.5%	3.1%	14.5%	890.3%	315.7%	-0.4089%	1150.1%	IT	
LT	33.6%	-49.2%	66.7%	24.9%	176.0%	7.8%	-76.3%	-22.5%	-19.6%	10.9%	35.4%	1.4%	1.4%	3.9%	LT	
LU	17.5%	-89.6%	55.1%	23.4%	64.2%	-6.9%	-75.6%	-21.2%	14.5%	11.09%	238.1%	0.3%	-0.1%	0.5%	LU	
LV	-28.5%	-76.3%	89.6%	257.9%	2140.7%	2.2%	-90.1%	-22.9%	59.6%	11.5%	60.8%	2.8%	11.2%	27.8%	LV	
MT	2.6%	-80.5%	87.0%	233.0%	76.6%	0.7%	-88.4%	-13.1%	0.0%	20.9%	41.9%	0.0%	0.0%	0.4%	MT	
NL	-18.6%	-75.8%	34.8%	10.1%	167.8%	-1.6%	-62.4%	-20.0%	-9.1%	8.3%	61.3%	0.7%	0.0%	1.2%	NL	
PL	-5.9%	-49.5%	82.6%	79.2%	18495.2%	-0.4%	-2.4%	-18.1%	28.4%	0.0%	113.8%	28.0%	10.1%	386.1%	PL	
PT	54.1%	-40.9%	92.2%	8.3%	81.3%	-22.4%	-83.8%	-46.2%	3.7%	42.0%	47.3%	12.8%	-0.6%	109.6%	PT	
RO	-14.4%	-68.7%	129.3%	274.2%	3436.6%	-19.0%	-75.9%	-32.4%	-73.9%	22.8%	21.0%	12.2%	5.8%	57.0%	RO	
SE	4.4%	-62.3%	14.9%	0.8%	3.6%	-1.8%	-73.0%	-41.9%	-16.7%	20.6%	118.2%	9.1%	-5.0%	155.2%	SE	
SI	25.7%	-64.8%	70.1%	60.4%	134.2%	-7.4%	-77.5%	-26.8%	-26.2%	18.0%	95.1%	6.6%	10.4%	26.6%	SI	
SK	-31.1%	-61.4%	38.5%	301.0%	923.1%	-4.4%	-62.8%	-6.6%	0.4%	27.9%	80.6%	46.3%	26.9%	1125.9%	SK	
UK	n.a.	-70.0%	9.7%	57.9%	911.0%	14.5%	-85.9%	-0.5%	8.5%	16.6%	94.5%	14.8%	0.0%	217.0%	UK	
EU28	n.a.	-66.7%	56.7%	n.a.	n.a.	n.a.	n.a.	-12.4%	-4.4%	15.4%	119.2%	28.6%	1.9%	154.3%	EU28	
Median	-4.9%	-60.7%	60.04%	78.12%	886.9%	-5.1%	-75.8%	-18.0%	-2.5%	16.8%	109.6%	13.2%	1.5%	124.5%	Median	
Cut-off	16.5%	-40.4%	29.6%	18.6%	79.4%	3.0%	-54.2%	-4.5%	-27.6%	11.1%	53.3%	2.5%	-0.4%	20.2%	Cut-off	

Notes: ⁽¹⁾ Data for Belgium and Poland refer to 2014-2017; ⁽²⁾ 2013 data for the EU refer to EU27; ⁽³⁾ data for Greece refer to 2014-2017 and for Italy to 2015-2017. n.a. = not available data.

Equal or above the median (equal or below, if ^(*)).

Below the cut-off at 20th percentile (above 80th percentile, if ^(*)).

Otherwise.

Source: Digital scoreboard (2018)

1.4. ELECTRICITY AND NATURAL GAS

The improvement of market functioning in energy sectors is a key element to increase the efficiency of these sectors and the economy as a whole. Areas of importance include the level of competition in wholesale and retail markets, the regulatory environment (primarily vertical separation and the regulation of end-user prices), interconnection capacities and the resilience of the gas system. The objective of the current exercise is to provide an overview of the energy market conditions and identify situations where further assessment might be needed. Therefore, the set of selected indicators has to be considered as a basis for further country-specific in-depth economic analysis. Table 1.4.1 provides an overview of the indicators reflecting the current overall competitive situation and market functioning of electricity and gas markets in EU Member States. Table 1.4.2 shows the progress achieved during the last five available years.

The overall competitive situation and market functioning across Member States is still heterogeneous. An insufficient degree of market opening could impede the proper functioning of the national energy markets and hence create bottlenecks in access to the market, in infrastructure interconnection and in the supply of services by operators.

Recent developments in the electricity sector, including a decrease during 2011-2016 in the market share of the main producers and retailers, provide some indications of improvement in the degree of market competition in this sector. Such decreases are more pronounced in electricity generation (-7.9 pp) and more modest in electricity retail markets (-4.1 pp). During 2011-2016 the incumbents' market shares have also decreased in the gas sector, especially in the retail market (-9.0pp), whereas the wholesale market shows only a very minor decrease (-0.6pp).

In the electricity market, Member States made progress with the unbundling²⁰ of the transmission system operator. In 2013, unbundling procedures were still on-going in nine Member States and not even started in ten other Member States. According to the latest data (2018) unbundling was certified for all Member States (except Cyprus, Luxembourg and Malta, which are exempted²¹). In the gas market, in 2018 unbundling procedures are still not certified in a few Member States (Estonia, Croatia). This reflects substantial progress compared to the situation in 2013, when unbundling procedures were certified in only three countries, i.e. France, Ireland and Italy.

The number of countries applying price regulation decreased between 2013 and 2017, for non-household consumers in the electricity sector and for both household and non-household consumers in the gas markets (Table 1.4.2). Nevertheless, in 2017 there were still fourteen countries, which applied price regulation in at least one of the two subsectors and/or consumer markets. Price regulation in 2017 was more commonly applied to households than to non-household consumers.

Cross-border electricity interconnectivity capacities are key elements for a well-functioning internal energy market and they have been identified as one of the main priorities of the EU agenda. By 2017 the 2020 interconnectivity targets had been reached by seventeen Member States.

Concerning resilience of the gas system, during 2012-2016 progress was made in the EU on average as well as in the majority of the Member States (Table 1.4.2). For six Member States (Denmark, Ireland, Italy, Luxembourg, Romania and Slovenia) the indicator shows a decrease in resilience. As of 2016, resilience of the gas system remains rather low in Bulgaria, Cyprus, Luxembourg, Malta and Sweden.

⁽²⁰⁾ Unbundling in the energy sector refers to the separation of energy supply and generation from the operation of transmission networks. See also: <https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation>

⁽²¹⁾ The exemption for these Member States is granted based on the presence of substantial problems for the operation of their small isolated systems.

Box 1.4.1: Indicators assessing competition in energy markets

The assessment of the energy sector is based on the following indicators:

- *Electricity market indicators*, including: i) The number of main⁽¹⁾ electricity producers, ii) The cumulative market share of the main electricity producers, iii) The type and certification status of the unbundling regime, iv) The cumulative market share of main retailers, v) The application of price regulation for non-households, vi) The application of price regulation for households, (vii) The level of the cross-border electricity interconnection capacities⁽²⁾.
- *Gas market indicators*, including: i) The number of main gas importers, ii) The cumulative market share of the main gas importers, iii) The type and certification status of the unbundling regime, iv) The cumulative market share of main retailers, v) The application of price regulation for non-households, vi) The application of price regulation for households, (vii) The resilience of the gas system.⁽³⁾

As reported in Tables 1.4.1 and 1.4.2, coloured labels are assigned to all Member States for each indicator, based on the following approach: "green labels" indicate the best performances and "yellow labels" intermediate performances, while "red labels" are assigned to the worst performances.

⁽¹⁾ For both electricity and gas, "main" producers or retailers refers to producers or retailers with a market share higher than 5%.

⁽²⁾ The indicator represents the difference between the current level of the interconnection capacities and the 2020 interconnectivity target

⁽³⁾ This indicator is based on the formula as defined in article 5 of Regulation 2017/1938 which describes the ability of the technical capacity of the gas infrastructure to satisfy total gas demand.

Table 1.4.1: Market functioning and regulatory environment in the energy sector

	Cumulative Market Share Generation, Main Producers/Entities - %	Certification for effective unbundling (EU) (*)	Cumulative Market Share, Main Retailers %	Price Regulation Non-household (**)	Price Regulation Household (**)	Interconnectivity level	Cumulative Market Share, Main Entities - %	Certification for effective unbundling (EU) (*)	Cumulative Market Share, Main Retailers %	Price Regulation Non-household (**)	Price Regulation Household (**)	Resilience of the gas system
Year	2016	2018	2016	2017	2017	2017	2016	2018	2016	2017	2017	2016
AT	52.1	ITO/OU	77			15.3	73	ITO	n.a.			232.6
BE	71.1	OU	74			18.9	81.6	OU	34.4			279
BG	78.3	ITO (2017)	64.8			7.1	96.9	ITO (2015)	n.a.			50.6
CY	100		100			0		n.a.	n.a.			0
CZ	59.8	ITO	66.1			19.3	65.5	ITO	35			373.5
DE	72.1	OU/ITO				8.9	n.a.	ITO+OU	n.a.			197
DK	41.7	OU				50.6	n.a.	OU	n.a.			135
EE	80.8	OU	68.4			23.7	100	OU	92			104.5
EL	86.6	ITO	88			10.6	95	ITO	76.1			108.8
ES	63.8	OU	78.7			5.8	82.4	ISO+OU	35.6			132
FI	62.7	OU	63.4			28.8	100	-	90			129.1
FR	87.6	ITO	79.3			9.4	84.3	ITO+OU	35.8			131
HR	95.6	ITO	86			52	90.2	OU	38.3			100.6
HU	76.3	ITO	96.1			58.3	82.4	ITO+OU	23.3			129
IE	83.5	-	89.9			7.4	95.9	-	47.7			134
IT	39	OU	40			8.2	84.8	ITO+OU	21.4			105.5
LT	48.9	OU	88.9			23.7	96.9	OU	83.3			117
LU	50.4		92			109.2	98.3		33.5			0
LV	58.6	ISO	90.2			23.7	100	OU	100			220.7
MT	100		100			24.2	n.a.	-	n.a.			0
NL	56	OU	73			18.1	n.a.	OU	n.a.			198
PL	29.9	OU	78.4			4	83.1	ISO+OU	43.2			133.9
PT	71.2	OU	88.3			8.7	97.2	OU	44.7			110
RO	65.8	ISO	60.7			6.9	89.4	ISO	27.1			100.7
SE	71.4	OU	35.2			25.6	100	ISO+OU	n.a.			15
SI	94.3	ITO	94.1			83.6	96.2	ITO	47.8			57.4
SK	71.3	OU	75			43.3	98.7	ITO	55.5			305.2
UK	59	ITO/OU	79.9			5.9	79.1	OU	21.3			140
EU28	68.9		78.0			25.0	90.0		49.3			133.6

(*) ITO: independent transmission operator; ISO: independent system operator, OU: ownership unbundling. In green, unbundling in effect; in red, procedures for unbundling not started.

(**) In green, no price regulation; in red, price regulation

Performance better than median Performance worse than median Among 20% worst performers

Source: Market share indicators: DG ENER - Energy datasheets: EU28 countries - update 14 Feb. 2018.

Unbundling indicators: DG ENER overview of Commission opinions on draft certification decisions:

https://ec.europa.eu/energy/sites/ener/files/documents/certifications_decisions_final2018.pdf

Price regulation indicators: CEER - Retail markets Monitoring Report - 21 November 2017

Resilience and interconnectedness indicators: European Commission's Energy Union Factsheets accompanying the third Report on the State of the Energy Union

Table 1.4.2: Progress in market functioning and regulatory environment in the energy sector (total progress over the considered period)

	Cumulative Market Share Generation, Main Producers/Entities - %	Certification for effective unbundling (EU) (*)	Cumulative Market Share, Main Retailers %	Price Regulation Non-household (**)	Price Regulation Household (**)	Interconnectivity level	Cumulative Market Share, Main Entities - %	Certification for effective unbundling (EU) (*)	Cumulative Market Share, Main Retailers %	Price Regulation Non-household (**)	Price Regulation Household (**)	Resilience of the gas system
Year	2011-2016	2013-2018	2011-2016	2013-2017	2013-2017	2012-2017	2011-2016	2013-2018	2013-2016	2013-2017	2013-2017	2012-2016
AT	-3		15			5.3	-3	ITO/ISO=>ITO	n.a.			71.6
BE	-13		-15			8.9	-8					71.0
BG	-4		3			-2.9	-3					9.6
CY	0		0			-10.0	n.a.	n.a.	n.a.	n.a.	n.a.	0.0
CZ	-10		-19			9.3	-16		2			104.5
DE	13		n.a.			-1.1	n.a.					17.0
DK	-19		n.a.			40.6	n.a.	n.a.				-5.0
EE	-6		-10			13.7	0		2			15.5
EL	n.a.		n.a.			0.6	n.a.	ITO/OU=>ITO				13.8
ES	-3		-10			-4.2	4		7			15.0
FI	-1		n.a.			18.8	0	n.a.	5			26.7
FR	2		0			-0.6	-8	ITO=>ITO+OU	-28			1.0
HR	-2	n.a.	-12	n.a.	n.a.	42.0	-10		2	n.a.	n.a.	n.a.
HU	15		13			48.3	0	ITO=>ITO+OU	1			24.0
IE	-10	n.a.	-7			-2.6	18	n.a.	-10			-7.0
IT	-9		-6			-1.8	15		-4			-0.6
LT	-26		4			13.7	-3		-15			89.6
LU	-40		1			99.2	n.a.		n.a.			-44.2
LV	-27		-10			13.7	0		0			66.9
MT	0		0			14.2	n.a.	n.a.	n.a.	n.a.	n.a.	0.0
NL	-2		-1			8.1	n.a.	n.a.				36.0
PL	-14		5			-6.0	-14		-50			31.9
PT	3		-8			-1.3	5		-10			8.5
RO	-25		-6			-3.1	9		1			-23.8
SE	-9		-14			15.6	0	OU=>ISO+OU	n.a.			3.0
SI	-1		-3			73.6	-3		-14			-18.7
SK	-6		-11			33.3	0		-14			98.8
UK	-16	OU=>IO/ITO	-8			-4.1	4		-30			31.4
EU28	-7.9		-4.1			15.0	-0.6		-9.0			23.6

(*) ITO: independent transmission operator; ISO: independent system operator, OU: ownership unbundling.

In green, unbundling entered in effect during the period; in orange, unbundling was already in effect; in red, unbundling not yet in effect.

(**) In green, price regulation abolished; in red, price regulation introduced; in orange, no change in regulation

Progress better than median Progress worse than median No progress

Source: Market share indicators: DG ENER - Energy datasheets: EU28 countries - update 14 Feb. 2018.

Unbundling indicators: DG ENER - overview of Commission opinions on draft certification decisions:

https://ec.europa.eu/energy/sites/ener/files/documents/certifications_decisions_final2018.pdf

Price regulation indicators: CEER - Retail markets Monitoring Report - 21 November 2017

Resilience and Interconnectedness indicators: European Commission's Energy Union Factsheets accompanying the third Report on the State of the Energy Union (2017)

1.5. TRANSPORT

The EU regulation of transport greatly varies across subsectors, i.e. railways, road and air transport. The degree of market opening differs across these transport modes, with road and air having long been the most advanced. Market functioning and competitive outcomes also show marked differences across transport modes, reflecting a different pace of implementation.

