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A 'Manufacturing Imperative' in the EU – Europe's Position in Global Manufacturing and the Role of Industrial Policy

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Abstract

Industrial policies in the EU have markedly shifted towards 'horizontal' measures and framework polices. The sustained de-industrialisation of several European economies and a general perception that countries with a strong manufacturing base emerged from the crisis in a strengthened position put the issue of industrial capacities back on the agenda. This process was paralleled by a renewed interest in specific industrial policies targeted at the manufacturing sector. Against this background, this report revisits some of the main arguments in favour of a manufacturing imperative and discusses them in a European context also showing the limitations and caveats of these arguments. It proceeds by identifying the main challenges ahead of European manufacturing given the structural changes that occurred in the EU over the period 1995 to 2011. It also provides an analysis of a number of industrial policy measures that are important in a European context such as state aid by EU Member States, public R&D support for firms and the role of initial vocational training systems as a potential 'soft' industrial policy tool. Based on the results of the analysis, the report summarises the policy implications and offers recommendation to master the major structural challenges that lie ahead of European industry.

Keywords: *industrial policy, state aid, innovation support, competitiveness, structural change*

JEL classification: *F13, L52*

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Introduction

The economic crisis of 2008 has caused a change in the perception of the manufacturing sector in many countries among both economists and policy-makers. Manufacturing has redeemed its reputation in the sense that a comparatively large manufacturing sector is no longer considered to reflect an outdated economic structure, inadequate for a post-industrial, services-dominated economy such as the EU. Rather, nurtured by the observation that within the EU, countries that have maintained a larger manufacturing base fared better during and after the crisis (Reiner, 2012; Fürst, 2013), a dynamic manufacturing sector is again considered to be a prerequisite for an innovative and fast-growing economy. In a recent Communication the European Commission emphasises that a 'vibrant and highly competitive EU manufacturing sector' is a key element for solving societal changes ahead and a 'more sustainable, inclusive and resource-efficient economy' (European Commission, 2010a).

This altered perception of the role of manufacturing raised concerns that manufacturing production had declined too much (Warwick, 2013) in some Member States leading to a loss of knowledge, capabilities and supplier networks which have also been referred to as the 'manufacturing commons' (Pisano and Shih, 2009)[1]. Earlier arguments for a 'manufacturing imperative' (Rodrik, 2012) were re-discovered and the current structural shift out of manufacturing in advanced economies, including most EU Member States, started to look less advantageous. The urge felt by policy makers and the business community to maintain a comprehensive manufacturing base in Europe also led to a renewed interest in industrial policy in Europe and elsewhere (e.g. in the United States). The recent resurgence of interest in industrial policy and its potential to spur economic growth, sometimes heralded as a 'renaissance' of industrial policy (Reiner, 2012), has also been nurtured by concerns about growing competition from emerging economies, some of which have adopted, explicitly or implicitly, more activist industrial policies, often – as in the case of South Korea – targeted explicitly at the manufacturing sector. Given the rather successful experiences of some Asian economies with industrial policies, the question arises whether additional support measures destined for the domestic manufacturing sector – or the tradables sec-

[1] The industrial commons are a reference to the commons which is the land belonging to a (village) community as a whole and which could also be used by each member of the community (typically for grazing of animals). They can be described as the general stock of knowledge, competences and skills (often embodied in the workforce) and institutions (including supplier networks) relevant for modern manufacturing activities that can be shared and accessed by the manufacturing sector as a whole (Pisano and Shih, 2009).

tors more generally – would also be a viable strategy for Europe in order to assist firms in defending their competitive positions in international markets.

Linked to the new competition from emerging economies and the ever more granular international specialisation sparked by fragmentation of production, new phenomena such as international production sharing and offshoring have added a new facet to the discussion of industrial policy. The offshoring debate intensified anxieties about job losses particularly in the segment of medium-wage paying (but sometimes relatively low-skilled) occupations. This gave rise to 'bring manufacturing home'-initiatives which aim at re-locating previously outsourced production activities and other forms of economic nationalism. However, the preoccupation with job losses in times of low economic growth is not entirely new and to some extent the proclaimed renaissance of industrial policy simply reflects the business cycle-related calls for public intervention that have been observed in the past.