The objective of the current exercise is to provide an overview of the transport market conditions and identify situations where further assessment might be needed. Therefore, the set of selected indicators has to be considered as a basis for further country-specific in-depth economic analysis. Table 1.5.1 presents a set of indicators summarising the overall competitive situation and market functioning of transport markets in EU Member States. Table 1.5.2 illustrates the progress registered by these indicators over the last five available years. The indicators used in this assessment are discussed in Box 1.5.1.

1.5.1. Rail

Due to their history and structural characteristics, railway markets remain relatively concentrated in many Member States in comparison to the other transport sectors, and in particular the aviation sector. Competition is relatively high in the freight rail sector, which was liberalised at EU level in 2007. During 2012-2016 in this subsector the average market share⁽²²⁾ across Member States of the incumbent fell from 78% to 71%. The share decreased for most Member States, with the exception of Denmark, Estonia and Portugal. As of 2016, the market share of the incumbent is still 100% in four countries (Greece, Ireland⁽²³⁾, Lithuania and Luxembourg). Moreover, in five other countries (Croatia, Finland, Portugal, Slovenia and Slovakia) the share remains above 80%.

The degree of competition is lower in the passenger rail sector, which is set to be fully liberalised at EU level as of 2019 with the implementation of the 4th railway package. In the meantime, as a result of legal monopolies being allowed for domestic passenger services in the past, national incumbents still dominate the market, holding 87% of the market⁽²⁴⁾ at the EU level and 100% in eight Member States. In fact, during 2012-2016 the market share of the incumbent passenger operators at the EU level increased, albeit by only one percentage point. The increase was particularly high in Estonia (+50pp). The competing operators increased their share of the market in only five countries.

Public Service Obligations (PSO) in passenger rail refer to services of general interest for society which typically cannot be run commercially. Competent authorities ensure the provision of such services by awarding public service contracts to operators, specifying public service obligations, while compensating them financially and/or granting exclusive rights for the delivery of the services. During 2012-2016 the average share across Member States of passenger kilometres under public service obligations remained constant around 80%. The largest increases were experienced in Finland (+53pp) and Belgium (+10pp). In three Member States (Denmark, Ireland and Romania) all passenger rail services are provided under PSO. Furthermore, in Belgium, Croatia and Luxembourg the share is 98% or above.

Regarding the regulatory framework of railway markets, varying degrees of separation exist between infrastructure managers (IM) and service providers, i.e. Railway Undertakings (RU) across the EU. In

⁽²²⁾ The market here consists of the total number of tonne kilometres carried out on the territory of the Member State in question. This includes national transport as well as the part of international transport taking place within the country.

⁽²³⁾ In the case of Ireland the low market share may be linked to the fact that it enjoyed exemption from vertical unbundling rules until March 2013.

⁽²⁴⁾ The market here consists of the total number of passenger kilometres carried out on the territory of the Member State in question. This includes national transport as well as the part of international transport taking place within the country.

2018 a sizeable minority of Member States have a vertically integrated model based on an IM established as a separate legal entity but owned by a holding company which also owns and controls a railway undertaking. These include Austria, Germany, France, Italy, Latvia and Slovenia. In Luxembourg, Lithuania and Ireland, infrastructure management is fully integrated with service provision, but a separate independent body is in charge of the essential functions of infrastructure management (path allocation and infrastructure charging). Croatia used to have the same model, but has moved to a model with an independent IM. France has reverted to a holding. While all models remain legal, the 4th railway package has introduced more stringent criteria to ensure the impartiality of infrastructure managers, which Member States need to implement as of January 2019.

Regarding PSOs, there has been limited progress in the use of competitive tendering with a majority of Member States still directly awarding public service contracts. 2016 data indicate that Bulgaria, Czech Republic and Portugal have limited direct awarding and have used competitive tendering for their public service contracts. Poland and the UK, on the other hand, have started directly awarding part of their public service contracts whereas before they exclusively used competitive tendering. With the 4th railway package, competitive tendering will become the rule across the EU as of December 2019, with a transition period until December 2023. Several Member States, including Finland and the Czech Republic have already taken steps to start tendering public service contracts on a large scale, while in others, such as France, some competent authorities are preparing for it.

As a whole, the development towards a better functioning market seems to have somewhat stagnated, as progress in some respects can be recorded in parallel to back tracking in other aspects, e.g. in terms of a growing market share of the incumbent and less competitively awarding of PSOs. According to the scoreboard, the rail market opening and market functioning can overall be considered to be lagging behind in Greece, Finland, Croatia, Ireland, Lithuania and Slovenia. However, there are encouraging developments, as Member States prepare for implementation of the 4th railway package, which is expected to deploy its full effects in the next months and years.

Box 1.5.1: Indicators assessing competition in transport markets

The assessment of the transport sector is based on the following indicators⁽¹⁾:

- *Rail indicators*, including: i) the market share of the incumbent freight operator ii) the market share of the incumbent passenger operator iii) the share of public service obligations, iv) the model of vertical unbundling, v) the use of competitive tendering.
- *Road transport indicators*, including i) the cabotage penetration rate⁽²⁾, ii) the share of international activity⁽³⁾
- *Aviation indicators*, including i) the market share of the passenger incumbent, ii) the market share of low-cost carriers, iii) the share of cabotage in domestic flights⁽⁴⁾, iv) the share of 'cabotage' in intra-EU flights⁽⁵⁾.

As reported in Tables 1.A.5 and 1.A.6 in the Annex, coloured labels are assigned to all Member States for each indicator, based on the following approach: "green labels" indicate the best performances and "yellow labels" intermediate performances, while "red labels" are assigned to the worst performances.

⁽¹⁾ For rail and road the (market) share indicators are calculated based on either the number of freight or passenger kilometres. For aviation, the (market) share indicators are calculated based on the number of seats.

⁽²⁾ The share of haulage (tkm) within the Member State in question, carried out by a vehicle registered in another country.

⁽³⁾ The share of haulage (tkm) carried out by vehicles registered in the country in question, which took place in another country or between multiple other countries.

⁽⁴⁾ The share of seats on domestic flights within the Member State in question, carried out by a carrier registered in another country.

⁽⁵⁾ The share of seats on flights between the Member State in question and a second country, carried out by a carrier not registered in any of these two countries.

1.5.2. Road

In road transport, the international haulage of goods has been progressively liberalised in the EU. Cabotage is allowed on a temporary basis since 1998. In 2009, the rules have been somewhat clarified by Regulation 1072/2009. Nowadays, there are still some practical restrictions and cabotage penetration can still be considered as rather low.

For road freight transport the cabotage penetration rate was 3.2% in 2016 at the EU level. This is to some extent driven by comparatively high rates in Germany and France, two large transit countries. In about half of the Member States the rate is 1.0% or below. Cabotage rates tend to be lower in the countries that joined the EU starting from 2004 and/or are located in the periphery of the Union. The lowest rates are found in Bulgaria, Finland, Hungary, Poland and Romania. The indicators of the scoreboard show a considerable increase in cabotage penetration during 2011-2016. The cabotage penetration rate has almost doubled at the EU level (from 1.8% to 3.2%). In all countries the rate has increased during this period, except for Bulgaria, Denmark, Greece, Hungary, Ireland, Luxembourg and Slovenia.

During 2011-2016, the international activity of domestic hauliers, i.e. the sum of both cabotage and cross-trade, only modestly increased at EU level, from 7.8 to 11.4 %. Large increases occurred in Bulgaria, Croatia, Romania and the Baltics. However, eleven Member States saw a decline in the share, including Austria, Czech Republic, Hungary, Luxembourg and the Netherlands. In 2018, the share remains low for the four largest Member States as well as for Greece and Sweden.

In summary, during 2011-2016 a modest increase in competition is recorded in the road freight market in the EU, although a fair share of the Member States do not show progress in this respect. According to the scoreboard, competition in the road freight transport sector is lagging behind in Bulgaria, Greece, Finland, Croatia, Ireland, Luxembourg and Slovenia,

1.5.3. Aviation

Air transports are characterised by a high level of competition. Market opening at EU level has been successful and consumers have significantly benefited in terms of improved quality and affordability of services. During 2013-2018 the market share of the incumbent passenger operators decreased from 50% to 44% at the EU level. The share decreased for most Member States with only five countries showing an increase (Estonia, Greece, Finland, Latvia and Slovenia). In 2018, the incumbent had a market share above 70% in Estonia, Finland, Croatia, Luxembourg and Slovenia, thereby occupying a dominant market position.

The decrease in the market share of the incumbents coincides with an increasing market share of low-cost carriers from 37% to 43% at the EU level. However, in many Member States this is to a large degree caused by a very strong increase in low-cost carrier activity whereas the absolute supply by incumbents remained roughly the same during 2013-2018. As of 2018, the share of the low-cost carriers almost equals the share of the incumbents at the EU level, and in various MS actually exceeds it. Mirroring the dominant position of the incumbent, Estonia, Finland, Croatia and Luxembourg have a market share of low-cost carriers below 20%. Greece also has a low market share for low cost carriers, but its market is not dominated by the incumbent.

During 2013-2018, the share of cabotage in domestic flights in the EU increased from about 19 to 21%. The early liberalisation of cabotage in 1997 could explain its comparatively high level compared to the road freight sector and its more limited progress in recent years. While the majority of EU countries saw an increase in cabotage in this period, sharp decreases were seen in Denmark, Spain, Finland and Ireland. In a number of Member States, i.e., Austria, Belgium, Czech Republic, Croatia, Ireland and Latvia, the share of cabotage in domestic flights remains zero.

During 2013-2018 the share of 'cabotage' in intra-EU flights increased from 25% to 33%. Increases occurred in all Member States except Finland, Croatia, Hungary, Ireland and Slovakia. As of 2018, the share exceeds 15% in all Member States except Austria, Hungary, Ireland, the Netherlands and Slovenia.

Overall, during 2013-2018 the aviation sector, starting already from a fully liberalised and comparatively well-functioning market, still shows progress in terms of competition. Yet, market functioning in the air transport sector is somewhat lagging behind in Austria, Estonia, Finland, Croatia, Ireland, Luxembourg and Slovenia compared to other Member States.

Table 1.5.1: Market functioning and regulatory environment in transport sectors

	RAILWAYS					ROAD		AIR			
	Market share of incumbent freight operator	Market share of incumbent passenger operator	Share of PSOs, %	Unbundling with infrastructure manager (*)	PSO - Use of competitive tendering (**)	Cabotage Penetration rate	International activity of domestic hauliers	Market share of incumbent	Market share of low-cost carriers	Share of cabotage in domestic flights	Share of 'cabotage' in intra-EU flights
Year	2016	2016	2016	2018	2016	2016	2016	2018	2018	2018	2018
AT	73.9	88.3	69.4			5.3	8.3	66.2	30.5	0.0	11.2
BE	51.4	n.a.	98.2			8.7	8.1	50.3	41.6	0.0	36.8
BG	45.5	100.0	92.2			0.2	47.4	33.7	62.9	42.3	59.0
CY	n.a.	n.a.	n.a.	n.a.	n.a.	-	-	18.9	32.4	n.a.	27.0
CZ	65.1	n.a.	95.0			0.9	11.9	50.4	46.5	0.0	32.9
DE	54.5	84.3	58.5			5.6	1.6	56.1	38.7	9.9	22.8
DK	73.9	92.9	100.0			2.4	4.1	54.4	37.0	70.4	56.6
EE	79.9	94.0	94.0			1.3	31.4	87.9	7.9	100.0	42.8
EL	100.0	100.0	97.3			1.0	0.2	49.6	19.8	11.5	28.3
ES	70.5	100.0	43.0			0.9	3.0	26.7	51.8	17.0	37.7
FI	99.9	100.0	97.0			0.3	2.3	80.0	16.8	17.2	22.1
FR	59.0	95.0	38.0			6.3	0.3	54.6	25.9	16.5	23.5
HR	85.3	100.0	99.2			0.5	32.1	86.6	11.5	0.0	3.6
HU	57.9	96.7	95.4			0.2	21.3	28.6	70.9	n.a.	27.7
IE	100.0	100.0	100.0			1.8	5.1	42.3	53.7	0.0	0.6
IT	44.9	74.8	56.6			1.9	0.7	39.4	52.8	49.7	48.4
LT	100.0	100.0	67.4			1.0	56.1	35.3	64.7	n.a.	73.3
LU	100.0	n.a.	98.0			1.9	55.9	79.7	19.4	n.a.	18.1
LV	74.5	93.0	93.1	(1)		0.7	37.9	67.3	32.7	0.0	32.4
MT	n.a.	n.a.	n.a.	n.a.	n.a.	-	-	45.4	54.2	n.a.	53.1
NL	55.0	94.8	n.a.			2.9	8.8	62.4	34.0	100.0	14.4
PL	58.0	55.3	85.4	(1)		0.2	22.7	42.1	56.4	10.8	59.5
PT	84.6	91.7	8.3			0.7	22.4	48.6	41.3	26.2	34.7
RO	37.1	n.a.	100.0			0.5	39.2	33.1	66.2	23.1	54.3
SE	55.0	65.3	49.4			4.2	0.6	44.2	31.0	23.6	38.8
SI	87.0	100.0	97.4	(1)		0.5	44.0	79.0	21.0	n.a.	9.6
SK	80.1	84.7	91.7			1.9	42.4	15.0	85.0	100.0	78.6
UK	45.0	13.1	97.0			1.1	0.2	31.9	49.3	2.6	34.1
EU28	70.7	87.5	80.9			3.1	11.4	44.2	43.2	20.7	32.8

(*) In red, legally independent IM owned by a holding company which also owns and controls a railway undertaking; in orange, IM integrated in a structure responsible for transport operations.

Separate (institutionally independent) body in charge of essential functions; in green, IM institutionally independent from any railway undertaking.

(**) in red, direct negotiation only; in orange, direct negotiation and competitive tendering; in green competitive tendering only

(***) WEF indicators on the perception of ports facilities with 7 for well-developed and 1 for underdeveloped. In red, scores below the mean (5.2). In green, scores above EU average.

(1) Latvia, Poland and Slovenia have legally independent IMs owned by a holding company which also owns and controls a railway undertaking but with strong guarantees of organisational and decision-making independence in relation to the railway undertaking.

Performance better than median Performance worse than median Among 20% worst performers

Source: Rail: DG MOVE 6th Rail Market Monitoring Report (2019); Road: Eurostat (2018); Aviation: OAG (2018)

Table 1.5.2: Progress in market functioning and regulatory environment in transport sectors (total progress over the considered period)

Year	RAILWAYS					ROAD		AIR			
	Market share of incumbent freight operator	Market share of incumbent passenger operator	Share of PSOs, %	Unbundling with infrastructure manager (*)	PSO - Use of competitive tendering (**)	Cabotage Penetration rate	International activity of domestic hauliers	Market share of incumbent	Market share of low-cost carriers	Cabotage share	Cabotage share Intra-EU
	2012-2016	2012-2016	2012-2016	2012-2018	2012-2016	2011-2016	2011-2016	2013-2018	2013-2018	2013-2018	2013-2018
AT	-8.5	-6.0	3.4			1.7	-1.9	-3.4	2.0	0.0	9.1
BE	-35.2	n.a.	10.2			2.7	-0.4	-7.5	5.7	0.0	3.7
BG	-18.0	0.0	8.2			0.0	20.6	-31.2	27.7	42.3	28.2
CY	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-34.7	9.9	n.a.	10.9
CZ	-21.2	n.a.	-3.0			0.3	-11.5	-14.2	14.0	0.0	14.0
DE	-16.9	-5.7	-1.0			3.2	-0.6	-8.3	6.7	8.5	8.5
DK	0.9	2.9	4.0			-0.2	-1.6	-7.7	0.3	-29.6	2.5
EE	9.9	50.0	1.5			1.2	7.1	7.3	-3.1	100.0	30.4
EL	n.a.	n.a.	-2.7			-0.1	0.1	3.4	14.4	-4.0	16.8
ES	-12.8	0.0	-8.0			0.4	0.5	-2.1	1.5	-8.1	9.6
FI	-0.1	0.0	53.0			0.1	0.9	6.1	-1.1	-29.8	-1.1
FR	-9.0	n.a.	0.0			2.8	0.0	-14.1	2.7	1.3	0.7
HR	n.a.	n.a.	n.a.			0.5	23.4	-5.7	3.8	0.0	-4.2
HU	-10.3	-0.4	0.4			-0.5	-5.3	-6.5	6.3	n.a.	-6.6
IE	0.0	0.0	0.0			-0.3	-1.5	-12.0	9.5	-38.8	-2.5
IT	-31.0	-16.9	4.1			0.7	0.3	-1.2	9.5	12.4	7.4
LT	0.0	0.0	4.4			0.7	14.2	-5.9	5.9	n.a.	10.4
LU	0.0	n.a.	-2.0		n.a.	-1.1	-8.7	-16.9	16.1	n.a.	10.2
LV	-2.9	4.7	5.1			0.4	8.6	0.4	0.1	n.a.	2.6
MT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-14.1	16.4	n.a.	19.5
NL	-9.0	-0.2	n.a.		n.a.	1.3	-3.0	-4.7	3.3	0.0	0.3
PL	-9.1	6.7	0.9			0.1	7.5	-7.8	6.8	10.8	5.0
PT	1.2	1.3	-70.7			0.4	8.9	-5.5	10.9	13.4	9.8
RO	-9.2	n.a.	5.0			0.2	28.9	-20.2	23.1	23.1	18.1
SE	n.a.	n.a.	3.4			1.3	-0.6	-3.2	0.9	3.0	3.4
SI	-3.5	0.0	-0.6			0.0	5.4	-0.1	0.1	n.a.	-2.7
SK	-8.1	-12.0	-0.3			0.5	6.1	1.7	14.1	100.0	6.7
UK	-1.4	3.3	1.0			0.4	-0.1	-7.0	7.8	-2.0	10.9
EU28	-7.2	1.2	0.8			1.4	3.6	-6.2	6.2	1.8	7.6

Progress better than median
 Progress worse than median
 No progress

Source: Rail: DG MOVE Rail Market Monitoring Report (2014, 2016, 2019); Road: Eurostat (2018); Aviation: OAG (2018)

1.6. CONCLUSIONS ON MARKET FUNCTIONING AND REGULATORY ENVIRONMENT

Well-functioning, competitive and integrated markets in network industries (telecommunications, energy and transport) are important for the functioning of the EU economy. The EU has pursued an active agenda to open up these markets to competition with the aim of improving efficiency. The progress of this market opening process in the various markets is heterogeneous.

As shown by the considered indicators, in spite of a certain degree of discrepancy among Member States progress occurred in the recent years, especially in the telecommunications sector. However, according to this analysis some countries still lag behind, especially Croatia, followed by Bulgaria, Cyprus, Greece and Luxembourg (Table 1.6.1). Cyprus is underperforming in the regulatory environment and in mobile communications; Bulgaria in both mobile and fixed communications. In Luxembourg, weaknesses are concentrated in the regulatory environment, while in Greece in the fixed communications. The smallest improvements were registered in mobile communications, which in the case of Luxembourg and Sweden might be explained by the high standards already achieved in these countries. To a certain extent, similar considerations also apply to Belgium and Latvia, which are experiencing limited progress in the fixed communications.

Table 1.6.1: Progress in market functioning and competition in the telecommunications sector

	Weak performance	Little progress achieved in recent years
Regulatory environment	CY, HR, LU	
Mobile communications	BG, CY, EL, HR	EL, LU, PT, SE
Fixed communications	BG, EL, HR	BE, LT

Notes: The MSs in the column "Weak performance" are the weakest performers overall, i.e. those with the highest overall share of red indicators (i.e. 80th percentile cut-off), that are also among the weakest performers in a specific dimension, i.e. regulatory environment, mobile communications or fixed communications. The MSs in the column "Little progress achieved..." are those that experienced the lowest progress overall (i.e. 80th percentile cut-off) and also in a specific dimension. In both cases, the overall share of red indicators is calculated as a weighted average across the identified policy areas, with each policy area receiving the same weight.

Source: European Commission (2018)

Compared to the telecommunications sector, the energy and transport markets are lagging behind according to this analysis. Despite some improvements in both the regulatory environment and competition, in the energy and transport markets there is still scope for further progress, as evidenced by relatively high market concentration levels in many Member States.

According to this analysis, Bulgaria, Cyprus, France, Hungary and Malta lag behind in the energy sector (Table 1.6.2). These countries perform poorly in both the electricity and the natural gas subsector, except for Cyprus and Malta which are mainly lagging in the electricity sector. The comparatively weak performance of Bulgaria, France and Hungary may reflect the modest progress registered in recent years, which was also experienced by Spain, Ireland, Italy, Poland, Portugal, Romania and the United Kingdom.

Table 1.6.2: Progress in market functioning and competition in the energy sector

	Weak performance	Little progress achieved in recent years
Electricity	BG, CY, FR, HU, MT	BG, FR, HU, PL, PT, UK
Natural gas	BG, FR, HU	ES, HU, IE, IT, PT, RO, UK

Notes: The MSs in the column "Weak performance" are the weakest performers overall, i.e. those with the highest overall share of red indicators (i.e. 80th percentile cut-off), that are also among the weakest performers in a specific dimension i.e. electricity or natural gas. The MSs in the column "Little progress achieved..." are those that experienced the lowest progress overall (i.e. 80th percentile cut-off) and also in a specific dimension. In both cases, the overall share of red indicators is calculated as a weighted average across the identified policy areas, with each policy area receiving the same weight.

Source: European commission (2018)

According to this analysis, Greece, Finland, Croatia, Ireland and Slovenia are the poorest overall performers in the transport sector (Table 1.6.3). This results from a weak performance in two or more of

the subsectors covered in the assessment. Denmark, Finland, Hungary, Ireland and the United Kingdom registered the least progress in recent years. These countries showed very little progress in the road and air sectors, with the exception of Finland, which showed little progress only in the aviation sector. Denmark and the United Kingdom furthermore made little progress in market functioning in the rail sector, although in the case of the United Kingdom this should be seen against the background of it having the highest degree of competition in rail transport in the EU28.

Table 1.6.3: Progress in market functioning and competition in the transport sector

	Weak performance	Little progress achieved in recent years
Rail	EL, FI, HR, IE, SI	DK, UK
Road	EL, FI	DK, HU, IE, UK
Aviation	FI, HR, IE, SI	DK, FI, HU, IE, UK

Notes: The MSs in the column "Weak performance" are the weakest performers overall, i.e. those with the highest overall share of red indicators (i.e. 80th percentile cut-off), that are also among the weakest performers in a specific dimension, i.e. rail, road or aviation. The MSs in the column "Little progress achieved..." are those that experienced the lowest progress overall (i.e. 80th percentile cut-off) and also in a specific dimension. In both cases, the overall share of red indicators is calculated as a weighted average across the identified policy areas, with each policy area receiving the same weight.

Source: European commission (2018)

2. ASSESSING THE DEGREE OF CONVERGENCE IN EU NETWORK INDUSTRIES: EVIDENCE FROM THE TELECOMMUNICATIONS, ENERGY AND TRANSPORT SECTORS

2.1. INTRODUCTION

Progress towards greater market integration is expected to be reflected in lower price differentials for similar products across countries. This implies that profit incentives and market forces induce consumer prices to converge to the same level. The theoretical foundation of this assumption is the Law of One Price (LOOP), which in its strong form suggests that in the absence of natural and regulatory barriers the potential for arbitrage strategies should underpin the equalisation of prices of identical goods and services across countries. Commodities are expected to sell for the same price in each region of the internal market (Obstfeld and Rogoff, 1996). Reasons for the law to be violated may be attributed to country and sector specific characteristics like taxes, market structure, consumer behaviour, geographical position and degree of tradability of products or services. However, convergence based on the weak or relative version of the LOOP, which allows for long term consumer price differentials due to such country and sector specific factors, might still occur. The implications of the relative versus absolute version of the LOOP are illustrated in Goldberg and Verboven (2001). The degree to which the LOOP holds may differ across the network sectors.

In the energy sector the high level of tradability should ensure market integration. Consuming one kWh of electricity or one cubic metre of natural gas means consuming the same good everywhere in the EU and this ensures tradability. Nevertheless, production costs of one kWh of electricity or one cubic metre of natural gas might differ across countries, depending on the generation process in place and the natural resources used. In countries which are not self-sufficient in energy production consumer prices include the costs of import. Additionally, prices might vary due to differences in national policies (e.g. levies and taxes).

In the transport and telecommunications sectors the degree of market integration is expected to be lower than in the energy sector. First and foremost, transport services are a strictly non-tradable good. Consumption and production take place in the same location (e.g. a trip from Brussels to Paris can neither be produced nor consumed in Germany). This means that any variation in production costs due to geomorphological and demographical factors (e.g. population density) and sector-specific factors (e.g. infrastructure access charges, subsidisation) is likely to be reflected in consumer prices. At best, a weak version of the LOOP can be expected for the transport sectors, which accounts for difference in service production costs due to such factors. In addition to a low degree of tradability, in the air and rail sectors there is a high degree of product heterogeneity. Firstly, each route can be considered to be a different (unique) service. Moreover, transport services also differ on a number of aspects (degree of comfort, travel time, accessibility and connectivity, passenger rights, various fringe services) including pricing policy (single, round trip, monthly cards, discounts based on age/profession). This further complicates price comparison from a practical point of view.

In the telecommunications sector services are tradable only to a certain extent. Both fixed and mobile internet connections reflect the geographical technological availability. The same also holds for fixed and mobile phone conversations. Therefore, consumer prices for such services reflect the easiness of connection in that specific place, which in turn depends on the broadband coverage. In rural areas broadband coverage is usually lower than in urban areas, due to higher deployment costs and lower population density (digital divide). Services are thus directly comparable only between areas with analogous geomorphological and demographic factors. Therefore, also in this sector the degree of market integration is expected to be lower than in the energy sector.

Building on the theory of the LOOP, this section empirically investigates whether and, if so, to what extent price convergence occurred in the telecommunications, energy and transport sectors during the period 1999-2017. An econometric analysis is carried out in order to test for σ -convergence and β -convergence in consumer prices.

2.2. LITERATURE REVIEW

2.2.1. Methodologies

In the empirical literature two general concepts of convergence are usually employed: the β -convergence (Baumol, 1986) and σ -convergence (Quah, 1993). These two concepts have been extensively used to assess regional or cross-country macroeconomic convergence (Abreu *et al.*, 2005), but also to analyse price convergence in various product and service markets (Rogers, 2002; Lutz, 2004 and Goldberg and Verbove, 2005). In the context of prices these concepts imply the following. In its absolute form, β -convergence refers to a process in which the considered markets converge towards the same price level. This form of β -convergence occurs when a (partial) negative correlation exists between the increase in prices over time and their initial level. The conditional form of β -convergence postulates instead the presence of such convergence only after accounting for certain determinant factors in order to control for different steady states. σ -convergence refers to a reduction over time of the dispersion of prices (measured for instance by the coefficient of variation) across the considered markets. According to the literature, β -convergence is necessary but not sufficient for the existence of σ -convergence (Barro and Sala-i-Martin, 1995).

Dreger *et al.* (2007) for instance applied β - and σ -convergence to investigate the effects of EU enlargement on price convergence in the internal EU market. They analysed whether price convergence to the mean occurred (β -convergence) and whether price dispersions decreased over time (σ -convergence) by looking at the evolution of the standard deviation of prices. The empirical analysis was based on comparative price levels (CPLs), obtained as the ratio between PPPs and nominal exchange rates of national currencies to the Euro. In the absence of absolute prices, relative price aggregates, such as consumer and producer price indexes, were not used since it is not possible to distinguish whether lower price dispersion depends on price convergence or rather on a change in the weighting scheme of individual sub-aggregates. However, since they reflect cumulated inflation rates and not absolute price levels, they are informative about catch up, but not about advances in competition. The analysis was based on a panel framework and to avoid multi-collinearity a factor analysis was performed, i.e. a catching up factor was extracted by principal component analysis.

2.2.2. Empirical findings

Several contributions in the literature investigated the evolution of prices in the EU Single Market. The wave of reforms which took place in several Member States during the 1990s sparked specific interest in price developments in network industries.

European Commission (2001) found substantial differences in price levels (expressed in PPP) across EU15 countries between 1985 and 1999 despite a process of price convergence (including indirect taxation). A different evolution of prices across network industries also emerged. A clear downward price trend was identified in the EU15 telecommunications sector (about -17.5% in nominal terms) between January 1996 and May 2001. In the energy sector, electricity prices exhibited a limited decline over the same period (about 2%), while natural gas prices followed a fluctuating path. The authors found this to be in conflict with the LOOP, since in an integrated market with no transport costs prices of tradable products and services expressed in the same currency should not differ geographically. The authors identified a number of factors explaining such deviation from the LOOP. These include macroeconomic factors (e.g. standards of living, exchange rate fluctuations, growing importance of non-tradable services); microeconomic factors (e.g. transport and distribution costs, regulatory and fiscal systems, imperfect competition in product markets) and structural factors (e.g. the completion of the Single Market, the creation of the EMU and the liberalisation of network industries).

Martin *et al.* (2005) empirically found downward impacts of regulatory reforms (advancing one year in the deregulation/liberalisation process) on prices in network industries, as a probable effect of the creation of the EU Single Market. Business class tickets in the passenger air transport sector were an exception, probably due to the existence of cross-subsidies among different types of tickets. For economy and promotional fares, competition tends to be stronger than for business class fares. The authors also found overall significant negative impacts of reducing public ownership in the energy sector, although the size of the impact varies with the user type. Trends in natural gas prices showed a strong dependence on oil prices.