The importance of industrial structures is widely accepted, the potential for economic policy to shape that structure, however, remains highly disputed, particularly in Europe where the track record of interventionist industrial policy experiments of the 1960s and 1970s was rather disappointing (Crafts, 2010; Owen, 2012). Industrial policy, understood as selective government interventions attempting to alter the structure of production towards industries that are expected to offer higher growth prospects (Pack and Saggi, 2006), can in principle try to foster structural change towards any sector or industry that government authorities consider to be 'strategic' or supportive of growth. Viewed through the lenses of a 'manufacturing imperative' perspective, the particular characteristics of manufacturing industries (such as externalities and increasing returns to scale[2]) call for industrial policies that redirect the European economy towards manufacturing activities and aim at strengthening or restoring the industrial commons.

The general industrial policy strategy at the EU level so far seems little affected by the new debate on the role of manufacturing and remains pro-competition-oriented, favouring general framework policies (such as the proper functioning of the Internal Market and competition rules) and 'horizontal' policies over sector-specific interventions[3].

Nevertheless, it seems that in the aftermath of the economic crisis the European Commission's focus on framework policies has been supplemented with more sector-specific policy objectives such as the definition of key priority areas which include inter alia the development of clean vehicles and vessels and smart grids (European Commission, 2012a). Sec-

[2] Increasing returns to scale can also arise from network externalities which play a role in a number of sectors that can be referred to as utilities such as water, gas and electricity, telecommunication or railway services.

[3] Among economists it is highly disputed whether horizontal measures are necessarily less distortive than sectoral interventions. De facto, horizontal policies are hardly neutral with regards to structure and sectors. Therefore the dichotomy between horizontal measures and vertical measures may be blurred or even meaningless (Pelkmans, 2006; Cohen, 2006; Midelfart and Overman, 2002; Chang, 2006).

tor-specific action may indeed be warranted in cases where the market mechanism is not able to bring about a resource allocation that is efficient and conducive to solving societal challenges – a prime example being environmental protection and the mitigation of climate change. A potential reason for that is the existence of path dependency in technological trajectories as documented for example in an under-provision of clean technologies (Aghion et al., 2010). A corollary of this is that the state has an important coordination role, helping to remove lock-in effects in technological developments. Importantly, the government actions required to fulfil this coordination function may need to go beyond purely horizontal industrial policy action.

Against this background, this chapter revisits some of the main arguments in favour of a manufacturing imperative and discusses them in a European context also showing the limitations and caveats of these arguments in a world of strong inter-linkages between the production of manufactures and services that enter the production process (Section 1). Section 2 proceeds by identifying the main challenges ahead of European manufacturing given the structural changes that occurred in the EU over the period 1995 to 2011. Section 3 analyses a number of industrial policy measures that are related to these structural challenges. Given the still prevalent use of state aid by EU Member States and the unique institutional framework which empowers the Commission to restrict the use of state aid, a quantitative analysis of state aid and its relationship with competitiveness and value added is undertaken. Due to the great importance that the European Commission attaches to innovation-related industrial policy, the study of public support measures continues with a firm-level study of the impact of public R&D support for firms on innovativeness and innovation output. Finally, Section 3 investigates the role of initial vocational training as a potential 'soft' industrial policy tool that feeds into the industrial commons. The concluding Section 4 discusses policy implications of the use of state aid, R&D support measures and vocational training in the context of the structural challenges.

1. The manufacturing imperative in a European Context

1.1 Introduction

This section provides the ground for the analysis of the structural shifts in the European manufacturing sector and the challenges ahead. In particular, it revisits some of the main arguments in favour of maintaining, re-building or creating – as the case may be – a strong manufacturing base in EU Member States while taking into account that modern manufacturing production is increasingly dependent on innovations and specialised services inputs. The latter have gained importance for product differentiation and quality improvements of manufactures that allow firms to charge higher prices and increase the value added of their activities. Therefore the discussion of the particular role of manufacturing for the economy has to be considered in the context of increasing inter-linkages between manufacturing and services.