Ilkowitz and Nicodème (2005) examined the evolution of market performance in EU network industries between January 1996 and January 2005, by considering the effects of increasing competition on market structure. Despite considerable market entries, at the end of this period most sectors were still dominated by incumbents. Several legal, physical and technical barriers still in place hindered effective competition, especially in the Energy sector. From the empirical analysis significant differences emerged in the impacts of liberalisation across countries and sectors. Some country specific (the number of years since the introduction of liberalisation, type and quality of regulation) and sector specific factors (technological changes, oil prices evolution over time) were identified as possible drivers of such differences. Results revealed a strong mean price convergence in telecommunications, especially for international and local calls (20% of annual converging rate and half-life equal to 3-3.5 years) and a slight convergence in the transport and electricity sectors (households), while no convergence emerged for the gas sector (households).

Dreger *et al.* (2007) found price convergence in the internal EU market between 1995 and 2005. Results showed that the speed of convergence increased due to enlargement. Both competition (trade openness, import penetration and business deregulation) and catching up (relative per capita income, productivity and wages) were relevant factors explaining the process of convergence. The catching up lead to a rise in the price level, while competition exerted a downward pressure on prices. Results also showed that the duration of participation of countries in the internal market may have an impact on price convergence. For the EU25 countries, a steep decline in price dispersion was observed until 2000, implying that the price levels in the most recent Member States rapidly converged to those in the EU12 in the course of their preparation for accession.

European Commission (2013) assessed market functioning in EU network industries and found a significant heterogeneity in competition and market conditions across countries and across network industries. Expected benefits for consumers and businesses from market integration did not fully materialise, resulting in market concentration and persistently high, and in some cases increasing, price dispersion, especially in the telecommunications energy sectors. According to the authors, in the period 2002-2011 price evolution reflected specific features such as technological changes and competitive pressures, national (geography, topology of legacy infrastructure) and international factors (commodity prices). However, the degree of market integration depended also on the transposition, implementation and enforcement of the EU ex ante regulatory framework⁽²⁵⁾. A certain degree of correlation emerged between the market shares of the main national operators and the relevant price levels across network industries: lower prices and/or lower incumbents' market shares tended to be observed in the same countries across network sectors.

⁽²⁵⁾ An ex ante regulatory framework represents a set of rules aimed to prevent possible undesirable market outcomes (market abuse, lack of competition). It differs from an ex-post regulatory approach, which aims at remedying actual undesirable market outcomes such as market abuse.

2.3. PRICE TRENDS IN EU NETWORK INDUSTRIES

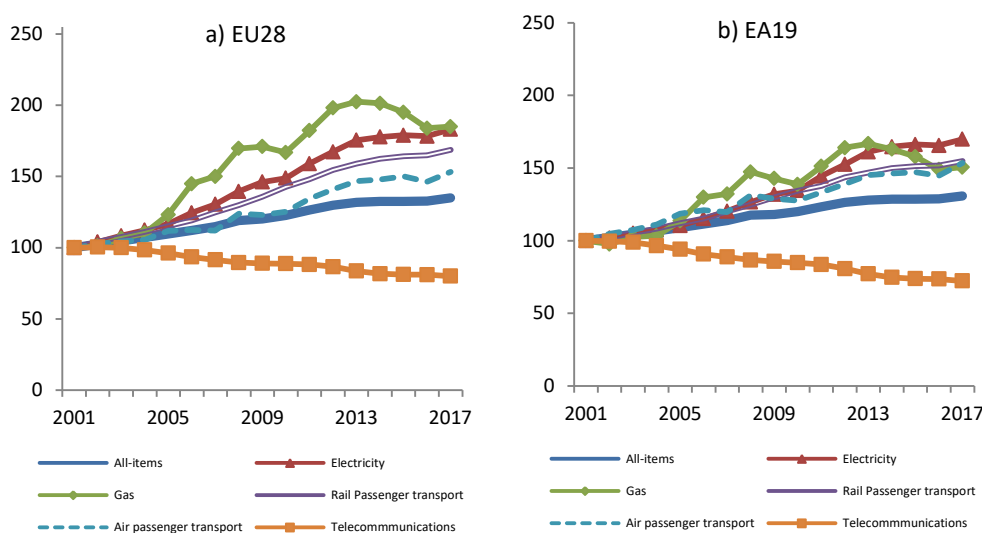
2.3.1. Evolution of price levels in EU network industries

The evolution of price levels in the selected network sectors can be described by data from the Harmonised Indices of Consumer Prices (HICP) available from Eurostat⁽²⁶⁾. These data provide information on consumer prices for the period 2001-2017. The subsectors covered are electricity and gas, passenger air⁽²⁷⁾ and railway, and telecommunications.

Between 2001 and 2017, in the EU28 the HICP for all-items increased on average by about 35% (Graph 2.3.1.a). The increase remained constant over the period. Prices in the energy subsectors increased more than the overall index by almost doubling in this period. In the transport passenger subsectors prices also increased more than the overall index, although less than in the energy subsectors. Telecommunications is the only sector in which prices actually decreased (by around 20%) during the period under consideration.

The evolution of price levels in the Euro Area was similar to that for the EU28 (Graph 2.3.1.b). Sectors ranked similarly in terms of their change in price levels, except for the gas subsector which ranked fourth (instead of first). In the energy and rail subsectors the increase in the price level was slightly lower than for the EU28 as a whole, while the air transport subsector shows a similar increase. The telecommunications sector experienced an even stronger decrease (around 28%) than at the EU28 level.

Graph 2.3.1: Evolution of price trends in network industries (1999-2016)



Notes: EU28 values do not include Croatia during 2001-2005 because of data unavailability. HICP (2001=100).
Source: Commission's services based on Eurostat's data (2018)

⁽²⁶⁾ Data series code: prc_hicp_aind. Sectorial data codes: CP00 - All-items; CP0451 - Electricity; CP0452 - Gas; CP0731 - Passenger transport by railway; CP0733 - Passenger transport by air; CP082_083 - Telephone and telefax equipment and services.

⁽²⁷⁾ The Eurostat HICP index for air transport covers also extra-EU fares which should be taken into account when comparing across sectors.

2.3.2. Cross country price variation in EU network industries

Price trends in the selected network industries across Member States can be further investigated through some simple descriptive statistics built on price level indices (PLIs)⁽²⁸⁾. Data are available from Eurostat for the period 1999-2017 for the energy⁽²⁹⁾ and transport subsectors⁽³⁰⁾ and for the period 2007-2017 for the telecommunications services⁽³¹⁾. The PLIs are expressed as comparative price levels (CPLs), corresponding to ratios between purchasing power parities (PPPs) and nominal exchange rates of national currencies to the Euro. The PPPs are based on price levels of the EU28⁽³²⁾. The use of relative prices is justified by the lack of available absolute prices for all the considered subsectors and services.

In 1999, the highest price dispersion across EU Member States was registered in the natural gas and rail transport subsectors (Table 2.3.1, column 1). Air transport prices displayed the least variation. The ranking for 2017 did not change (column 2). Price variation in the passenger air transport sector decreased slightly during 1999-2017 and in 2017 was still the lowest. However, variation in prices decreased considerably in the other three subsectors, most notably in the natural gas subsector. For the telecommunications services the variation in prices across EU Member States was lower than for the passenger transport and energy subsectors in 2007. However, for each of the telecommunication services the price variation increased during 2007-2017. In 2017, the price variation in the telecommunication services was therefore closer to that in the energy and transport sectors.

Table 2.3.1: Variation in price indices for the different network sectors (coefficient of variation 1999/2007 and 2017)

	EU28		EA19	
	1999	2017	1999	2017
Electricity	0,49	0,32	0,42	0,28
Natural gas	0,72	0,35	0,44	0,24
Passenger rail transport	0,66	0,52	0,52	0,48
Passenger air transport	0,21	0,16	0,20	0,16
	2007	2017	2007	2017
Wired telephone services	0,29	0,38	0,31	0,35
Wireless telephone services	0,36	0,41	0,37	0,43
Bundled telecommunication services	0,26	0,42	0,27	0,33
Internet access provision services	0,22	0,39	0,21	0,34

Source: Commission's services based on Eurostat's data (2018)

Similar trends and rankings are found for the Euro Area, although the cross-country variation in prices tends to be lower than for the EU (Table 2.3.1, columns 3 and 4). This holds mainly for the energy and transport sectors. For the Telecommunications services, differences were much smaller. A first possible

⁽²⁸⁾ Data on PLIs are publicly available from the Eurostat's website (data code: prc_ppp_ind). In our analysis we used more detailed data, received from Eurostat.

⁽²⁹⁾ Electricity and natural gas.

⁽³⁰⁾ Passenger rail transport and passenger air transport.

⁽³¹⁾ These include: wired telephone services, wireless telephone services, bundled telecommunication services and internet access provision services. From 1999 to 2006, data are available only for a single price index, covering all these services.

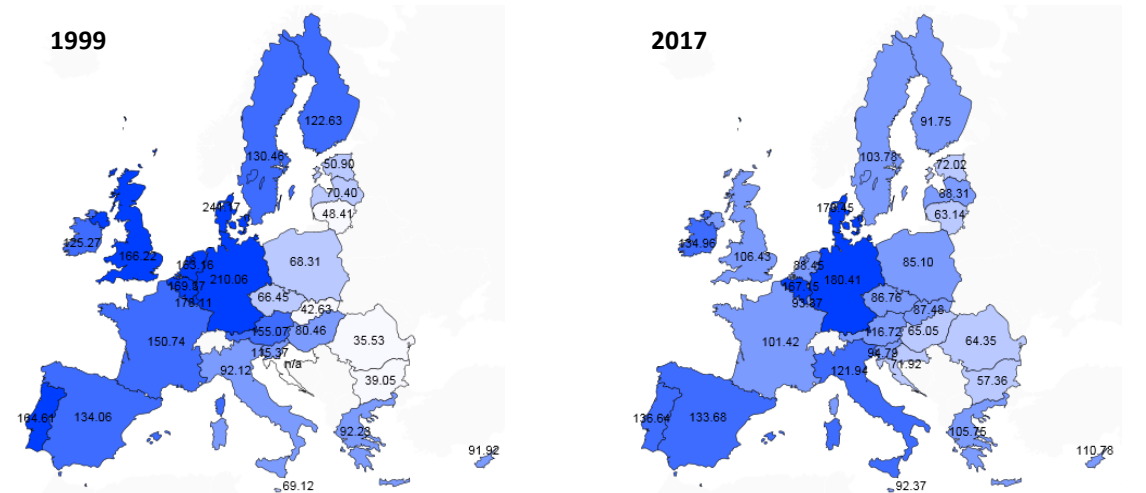
⁽³²⁾ Croatia is not taken into account in 1999.

explanation is that the LOOP manifests itself more strongly in the presence of a common currency⁽³³⁾. Secondly, the Euro Area countries form a more homogenous group than the EU Member States and price levels are likely to be related to GDP/capita through various channels. However, price levels can change also for other reasons, including increased competition, changes in tax levels, subsidies.

The maps in graphs 2.3.2-2.3.9 show for each subsector and service the price level index (i.e. the price relative to the EU average in the same year) in each Member State in the first and last year under consideration. The different colours reflect different degrees of price variation⁽³⁴⁾ and visually allow identifying whether a convergence or divergence took place by comparing the situation at the beginning and the end of the period.

The **electricity** sector displayed considerable price level variation in 1999 (Graph 2.3.1). Prices were significantly lower in the Member States that joined in 2004 or afterwards and higher in the original six Member States, Austria and Portugal. In 2017, the East-West divide narrowed. Relative price levels increased in the East-European Member States and decreased in the countries with the highest initial price level. The trend in the **natural gas** sector is very similar to what happened in the electricity sector (Graph 2.3.2): comparatively low initial prices in Eastern Europe and high initial prices in North-Western Europe. Again, the variation in prices decreased between 1999-2017 due to rises in the Eastern European Member States and reductions in countries with the highest initial price level.

Graph 2.3.2: Electricity price indices in EU Member States in 1999 and 2017 (EU=100)

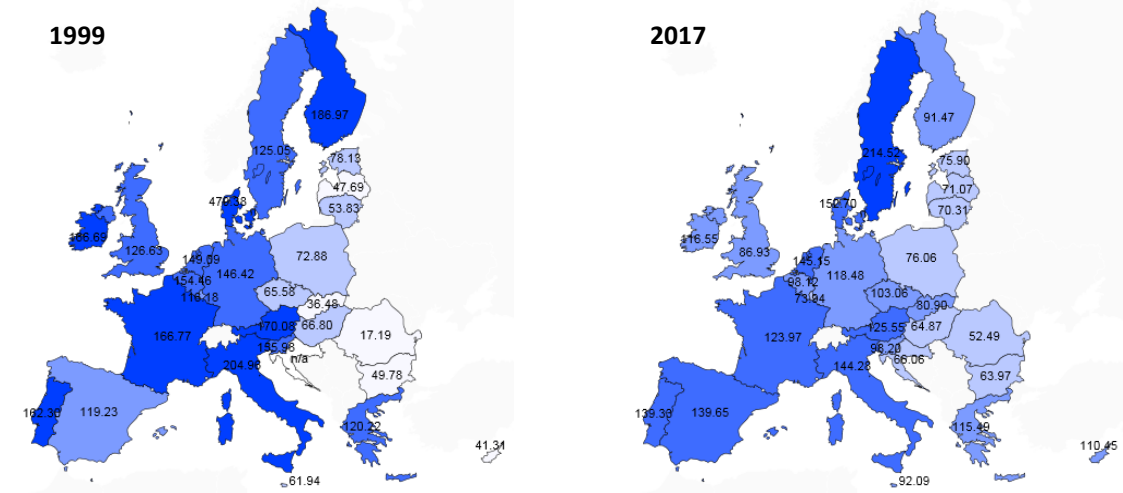


Source: Commission services based on Eurostat data (2018)

⁽³³⁾ Although the empirical evidence concerning the impact of the introduction of the Euro on price convergence is inconclusive, some of the studies (e.g. Mätha, 2005) have claimed that exchange rate stability promotes price convergence in the founding members of the Euro Area.

⁽³⁴⁾ The colours used represent five different price level index intervals, i.e. 0-50; 50-80; 80-120; 160 and higher. The darker tones correspond to the higher intervals.

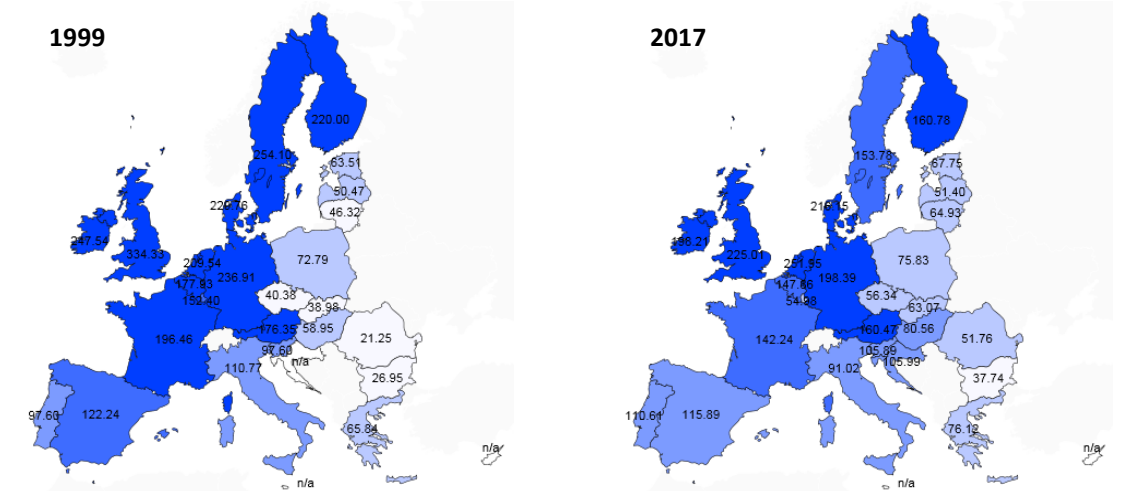
Graph 2.3.3: Natural gas price indices in EU Member States in 1999 and 2017 (EU=100)



Source: Commission services based on Eurostat

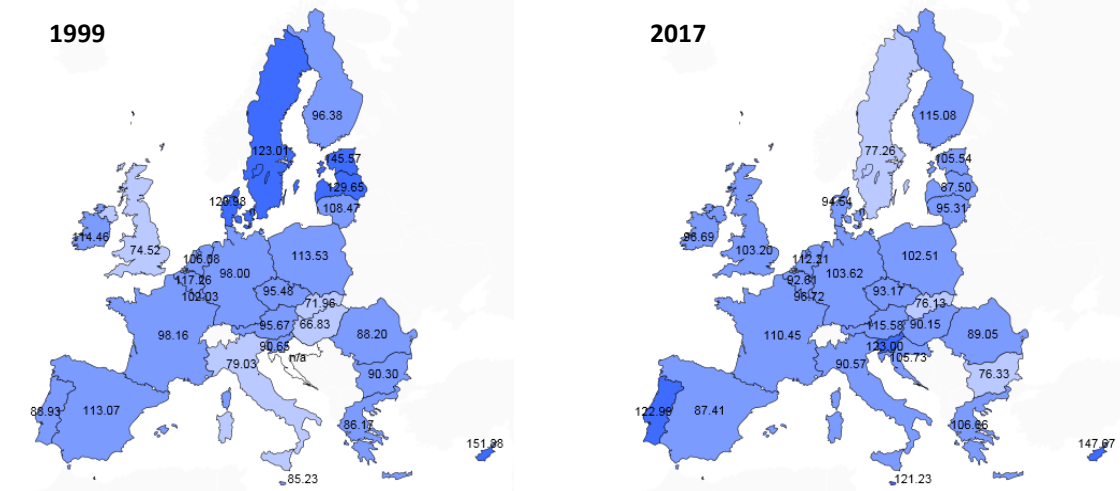
In the passenger **transport** subsectors price variation patterns vary depending on the transport mode. The **passenger rail** transport market shows a pattern very similar to the energy subsectors, i.e. initially high but decreasing price variation, caused by comparatively low, yet increasing relative price indices in the EU12 and high, yet decreasing relative prices in the EU15 (Graph 2.3.4). On the other hand, compared to rail transport the passenger **aviation sector** displayed relatively low initial variation in price levels among Member States, possibly reflecting the relatively advanced and early liberalisation of the sector and/or pre-1999 convergence. No clear East-West divide is discerned in this sector. Despite some changes in price level for individual Member States, the overall degree of price variation remained fairly stable throughout the period under consideration.

Graph 2.3.4: Passenger rail transport price indices in EU Member States in 1999 and 2017 (EU=100)



Source: Commission services based on Eurostat (2018)

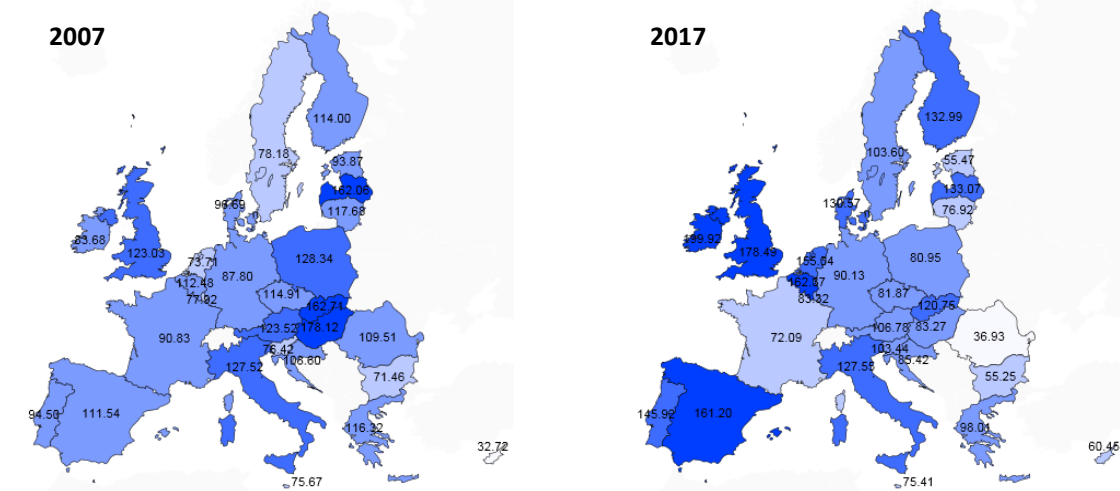
Graph 2.3.5: Passenger aviation price indices in EU Member States in 1999 and 2017 (EU=100)



Source: Commission services based on Eurostat (2018)

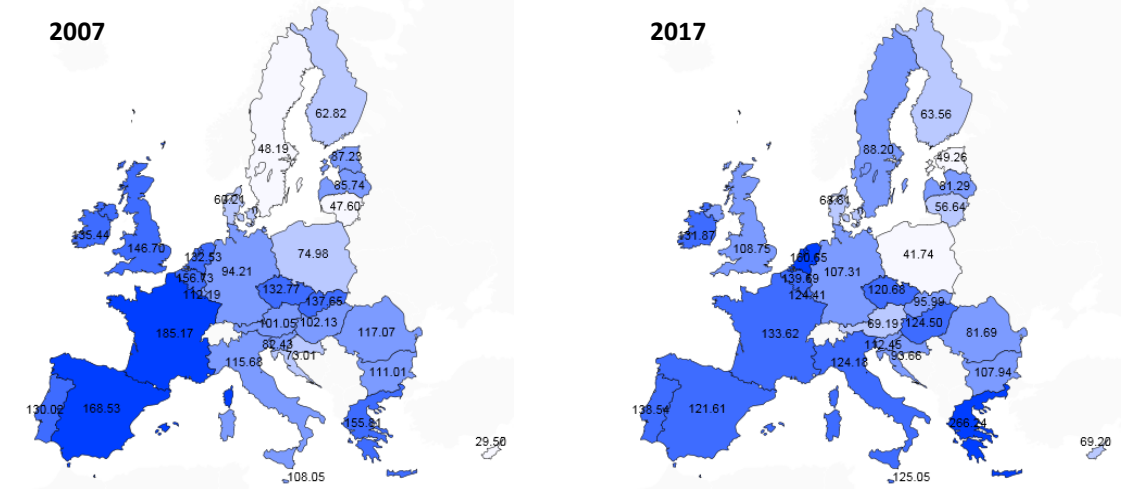
In the telecommunications sector, the initial price variation for both **wired** and **wireless phone services** was somewhat lower than in the energy and transport sectors (Graphs 2.3.6 and 2.3.7), but with significant differences across countries. The maps suggest that the variation in prices slightly increased rather than decreased between 2007 and 2017.

Graph 2.3.6: Wired telephone price indices in EU Member States in 2007 and 2017 (EU=100)



Source: Commission services based on Eurostat (2018)

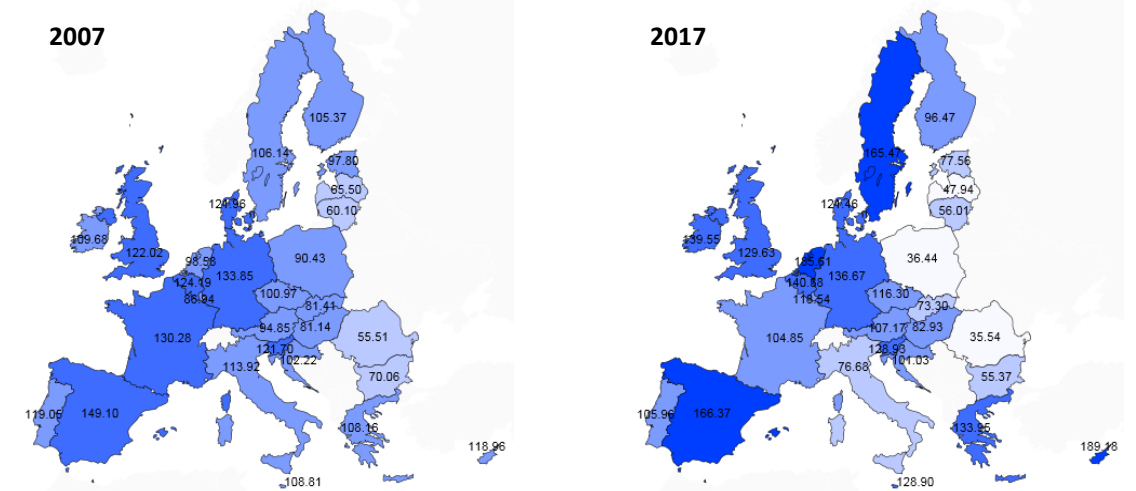
Graph 2.3.7: Wireless telephone price indices in EU Member States in 2007 and 2017 (EU=100)



Source: Commission services based on Eurostat (2018)

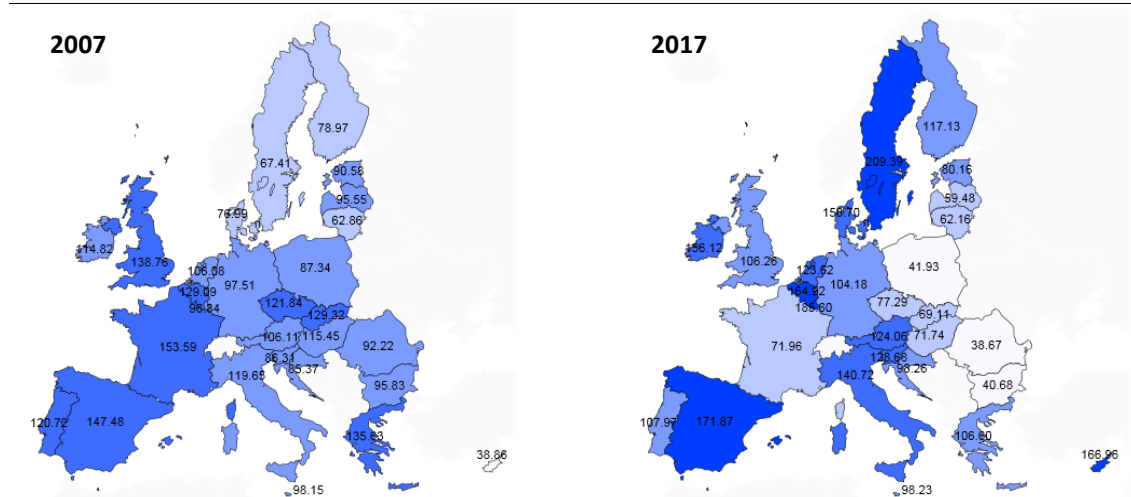
The initial variation in prices for the **internet access** and **bundled telecommunication services** was even lower than in the telephone services. However, the differences in prices rose considerably between 2007 and 2017 (Graphs 2.3.8 and 2.3.9). The particularly strong divergence registered in Internet access might have been driven by an increase in the relative price level in a number of EU15 countries, especially Germany and Spain, where prices were already high, and a decrease in relative price levels in a number of Central and Eastern European Member States, e.g. Poland, Romania and Bulgaria, where prices were already below average. For the bundled telecommunications service a number of significant changes have taken place between 2007 and 2017. Some Member States moved from comparatively lower to comparatively higher price levels (the Nordic countries), while others (France, Slovakia) moved in the opposite direction.

Graph 2.3.8: Internet access price indices in EU Member States in 2007 and 2017 (EU=100)



Source: Commission services based on Eurostat (2018)

Graph 2.3.9: Bundled telecom service price indices in EU Member States in 2007 and 2017 (EU=100)



Source: Commission services based on Eurostat (2018)

Finally, it is noteworthy that those subsectors which experienced the highest price increases during 1999-2017 (Graph 2.3.1) were the same in which price convergence was the strongest (Graphs 2.3.2-2.3.9). Notably, in the telecommunications sector, the only sector in which prices decreased during the considered period, a process of divergence took place (Graphs 2.3.6-2.3.9).

2.4. EMPIRICAL ANALYSIS

In order to assess whether convergence took place for prices in the network industries under investigation, this section empirically tests for the presence of σ -convergence and β -convergence. The analysis is based on the Price Level Indices (PLIs) provided by Eurostat.

2.4.1. Testing for σ -convergence

σ -convergence captures the degree to which the cross-sectional dispersion of the variable of interest decreases over time (see Box 2.4.1). If a variable is converging, its dispersion is downward sloping and possibly heading to zero.

Table 2.4.1: Results of the estimations of σ -convergence for the energy, transport and telecommunications sectors

	Electricity	Natural gas	Rail	Air	Wired phone	Wireless phone	Bundled telecom	Internet access
Trend variable	-.00808***	-.0185***	-.0149***	-.00193***	.00649***	.00579***	.0205***	.0208***
Constant	.421***	.593***	.767***	.226***	.215***	.326***	.066***	.0437***
N	532	532	494	532	308	308	308	308
Adjusted R-square	0.684	0.696	0.832	0.149	0.302	0.473	0.845	0.765

***P<0.01, **p<0.05, *p<0.1

The coefficient of the trend variable represents the speed of convergence

Source: Commission services based on Eurostat (2018)

The results of the estimation of σ -convergence in the sampled markets are shown in Table 2.4.1. Graph 2.4.1 displays the evolution of the price variation and the estimated relationships for the different sectors.

The significant and negative coefficient of the linear trend variable provides evidence of the presence of σ -convergence of the price level indices in each of the energy and transport subsectors. Results indicate that the price levels of natural gas converged to the mean at a higher rate per year than the price indices of electricity and passenger rail transport. Significant divergence occurred instead for the price level indices of wired phone services, wireless phone services, bundled telecommunications services and internet access.

Box 2.4.1: σ -CONVERGENCE

The concept of σ -convergence is related to the trend in the price variation across countries. σ -convergence occurs if and when the variation in prices follows a decreasing pattern over time. Therefore, σ -convergence is useful to analyse the degree of market integration. Price variation is usually measured by the standard deviation or the coefficient of variation.