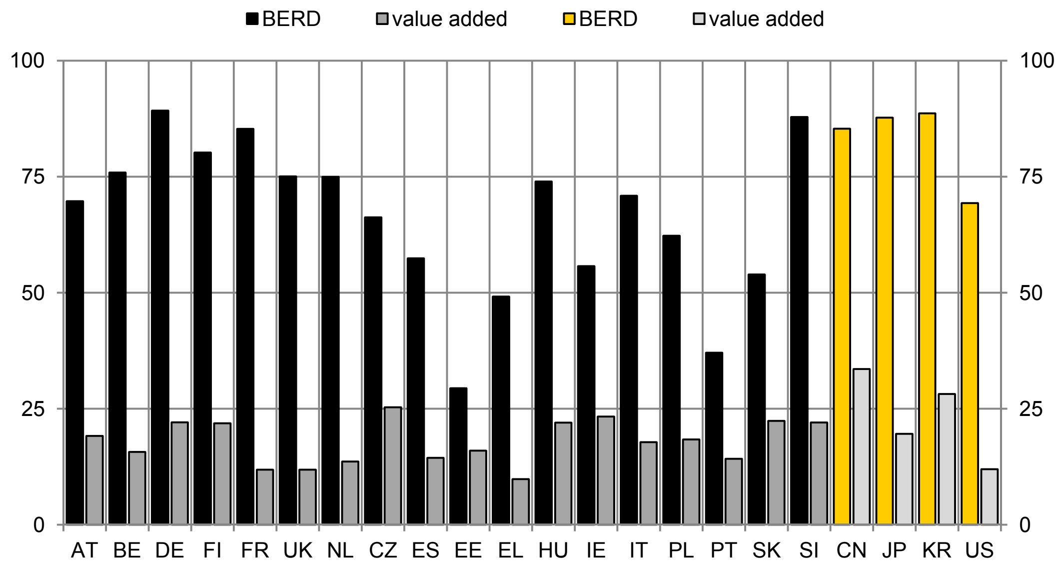
Many arguments have been brought forward for why a thriving manufacturing sector is a prerequisite for any economy aiming for high growth and employment rates.

1.2 Manufacturing: the main source of innovation and technological progress

A first main argument in favour of a strong manufacturing base is that the manufacturing sector is the major source of technological progress (e.g. Baumol, 1967; Kaldor, 1968; UNIDO, 2002; Aiginger and Sieber, 2006; Helper et al., 2012). Inspection of firms' business expenditure on research and development (BERD) in the EU and other countries clearly supports this claim (Figure 1). Manufacturing firms are more inclined to undertake R&D than firms in the rest of the economy resulting in higher shares of the sector compared to its value added share. On average the share of the manufacturing sector in business R&D exceeds that of the value added share by a factor close to 4 in the EU Member States; the same holds for the United States, Japan and South Korea. Despite marked variations in the business R&D share of manufacturing firms, ranging from almost 90% in Germany to 29% in Estonia[4], it exceeds the value added share of manufacturing in all Member States. Consequently the R&D expenditures of firms indicate that the overwhelming majority of R&D activities take place in the manufacturing sector which can therefore be identified as the main source of innovation and technological progress.

Figure 1

Share of manufacturing in value added and in business expenditure on R&D (BERD), 2005-2009



Note: Business Expenditure on R&D includes R&D by foreign enterprises. Averages over the period 2005-2009 of available data.

Source: WIOD, WIPO, OECD ANBERD, wiiw calculations.

4 The median value of the business R&D share of manufacturing firms is 70.5% for the EU Member States.

While the essential role of manufacturing firms for innovation and technological progress is generally accepted, an important question is whether a thriving European manufacturing sector requires European innovative firms to also keep their production facilities in the EU. For Member States at the technological frontier it would, in principle, suffice if firms kept headquarter functions and in particular R&D activities in the domestic economy but move manufacturing production to low-wage destinations in order to reduce costs and increase their productivity. Such a vertical specialisation strategy could lead to a 'high-powered' manufacturing sector in Europe characterised by highly productive domestically innovating but internationally producing manufacturing firms.

While a successful vertical specialisation strategy supports firms' competitiveness and offshoring may also be seen as a necessity to survive international competition, a potential risk involved in the high-powered manufacturing strategy is a continuous 'leakage' of more complex activities to offshore destinations. The stepwise offshoring of more sophisticated production and engineering activities is the result of the building-up of capabilities in offshore destinations as well as communication and co-ordination failures. By spatially separating the production process, important direct feed-back loops between the research laboratory, engineering and the factory floor are weakened or entirely lost (e.g. when practical problems in the production process occur). As a result problem solving and incremental product development, engineering and design will increasingly be done locally (i.e. in the offshore-destination). This process implies not only a loss of production activities but over time the loss of essential know-how and capabilities – for individual firms but also for the economy as a whole. At the level of the economy, offshoring may thus lead to the erosion of the 'industrial commons' which can be described as the general stock of knowledge, competences and skills (often embodied in the workforce) and institutions (including supplier networks) relevant for modern manufacturing activities that can be shared and accessed by the manufacturing sector as a whole (Pisano and Shih, 2009)[5]. From a European perspective, the fact that offshoring is mainly taking place between EU Member States could turn out to be an advantage in this context, as in this case competences do not risk to be shifted out of the region.