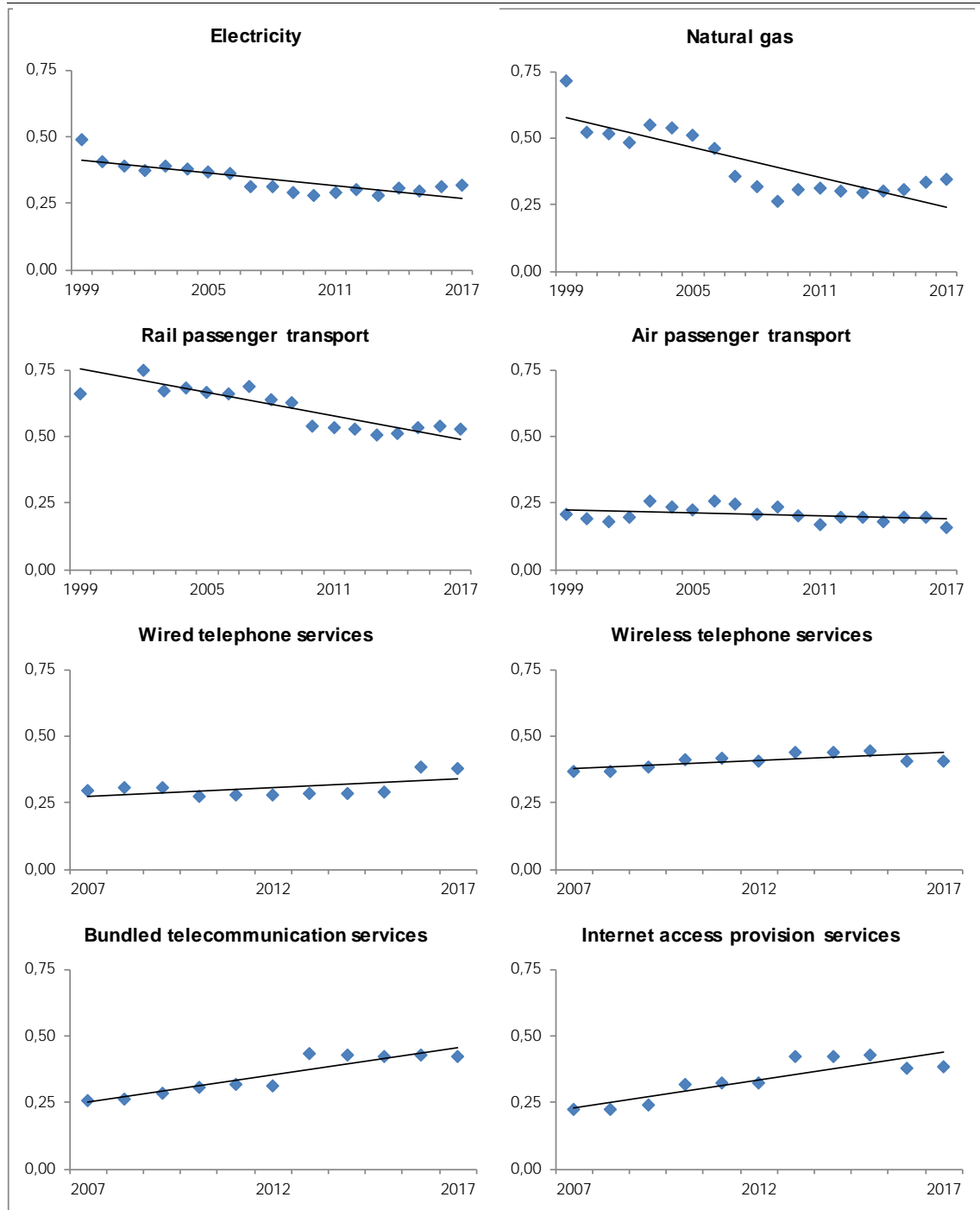
The presence of σ -convergence can be assessed by means of a regression analysis with the price variation as the dependent variable. Explanatory variables include linear and/or non-linear time trend variables and may include other explanatory variables.

The price variation D can be defined as follows:

$$D_t = \alpha + \sigma t + [\beta t^2] + e_t$$

where σ denotes the slope of the price dispersion trend t . Under the null hypothesis of no convergence, σ is equal to 0 or positive. By including the square of the trend variable the model can test whether the rate of convergence or divergence is decreasing or increasing over time.

Graph 2.4.1: Evolution of the coefficient of variation and fitted line representing σ -convergence for different sectors



Source: Commission services based on Eurostat (2018)

2.4.2. Testing for β -convergence

A panel unit root approach is used to test for β -convergence (See Box 2.4.2). This allows to empirically assess the presence of convergence of the long-term prices across Member States and to estimate the speed of convergence, i.e. how fast deviations from the long term price level are eliminated. Subsequently, the analysis is repeated for different time periods to investigate whether the pattern and speed of convergence changed over time. The detailed results of the estimations of β -convergence are presented in Tables A.1-3, in Annex A.

The estimated β -coefficients are negative and statistically significantly different from zero in all cases (Graph 2.4.2). This implies that there is a mean-reverting process in each of the transport and energy subsectors and telecommunications services, implying that prices in the different Member States converge in the long run. The comparative price level indices of the passenger air transport subsector displayed the highest speed of convergence, followed by those of the passenger rail and the two energy subsectors over the period 1999-2017 and the telecommunications services over the period 2007-2017. The CPL index of the passenger air transport displays a convergence coefficient of (0.39), indicating that the half-life for a price shock ⁽³⁵⁾ to be eliminated is slightly less than one year and a half. This is significantly shorter than that of the CPL index of bundled telecommunications services (almost three years), which has the lowest speed of convergence among all the selected CPL indices.

Splitting the sample into two sub-periods, i.e. 1999-2006 and 2007-2017, allows assessing whether the speed of convergence changed over time. The results show that for the natural gas, aviation and rail transport subsectors the β coefficients during the second period were higher than during the first period. In other words, the speed of convergence increased over time for these subsectors.

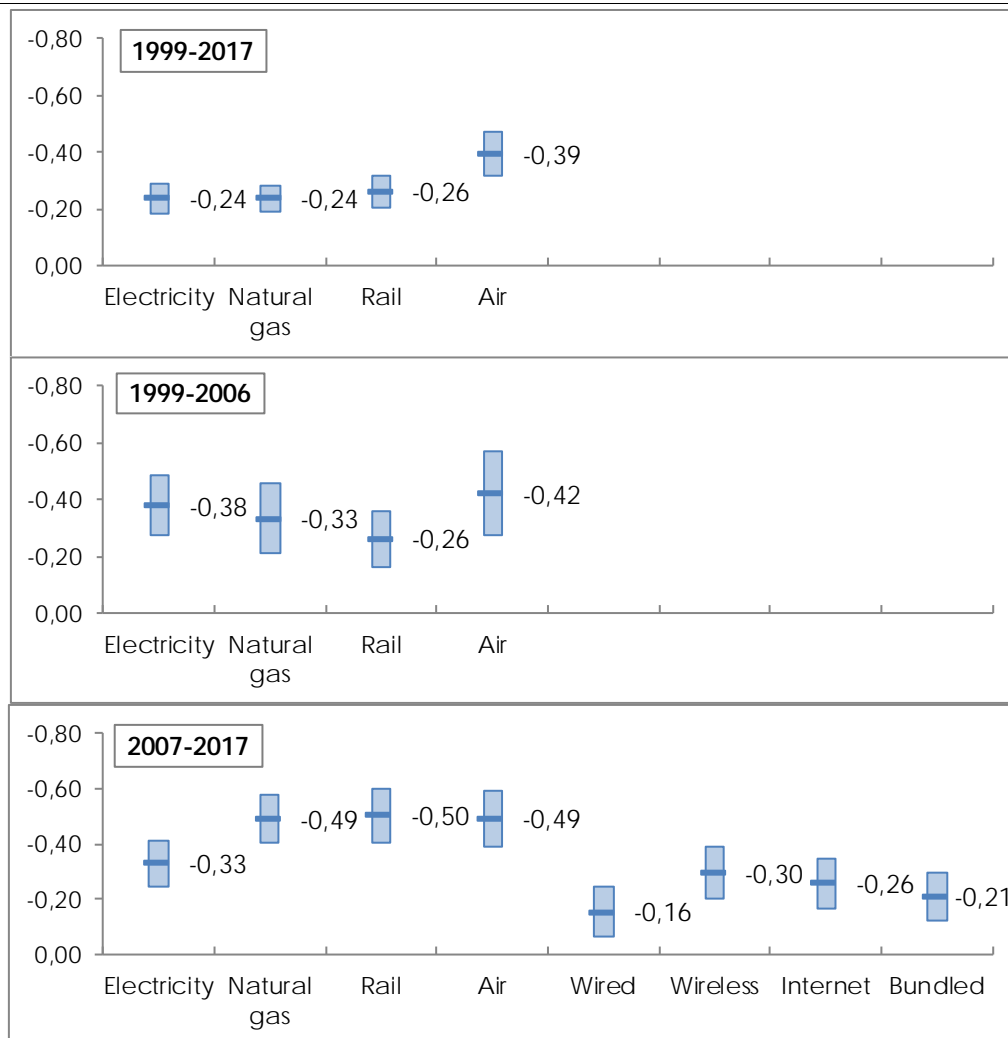
Estimation results indicate that for all CPL indices there was an overall tendency for prices in different Member States to converge (relative β -convergence). However, the significant country dummies for almost all subsectors/services (Graph 2.4.3) imply that country-specific factors prevented prices to converge to the same price level (i.e. no absolute β -convergence). Therefore, price differences across countries are likely to exist even in the long run. The CPL indices for the passenger air transport and bundled telecommunication services showed a higher homogeneity across Member States than those for the other subsectors. This suggests that country-specific factors played a smaller role in these subsectors.

In the EU the passenger rail transport market and the electricity and natural gas market appear more fragmented than the passenger air transport market and telecommunication services. The long-term systematic price differentials across countries were highly pronounced for the CPL indicator of these subsectors, implying that country specific factors played a crucial role in the formation of their prices, including topological structure of networks, non-competitive components of the consumer price (levies, network charges), national policies and other specificities in the electricity generation (e.g. fuel mix).

For the energy and rail transport sectors, the long-term price differentials of the East European Member States tended to be systematically below the EU28 average. Denmark, Germany, Ireland and the Netherlands were typically located at the higher end. For the aviation sector and the telecommunication services such a pattern was less obvious, since some East European Member States, most notably Czech Republic, Slovenia and Slovakia displayed much higher prices than the EU28 average price for some of the services.

⁽³⁵⁾ The half-life for a shock to be eliminated is calculated using the following formula: $\ln(0.5)/\ln(1+\beta)$.

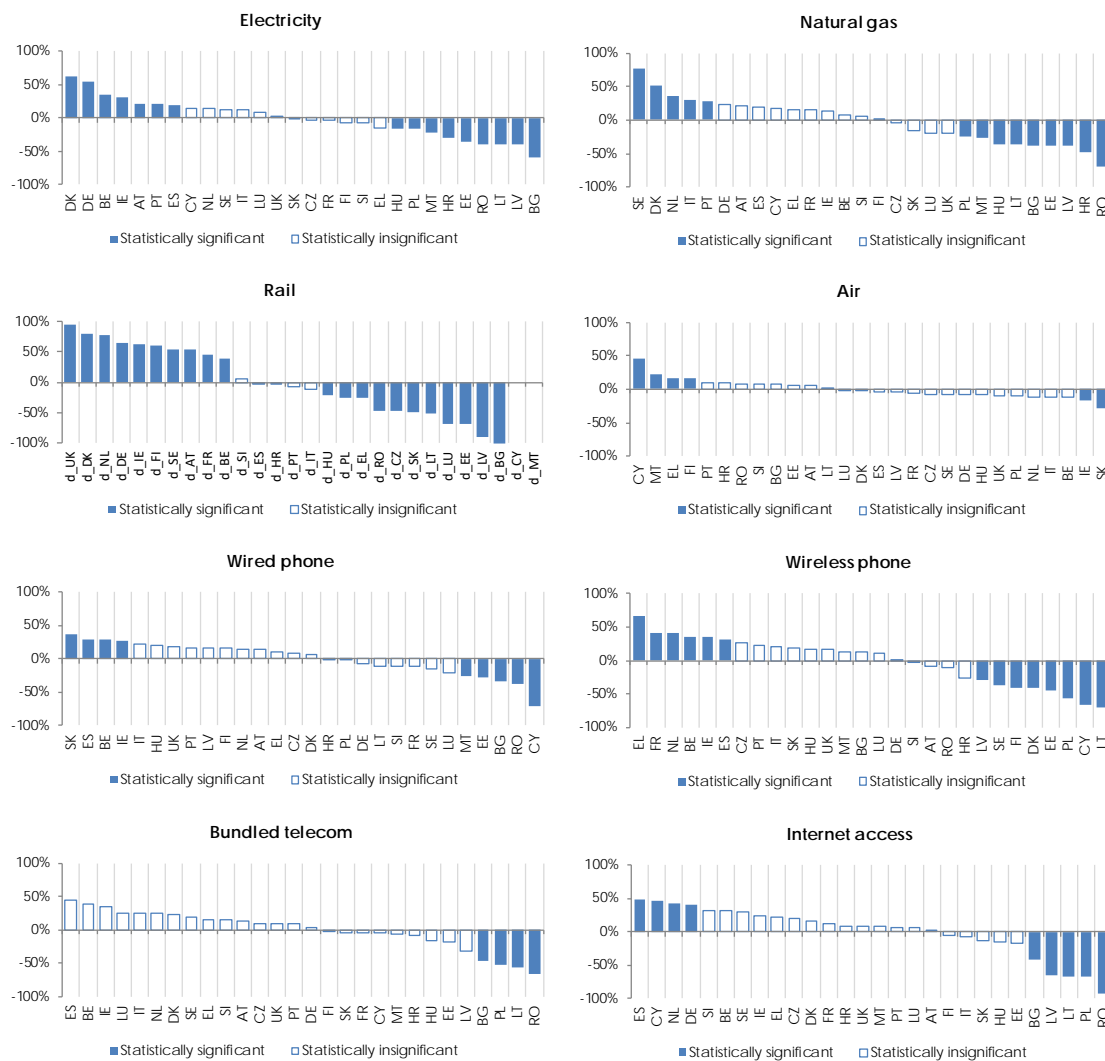
Graph 2.4.2: **Estimated β -coefficients by subsector/service in different time periods**



Notes: Horizontal lines in the middle of the bars represent the estimated β -coefficients. The height of the bars corresponds to the 95% confidence interval.

Source: Commission services based on Eurostat (2018).

Graph 2.4.3: Long-run systematic differences in price indices between Member States (1999-2017)



Notes: For the telecommunications sectors the time period is 2007-2017. The long run systematic differences are calculated as the ratio between the coefficient representing the country-specific effect and the additive inverse of the coefficient representing the convergence.

Source: Commission services based on Eurostat (2018)

Box 2.4.2: β -CONVERGENCE

β -convergence occurs when a (partial) negative correlation exists between the change in prices over time and their initial level. Prices in different markets then tend to converge to the same level. This implies that the time-series of relative prices is stationary or mean reverting. A common approach to empirically verify the existence of such convergence by testing for stationarity of the time-series is to apply unit root tests. The underlying assumption behind this approach is that markets are said to be perfectly integrated if the long-term difference of their price series is statistically equal to zero (or to a constant value in the case of relative converge). In other words, stationarity of relative prices indicates that while prices between two or more countries may differ in the short-term, the long term difference in prices will remain more or less unchanged.

The stationarity of relative prices is tested based on the results of unit root tests (equation 1) applied to the differences of prices between each Member State and the EU28 average. Following the approach of Dreher and Krieger (2008), the unit root tests are based on panel data, as proposed by Levin, Lin and Chu (2002) and Maddala and Wu (1999).