1.3 The production-services nexus in modern manufacturing

R&D and innovation are not the sole ingredients to a highly productive and internationally competitive manufacturing sector. In order to differentiate products and charge higher price-cost mark-ups manufacturing firms depend increasingly on sophisticated services

[5] Another concern is that offshoring has negative employment effects, at least in the short to medium term. In the long term, offshoring firms may still contribute positively to domestic employment if the offshoring strategy allows the firm to grow and expand its operations. Overall, the empirical results on the employment effects are mixed with the majority of contributions suggesting little impact of offshoring on employment or even positive effects in the long run (Hijzen and Swaim, 2007; Foster et al., 2012). Despite this, there is some evidence to suggest that offshoring has increased the elasticity of labour demand, making workers more vulnerable (Senses, 2010; Hijzen and Swaim, 2010).

inputs. The mirror image of this is that the manufacturing sector is an important source of demand for many services. Both aspects highlight the fact that goods and services often complement each other (Nordås and Kim, 2013). Moreover, evidence on the strong interdependences between manufacturing and services in the European economy is provided by the fact that manufacturing firms generate a growing amount of their sales from services. This 'servitisation' of manufacturing seems to be more developed among producers of complex manufactures (Dachs et al., 2013).

Figure 2

Service inputs into the manufacturing sector relative to manufacturing gross output for the EU-27, 1995-2011

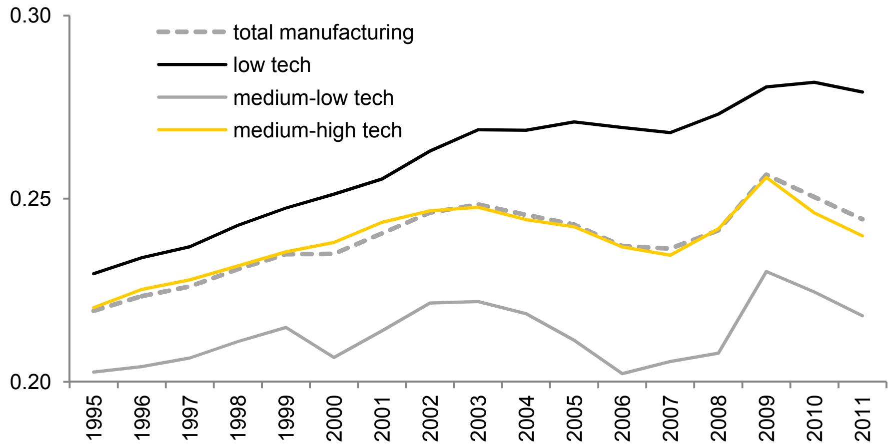
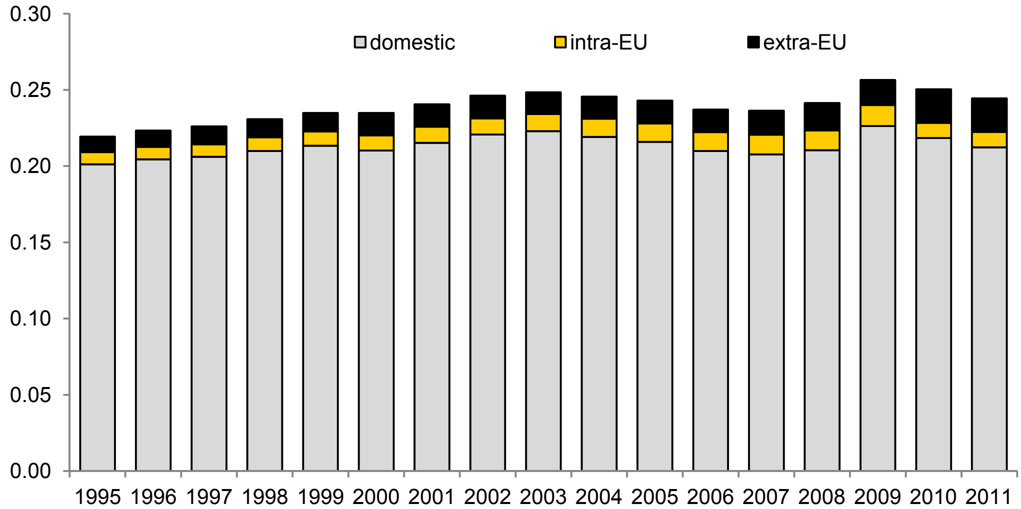


Figure 3

Service inputs into manufacturing (relative to manufacturing gross output) sourced from domestic economy, intra-EU and extra-EU, 1995-2011



Note: Calculations based on EU Member States and aggregated to the EU-27. Intra-EU includes the services sourced from EU Member States other than the Member States in question.