The dependent variable is defined as the first-difference in the log-price of network i and country k relative to the EU28 average, i.e. $\Delta p_{i,k,t} = p_{i,k,t} - p_{i,k,t-1}$, where $p_{i,k,t} = P_{i,k,t} - P_{i,EU28,t}$.

The econometric specification is then as follows:

$$\Delta p_{i,k,t} = \alpha_{i,k} + \beta_i p_{i,k,t-1} + \sum_{l=1}^L \gamma_l \Delta p_{i,k,t-l} + e_{i,k,t}, \quad (1)$$

where β_i denotes the presence and speed of convergence in sector i . Under the null hypothesis of no convergence, β_i is equal to 0. In this case a shock to $p_{i,k,t}$ is permanent. Convergence implies a negative β_i , with the approximate half-life, i.e. the time span necessary for current disparities to be halved, given by $-\ln(2)/\ln(1 + \beta)$.

The lagged first differences $\Delta p_{i,k,t-1}$ are used to account for possible serial correlation in the error term. The number of lags is determined employing the top-down approach of Campbell and Perron (1991)⁽¹⁾.

The dummies $\alpha_{i,k}$ capture network/country fixed effects accounting for non-time dependent, network specific price differences across countries. Such differences could reflect transportation costs (measured as percentages of price differences), unobserved quality by destination or mark-up. Including network/country fixed effects in the estimation implies that the relative version of the LOOP is tested. The estimated coefficients, divided by $-\beta_i$, can be interpreted as the long-run deviation from the average price ⁽²⁾. Large values of these network/country specific effects would indicate market segmentation, even if the relative version of the LOOP held in the data.

The absolute version of the LOOP is tested by leaving out the set of country dummies from equation (1).

The presence of β -convergence does not necessarily imply also σ -convergence, i.e. even when prices converge to the LOOP they might be dispersed over time.

⁽¹⁾ With consideration to the length of our time series we start with lag length 7 for the estimations of the energy and transport sectors and lag length 4 for the estimations of the telecommunications sectors.

⁽²⁾ The intuition is as follows. The coefficient α_i represents a country-specific drift. The mean-reverting effect βP starts to dominate the drift if P exceeds the (positive) value α_i/β or, in other words, if P minus α_i/β exceeds zero. Note that the first two right-hand terms in equation (1) can indeed be rewritten as: $\beta(P - \alpha_i/\beta)$.

2.5. CONCLUSIONS ON PRICE CONVERGENCE

Progress towards greater market integration is expected to be reflected in lower price differentials for similar products and services across countries. This section of the paper assessed whether among the EU Member States price convergence took place in the telecommunications sector in the period 2007-2017 and in the energy and transport sectors during the period 1999-2017.

Data show that during the considered periods consumer prices in the transport subsectors (passenger rail and air transport) and especially in the energy subsectors (electricity and natural gas) increased at a higher rate than the price of a representative bundle of consumer goods. This may be explained by the overall evolution of fossil fuel prices during this period. By contrast, in the telecommunications sector prices decreased during 2007-2017.

Results from the proposed econometric analysis indicate that in the energy and passenger transport subsectors the variation in prices between Member States significantly decreased during 1999-2017 (i.e. a significant negative time trend was found). For each of the considered telecommunications services (wired phone, wireless phone, internet access, bundled telecom services) price variation instead increased.

However, in all network industries a long-term process of convergence took place. Despite possible deviations in the short term, in the long run prices in the Member States converged. The speed of convergence was comparatively lower in the telecommunications sector than in the transport and energy sectors. Furthermore, the results indicate that in the transport subsectors and in natural gas the speed of convergence increased over time, i.e. it was higher during 1999-2006 than during 2007-2017.

Overall, price convergence occurred in the considered network industries, although results for the telecommunications sector are less conclusive than for the transport and energy sectors. This could be at least partially explained by three factors: i) the pace of technological development has been faster in the telecommunications sector and has varied considerably across countries; ii) policy developments in market functioning and regulatory environment have started taking place more recently and they might still need to fully display their effects and iii) the time range of available data was shorter for the telecommunications sector and therefore the results of the analysis are less robust from a statistical point of view.

It is also notable that those sectors which experienced the highest price increase between 1999 and 2017, i.e. the transport and energy sectors, also registered the strongest price convergence. Conversely, for the telecommunications sector, in which prices decreased during the considered period, the results are more ambiguous.

Finally, it is worth mentioning that the current analysis did not intend to identify the drivers of the process of convergence. Therefore, further analysis would be needed to establish the existence of any positive correlation between the developments in market functioning and integration, and the convergence in prices.

FINAL REMARKS

This paper investigated the state of progress in completing the EU Single Market in selected network industries, i.e. telecommunications, energy and transport sectors. Its aim was twofold. First, to assess whether in the considered sectors any concrete improvement in market functioning was recently realised, possibly also reflecting specific policy initiatives undertaken to speed up the process. Second, to investigate whether prices converged across Member States.

The development of a common market is an integral part of the creation of the EU since its beginning. With some differences across sectors, this process started in network industries already a few decades ago. However, the interest in analysing the impact on price convergence has lost its traction over time. The intention of this paper was to bridge this gap.

The first section of the paper considered the state of play and progress in market integration and the regulatory environment in EU network industries. The assessment built on the work done in the two previous papers (European Commission, 2013 and European Commission, 2014), by updating a set of performance indicators reflecting the technological and regulatory evolution of each specific sector. Following the creation of the EU Single Market, overall progress across countries was expected over time. However, results showed a rather heterogeneous development by sector and by country. Market opening is overall more pronounced in the telecommunications sector, due to more substantial progress over the last years. Despite some improvements in both the regulatory environment and competition, in the energy and transport markets there is still scope for further progress as evidenced by relatively high levels of market concentration in many Member States.

The second section of the paper empirically analysed price convergence in the considered sectors. In agreement with the Law of One Price (LOOP), progress towards greater market integration was expected to be reflected in lower price differentials for similar products and services across countries. According to the econometric tests performed, between 1999 and 2017 overall price convergence to the mean took place in network industries, which is in line with the LOOP. In the passenger transport and energy subsectors, the speed of convergence was comparatively high, and it even increased over time. This might have been at least partially induced by the EU legislation, e.g. the comprehensive 2009 “Third Legislative Package” in the energy sector and the 2007 “Third railway package” introducing open access rights for international rail passenger services including cabotage. In the air sector the ever increasing market share of low-cost carriers during the period may have accelerated the price convergence process. However, a proper identification of the drivers of price convergence would be needed to establish the existence of any positive correlation between the developments in market functioning/integration and price convergence. In particular, freight transport would need to be added to allow for having a fuller picture.

Results for the telecommunications sector are less conclusive than for the transport and energy sectors. The speed of convergence was comparatively lower in the telecommunications sector than in the transport and energy sectors. In interpreting such results, it has to be borne in mind that policy developments in market functioning and regulatory environment have started taking place more recently in this sector and might still need to fully display their effects. Moreover it is worth mentioning that the price decrease registered in the telecommunications sector might depend on the more intense technological development occurred in recent years. Finally, data availability for the telecommunications sector (2007-2017) was more limited than in the other sectors and therefore results are less reliable. Again, a proper identification of the drivers of price convergence could shed light on the interpretation of the results.

From a policy perspective, the proposed analysis shows that some progress towards the completion of an EU common market has been achieved, although further analysis would be needed to establish the existence of any positive correlation between the developments in market functioning and integration, and the convergence in prices. Notwithstanding the progress, further efforts are still needed to strengthen the process and make the market functioning and regulation more homogeneous across Member States.

REFERENCES

Abreu, M., H. de Groot and R. Florax (2005), 'A Meta-Analysis of β -Convergence: the Legendary 2%', *Journal of Economic Surveys*, Vol. 19 No 3, pp. 389-420, available at <https://onlinelibrary.wiley.com/toc/14676419/2005/19/3>.

Barro, R. and X. Sala-i-Martin, (1995), 'Economic Growth', MIT Press, New York.

Baumol W.J. (1986), 'Productivity Growth, Convergence, and Welfare: What the Long-Run Data show', *The American Economic Review*, Vol. 76, No 5, pp. 1072-1085, available at https://www.jstor.org/stable/1816469?seq=2#page_scan_tab_contents.

Campbell J.Y. and P. Perron (1991), 'Pitfalls and opportunities: what macroeconomists should know about unit roots', Technical Working Paper No. 100, National Bureau of Economic Research (NBER) Cambridge, Massachusetts, available at <http://www.nber.org/papers/t0100.pdf>.

Council of the European Communities (1987a), Council Regulation (EEC) No 3975/87 of 14 December 1987 on laying down the procedure for the application of the rules on competition to undertakings in the air transport sector, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1533645443981&uri=CELEX:31987R3975>

Commission of the European Communities (1988), Commission Directive of 16 May 1988 on competition in the markets in telecommunications terminal equipment, 88/301/EEC, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31988L0301&from=EN>

Commission of the European Communities (1990), Commission Directive of 28 June 1990 on competition in the markets for telecommunications services, 90/388/EEC, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31990L0388&from=GA>

Commission of the European Communities (1996), Commission Directive 96/19/EC of 13 March 1996 amending Directive 90/388/EEC with regard to the implementation of full competition in telecommunications markets, 96/19/EC, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31996L0019&from=FR>

Council of the European communities (1987b), Council Regulation (EEC) No 3976/87 of 14 December 1987 on the application of Article 85 (3) of the Treaty to certain categories of agreements and concerted practices in the air transport sector, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1533645496536&uri=CELEX:31987R3976>

Council of the European communities (1987c), Council Directive (EEC) No 601/87 of 14 December 1987 on fares for scheduled air services between Member States, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1533645590404&uri=CELEX:31987L0601>

Council of the European communities (1990a), Council Directive (EEC) No 2342/90 of 24 July 1990 on fares for scheduled air services, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1533645727391&uri=CELEX:31990R2342>

Council of the European communities (1990b), Council Directive (EEC) No 2443/90 of 24 July 1990 on access for air carriers to scheduled intra-Community air service routes and on the sharing of passenger capacity between air carriers on scheduled air services between Member States, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1533645811484&uri=CELEX:31990R2343>

Council of the European communities (1990c), Council Directive (EEC) No 2344/90 of 24 July 1990 on amending Regulation (EEC) No 3976/87 on the application of article 85 (3) of the treaty to certain

categories of agreements and concerted practices in the air transport sector, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1533645843263&uri=CELEX:31990R2344>

Council of the European Communities (1992a), Council Regulation (EEC) No 2407/92 of 23 July 1992 on licensing of air carriers, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31992R2407&from=EN>.

Council of the European Communities (1992b), Council Regulation (EEC) No 2408/92 of 23 July 1992 on access for Community air carriers to intra-Community air routes, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31992R2408&from=EN>.

Council of the European Communities (1992c), Council Regulations (EEC) No 2409/92 of 23 July 1992 on fares and rates for air services, available at <https://publications.europa.eu/en/publication-detail/-/publication/b762ec5d-3407-4f3e-9d4b-3a4d396794b4/language-en>.

Council of the European Union (2017), Council Directive amending Directive 2006/112/EC and Directive 2009/132/EC as regards certain value added tax obligations for supplies of services and distance sales of goods, 14126/17, available at <http://www.consilium.europa.eu/media/31929/st14126en17.pdf>.

Dreger, C., K. Kholodilin, K. Lommatzsch, J. Slacalek, and P. Wozniak (2007), 'Price convergence in the enlarged internal market', DG ECFIN Economic Papers, available at http://ec.europa.eu/economy_finance/publications/pages/publication10179_en.pdf.

Dreher, A. and T. Krieger (2008), 'Do Prices for petroleum products converge in a unified Europe with non-harmonized tax rates?' The Energy Journal, Vol. 29, No. pp. 61-88, available at: https://www.jstor.org/stable/41323144?seq=1#page_scan_tab_contents.

European Commission (2001), 'Price levels and price dispersion in the EU', Supplement A, Economic Trends No 7 - July 2001.

European Commission (2013), 'Market Functioning in Network Industries: Electronic Communications, Energy and Transport', European Economy, Occasional Papers 129, February 2013, available at http://ec.europa.eu/economy_finance/publications/occasional_paper/2013/pdf/ocp129_en.pdf.

European Commission (2014a), 'Market functioning in Network Industries – Electronic Communications, Energy and Transport', European Economy Occasional Papers 204, December 2014, available at http://ec.europa.eu/economy_finance/publications/occasional_paper/2014/pdf/ocp204_en.pdf

European Commission (2014b), Fourth report on monitoring development of the rail market, COM(2014)353 final {SWD(2014)186 final}, available at https://ec.europa.eu/transport/modes/rail/market/market_monitoring_en

European Commission (2015), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'A Digital Single Market Strategy for Europe', COM/2015/0192 final, available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0192&from=EN>.

European Commission (2016a), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society', COM/2016/0587 final, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0587&from=EN>.

European Commission (2016b), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions '5G for Europe: An Action Plan', COM/2016/0588 final, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0588&from=en>.

European Commission (2016c), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, 'Clean energy for all Europeans', COM/2016/860 final, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0860&qid=1532963172574&from=EN>.

European Commission (2016d), Commission Implementing Regulation (EU) 2016/2286 of 15 December 2016 laying down detailed rules on the application of fair use policy and on the methodology for assessing the sustainability of the abolition of retail roaming surcharges and on the application to be submitted by a roaming provider for the purposes of that assessment, C/2016/8784, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R2286&from=EN>.

European Commission (2016e), Fifth report on monitoring development of the rail market, COM(2016)780 final {SWD(2016)427 final}, available at https://ec.europa.eu/transport/modes/rail/market/market_monitoring_en

European Commission (2017), Joint communication to the European Parliament and the Council 'Resilience, Deterrence and Defence: Building strong cybersecurity for the EU', JOIN/2017/0450 final, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017JC0450&from=EN>.

European Commission (2017), Communication to the European Parliament and the Council 'Making the most of NIS – towards the effective implementation of Directive (EU) 2016/1148 concerning measures for a high common level of security of network and information systems across the Union', COM/2017/0476 final, available at https://eur-lex.europa.eu/resource.html?uri=cellar:d829f91d-9859-11e7-b92d-01aa75ed71a1.0001.02/DOC_3&format=PDF.

European Commission (2018a), Communication to the European Parliament and the Council 'Stronger protection, new opportunities - Commission guidance on the direct application of the General Data Protection Regulation as of 25 May 2018', COM/2018/043 final, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0043>.

European Commission (2018b), Communication from the Commission, 'Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services', C/2018/2374, available at [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018XC0507\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018XC0507(01)&from=EN).

European Commission (2019), Sixth report on monitoring development of the rail market, COM(2019)51 final {SWD(2019)13 final}, available at https://ec.europa.eu/transport/modes/rail/market/market_monitoring_en

European Parliament and the Council of the European Union (1998), Directive 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for the internal market in natural gas, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31998L0030&from=EN>

European Parliament and the Council of the European Union (2002), Directive 2002/21/EC of the European Parliament and the Council of 7 March 2002 on a common regulatory framework for electronic

communications networks and services (Framework Directive), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0021&from=FR>

European Parliament and the Council of the European Union (2003a), Directive 2003/54/EC of the European Parliament and the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC - Statements made with regard to decommissioning and waste management activities, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0054&from=EN>.

European Parliament and the Council of the European Union (2003b), Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0055&from=EN>.

European Parliament and the Council of the European Union (2009a), Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0072&from=EN>.

European Parliament and the Council of the European Union (2009b), Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0073&from=EN>.

European Parliament and the Council of the European Union (2009c), Directive 2009/12/EC of the European Parliament and of the Council of 11 March 2009 on airport charges (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0012&from=EN>

European Parliament and the Council of the European Union (2009d), Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R0713&from=EN>.

European Parliament and the Council of the European Union (2009e), Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003 (Text with EEA relevance), available at <https://publications.europa.eu/en/publication-detail/-/publication/924a1d7c-1961-4421-be9e-3c740524436e/language-en>.

European Parliament and the Council of the European Union (2009f), Regulation (EC) No 1072/2009 of the European Parliament and of the Council of 21 October 2009 on common rules for access to the international road haulage market, available at <https://eur-lex.europa.eu/legal-content/En/TXT/PDF/?uri=CELEX:32009R1072>

European Parliament and the Council of the European Union (2009g), Regulation (EC) No 1211/2009 of the European Parliament and of the Council of 25 November 2009 establishing the Body of European Regulators for Electronic Communications (BEREC) and the Office, OJ L 337/1 18.12.2009, available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0001:0010:EN:PDF>.

European Parliament and the Council of the European Union (2015), Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on

public mobile communications networks within the Union, OJ L 310, 26.11.2015, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R2120&from=EN>.

European Parliament and the Council of the European Union (2016a), Regulation (EU) 2016/2338 of the European Parliament and of the Council of 14 December 2016 amending Regulation (EC) No 1370/2007 concerning the opening of the market for domestic passenger transport services by rail, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R2338>

European Parliament and the Council of the European Union (2016b), Directive (EU) 2016/2370 of the European Parliament and of the Council of 14 December 2016 amending Directive 2012/34/EU as regards the opening of the market for domestic passenger transport services by rail and the governance of the railway infrastructure, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016L2370>

European Parliament and the Council of the European Union (2016c), Regulation (EU) 2016/2337 of the European Parliament and of the Council of 14 December 2016 repealing Regulation (EEC) No 1192/69 of the Council on common rules for the normalisation of the accounts of railway undertakings, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016R2337>

European Parliament and the Council of the European Union (2017), Regulation (EU) 2017/1953 of the European Parliament and of the Council of 25 October 2017 amending Regulations (EU) No 1316/2013 and (EU) No 283/2014 as regards the promotion of internet connectivity in local communities (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2017:286:FULL&from=EN>

European Parliament and the Council of the European Union (2018), Regulation (EU) 2018/302 of the European Parliament and of the Council of 28 February 2018 on addressing unjustified geo-blocking and other forms of discrimination based on customers' nationality, place of residence or place of establishment within the internal market and amending Regulations (EC) No 2006/2004 and (EU) 2017/2394 and Directive 2009/22/EC (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0302&from=EN>.

European Parliament and the Council of the European Union (2018), Directive 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (Recast) (Text with EEA relevance), available at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2018:321:FULL&from=EN>

Goldberg, P.K. and F. Verboven (2005), 'Market integration and convergence to the law of one price: evidence from the European car market', *Journal of International Economics*, Vol. 65, No 1, pp. 49-73, available at https://ac.els-cdn.com/S0022199604000194/1-s2.0-S0022199604000194-main.pdf?_tid=cb320fff-7acc-41bc-a8c5-45d338d6d296&acdnat=1532960645_d60863c58c9f735b365c91f44709f431.

Ilkovitz, F. and G. Nicodème (2005), 'Evaluation of market performance in network industries: a European perspective in Reforming network industries: experiences in Europe and Belgium', Highlights of the conference "The Lisbon Strategy: a motor for market reforms of the network industries" (2005), jointly organised by the European Economic and Social Committee, the Belgian Central Economic Council and the Belgian Federal Planning Bureau, available at http://www.ccecrb.fgov.be/txt/fr/industrie_reseaux_version_finale_200306.pdf.

Levin, A., C. Lin and C.S. Chu (2002), 'Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties', *Journal of Econometrics*, Vol.108, pp. 1-24.

Lutz, M. (2004) 'Price convergence under EMU? First estimates', in Deardorff A. (ed), 'Past, present, and future of the European Union', Proceedings of the 13th World Congress of the International Economic Association, Macmillan Press.

Maddala, G.S. and S. Wu (1999), 'A Comparative Study of Unit Root Tests with Panel Data and a Simple New Test', Oxford Bulletin of Economics and Statistics, Vol. 61, pp. 631-652.

Martin, R., M. Roma and I. Vansteenkiste (2005), 'Regulatory reforms in selected EU network industries', ECB Occasional papers series, No 28, April 2005, available at <https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp28.pdf>.

Obstfeldt, M. and K. Rogoff (1996), 'Foundations of international macroeconomics', Cambridge (Mass.), MIT Press.

Quah D.T. (1993), 'Galton's Fallacy and the Convergence Hypothesis', Scandinavian Journal of Economics, Vol. 95, No 3, pp. 427-43, available at <https://www.jstor.org/stable/pdf/3440905.pdf?refreqid=excelsior%3A2f8d6dbcc3939c0559fb9700c684a2a1>.

Rogers J.H. (2002), 'Monetary union, price level convergence, and inflation: How close is Europe to the United States?', International Finance Discussion Papers No 740, Washington: Board of Governors of the Federal System, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=345160.

ANNEX A

Detailed econometric results

Table A.1: Results of unit-root test estimations for the energy and transport sectors (1999-2017)

	Electricity	Natural gas	Rail	Air
P_{t-1}	-.238***	-.237***	-.26***	-.392***
ΔP_{t-1}	.176***	.167***	.0854**	0.0624
AT	.0502**	.0517*	.141***	0.0221
BE	.0835***	0.0203	.0999***	-.0486*
BG	-.142***	-.0907***	-.265***	0.0265
CY	.0348*	0.0427	(omitted)	.177***
CZ	-0.00635	-0.00944	-.121***	-0.0274
DE	.128***	.0534*	.171***	-0.0332
DK	.147***	.123***	.208***	-0.0108
EE	-.0844***	-.0909***	-.181***	0.0255
EL	-.0352*	0.0371	-.0684***	.0673**
ES	.0468**	.0474*	-0.00757	-0.014
FI	-0.0168	0.00506	.158***	.0654**
FR	-0.00967	0.0369	.12***	-0.0237
HR	-.0703***	-.112***	-0.0104	0.035
HU	-.0388**	-.0854***	-.0535**	-0.0337
IE	.0741***	0.0337	.165***	-.0666**
IT	0.028	.0731**	-0.0323	-0.0459
LT	-.0946***	-.0856***	-.133***	0.0013
LU	0.0195	-0.0452	-.177***	-0.00044
LV	-.0959***	-.0911***	-.232***	-0.0155
MT	-.0507**	-.0625**	(omitted)	.0896***
NL	0.0327	.0852***	.202***	-0.0457
PL	-.04**	-.0596**	-0.0642***	-0.036
PT	.049**	.0682**	-0.0173	0.0376
RO	-.0933***	-.166***	-.12***	0.0339
SE	0.0299	.181***	.143***	-0.029
SI	-0.0189	0.0141	0.0155	0.0329
SK	-0.00417	-0.0393	-.128***	-.113***
UK	0.00764	-.0473*	.246***	-0.0356
N	472	472	438	472
Adjusted R-square	0.128	0.176	0.146	0.145

Notes: *** $P < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The coefficient of P_{t-1} represents the speed of convergence.

The ratio between the coefficients representing the country-specific effects and the additive inverse of the convergence coefficients corresponds to the average systematic difference from the EU28 average price level.

Source: Commission services based on Eurostat (2018)

Table A.2: Results of unit-root test estimations for the energy and transport sectors (1999-2006)

	Electricity	Natural gas	Rail	Air
P_{t-1}	-.377***	-.333***	-.262***	-.419***
ΔP_{t-1}	.144**	.192**	0.0508	0.00349
AT	.112***	.131**	.131***	0.00792
BE	.141***	0.0883	.0896**	-.101**
BG	-.251***	-.147**	-.264***	.118***
CY	-0.00401	-0.0598	(omitted)	.234***
CZ	0.0341	-0.0314	-.151***	-0.0115
DE	.198***	.15**	.146***	-.0877**
DK	.297***	.288***	.193***	0.0324
EE	-.147***	-.176***	-.214***	-0.0277
EL	-.115***	-0.0079	-.0995***	.0826*
ES	0.0275	0.0789	-0.00374	-0.0408
FI	0.00681	.188***	.159***	.0771*
FR	0.0447	0.1	.109***	-.12***
HR	-.0923*	-0.131	-0.066	0.0847
HU	-0.0281	-.174***	-.0909**	-.0852*
IE	.129***	.139**	.179***	-.144***
IT	0.00566	.113*	-0.00645	0.0328
LT	-.162***	-.177***	-.18***	-0.0216
LU	.103***	-0.0236	-.0776***	0.0573
LV	-.233***	-.258***	-.315***	0.016
MT	-.225***	-.322***	(omitted)	.115***
NL	.193***	.153***	.186***	-0.0506
PL	-.102***	-0.0927	-.0577*	-.074*
PT	0.042	.114*	0.00963	0.0117
RO	-.136***	-.28***	-0.094	.112**
SE	.106***	.287***	.155***	-0.00072
SI	-0.0271	0.048	0.02	-0.05
SK	-0.0245	-0.0573	-.184***	0.0507
UK	0.0144	-0.0707	.34***	-.133***
N	164	164	152	164
Adjusted R-square	0.3	0.209	0.357	0.174

Notes: *** $P < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The coefficient of P_{t-1} represents the speed of convergence.

The ratio between the coefficients representing the country-specific effect and the additive inverse of the convergence coefficients corresponds to the average systematic difference from the EU28 average price level.

Source: Commission services based on Eurostat (2018)

Table A.3: Results of unit-root test estimations for the energy, transport and telecommunication sectors (2007-2017)

	Electricity	Natural gas	Rail	Air	Wired phone	Wireless phone	Bundled telecom	Internet access
P_{t-1}	-.33***	-.49***	-.385***	-.491***	-.155***	-.295***	-.209***	-.257***
ΔP_{t-1}	.168***	.199***	.141***	0.0444	0.0474	0.0734	0.0257	-0.0331
AT	.0568**	.0768***	.201***	0.0352	0.00739	-0.0471	0.023	-0.00918
BE	.116***	0.0241	.154***	-.0607*	.07*	.105**	0.0918	.0877**
BG	-.2***	-.166***	-.379***	-0.00103	-.0893**	0.0234	-.17***	-.158***
CY	.0758***	.115***	(omitted)	.191***	-0.0599	-.14**	.107*	.186***
CZ	-0.0203	-0.0115	-.175***	-0.0338	-0.0125	0.063	-0.0111	0.0279
DE	.175***	.0718***	.268***	-0.00757	-0.017	-0.00159	0.00743	.113***
DK	.187***	.208***	.298***	-0.0463	0.0403	-.124***	.11*	0.0528
EE	-.118***	-.154***	-.224***	.11***	-.0889**	-.18***	-0.0559	-.0677**
EL	-0.0234	.0882***	-.0689**	.0718**	0.0025	.235***	0.0178	.0595*
ES	.0867***	.0859***	0.0119	-0.00283	.0814**	.09**	.104*	.139***
FI	-0.0319	-.0417*	.223***	.0634*	0.0401	-.134***	0.0138	-0.0182
FR	-0.0273	.0577**	.177***	0.0187	-0.0428	.128***	-0.0501	0.0231
HR	-.0904***	-.2***	-0.0153	0.0344	-0.022	-.0792*	-0.0172	0.0103
HU	-.0846***	-.171***	-.0749***	-0.0298	-0.0176	0.0627	-0.0801	-.0591*
IE	.0901***	0.0303	.242***	-.0583*	.103***	.116***	0.0882	.0641*
IT	.0595***	.14***	-.0596**	-.0762**	0.0375	.077*	0.0706	-0.0187
LT	-.121***	-.11***	-.156***	-0.0166	-0.0377	-.219***	-.114*	-.16***
LU	-0.00114	-.0787***	-.279***	-0.0133	-0.0241	0.0508	.0973*	0.0472
LV	-.0843***	-.1***	-.262***	-0.0102	0.00357	-.121***	-0.0896	-.177***
MT	0.0045	-0.0201	(omitted)	.0928***	-0.0493	.0683*	-0.00194	0.0427
NL	-0.00257	.134***	.302***	-0.0459	.0775**	.138***	0.063	.13***
PL	-.0657***	-.121***	-.1***	-0.0191	-0.0421	-.212***	-.147**	-.207***
PT	.0857***	.123***	-0.0392	.0673**	.0648*	.0719*	0.018	0.0155
RO	-.155***	-.381***	-.205***	-0.0164	-.141***	-0.042	-.193***	-.259***
SE	0.0228	.324***	.205***	-0.0497	-0.00799	-.0922**	.0984*	.1***
SI	-0.0202	0.0365	0.0231	.0751**	0.00464	-0.00235	0.0474	.0743**
SK	-0.0139	-.091***	-.167***	-.243***	0.0403	0.0275	-0.0608	-.0589*
UK	0.0099	-.0683***	.301***	0.00488	0.0564	0.0603	0.0165	0.029
N	280	280	260	280	280	280	280	280
Adjusted R-sq	0.178	0.275	0.237	0.222	0.0852	0.0914	0.0816	0.101

Notes: *** $P < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The coefficient of P_{t-1} represents the speed of convergence.

The ratio between the coefficients representing the country-specific effects and the additive inverse of the convergence coefficients correspond to the average systematic differences from the EU28 average price level.

Source: Commission services based on Eurostat (2018)

EUROPEAN ECONOMY DISCUSSION PAPERS

European Economy Discussion Papers can be accessed and downloaded free of charge from the following address:

[https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en?field_eurovoc_taxonomy_target_id_selective=All&field_core_nal_countries_tid_selective=All&field_core_date_published_value\[value\]\[year\]=All&field_core_tags_tid_i18n=22617](https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en?field_eurovoc_taxonomy_target_id_selective=All&field_core_nal_countries_tid_selective=All&field_core_date_published_value[value][year]=All&field_core_tags_tid_i18n=22617).

Titles published before July 2015 under the Economic Papers series can be accessed and downloaded free of charge from:

http://ec.europa.eu/economy_finance/publications/economic_paper/index_en.htm.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct Information Centres. You can find the address of the centre nearest you at: <http://europa.eu/contact>.

On the phone or by e-mail

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696 or
- by electronic mail via: <http://europa.eu/contact>.

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: <http://europa.eu>.

EU Publications

You can download or order free and priced EU publications from EU Bookshop at: <http://publications.europa.eu/bookshop>. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see <http://europa.eu/contact>).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex at: <http://eur-lex.europa.eu>.

Open data from the EU

The EU Open Data Portal (<http://data.europa.eu/euodp/en/data>) provides access to datasets from the EU. Data can be downloaded and reused for free, both for commercial and non-commercial purposes.