Source: WIOD, wiiw calculations.

Returning to the issue of supply linkages between the services and the manufacturing sector, an interesting indicator is the service intensity of the manufacturing sector, measured as the cost share of services in manufacturing gross output. During the period 1995-2011 the service intensity of the European manufacturing sector has increased from 22% in 1995 to 24% in 2011 with an interim high in 2009 (Figure 2).

This increase, which is discernible in low-tech, medium-low-tech as well as medium-high-tech industries, reflects the intensified inter-linkages between manufacturing and services. It is noticeable that, in contrast to R&D efforts and innovation which tend to be concentrated in advanced industries such as pharmaceuticals, the electronic industry, machinery and transport equipment industries (particularly the aircraft industry), there is no systematic relationship between services intensity and the technology intensity of industries (see also Nordås and Kim, 2013). The reason for this is that transport and sales services are more intensively used by low-tech industries. It is true, however, that business services are most intensively used by the medium-high-technology industries, although the differences across the three groups of industries are not very large. This could mean that precisely because innovation plays a less important role, low-tech industries must strongly rely on business services (such as marketing) in order to differentiate their products from competitors. An important feature of the inter-linkages between manufactures and services is that EU manufacturing firms source intermediate services almost exclusively nationally. On average, the share of domestically sourced services amounted to 87% in 2011 Figure 3). Another 4% were sourced from other EU Member States and 9% from third countries.

1.4 The ‘carrier function’ of manufactures

Another important structural feature is the fact that manufactures are highly tradable whereas this is only true for a subset of services. The higher tradability of manufactures combined with the increasing services intensity of manufactures imply that manufactures assume an important ’carrier function’ for services. Just as many chemical processes require carrier substances, many services require manufactures to be ‘carried’ to foreign customers. This carrier function stems from the fact that many services by themselves are not easily tradable as evidenced by the relatively small (though growing) share of intermediate services sourced from abroad. The high tradability of manufactures and the carrier function it provides for services are of course highly relevant for the EU’s external balance.

While the share of services in extra-EU gross exports of the EU-27 has grown considerably over the past decades, to about a third, it still falls far short of the (equally growing) share of services in both GDP[6] and value added exports[7]. This can be seen by compar-

[6] Typically, the share of services account for about 60-70% of GDP in advanced economies.

[7] Value added exports are a measure based on input-output methodology that reflects the value added created domestically in an industry or sector in order to satisfy foreign demand (see also Box 1 in Section 2).

ing the share of services in gross exports, i.e. 33%, to the share of services in extra-EU value added exports which amounted to 57%. Hence, in terms of value added exports the share of services exceeded that of manufactures which amounted to 37% in 2011. The magnified importance of services in terms of value added exports result from the fact that more services are embodied in exports of the manufacturing sector than vice versa[8]. Hence, for non-tradable services an internationally competitive manufacturing sector is needed in order to make services exportable and it supports building comparative advantages in services[9]. At the same time, services have become an essential factor in underpinning the competitiveness of manufactures.

Importantly, comparative advantages in non-tradable services require that the domestic industrial commons and a thriving domestic manufacturing base remain intact simply because the bulk of intermediate services that are integrated into manufactures are sourced from the domestic economy and not internationally. Hence, if the European manufacturing base were to be eroded – as has happened in the United States as argued by Pisano and Shih (2009) – this would have severe consequences for the trade account (see for example Helper et al., 2012; Aiginger and Sieber, 2006).

1.5 Productivity growth

Another common argument for the special role of manufacturing – which is strongly related to the innovation argument but nevertheless distinct from it – is that productivity growth is higher in manufacturing than in the rest of the economy. The productivity argument is related to the innovation argument because R&D and innovation feed into technological progress and productivity growth. It is distinct because the sector of origin of technological progress need not necessarily coincide with the sector that benefits most strongly from new technologies[10].

Irrespective of this distinction, it turns out that total factor productivity (TFP) growth in the manufacturing sector outperforms TFP growth in the total economy as well as that of business services across a sample of EU Member States and also the US (Figure 4). Within the EU the TFP growth differential between the manufacturing sector and the total economy is particularly large in Austria and in Germany but it is also present in the service-oriented British economy. The sole exceptions to this EU-wide pattern are Spain and Italy

8 Another factor is that vertical specialisation and trade in intermediates in general is more developed in manufacturing which ‘inflates’ the gross amounts of exports.

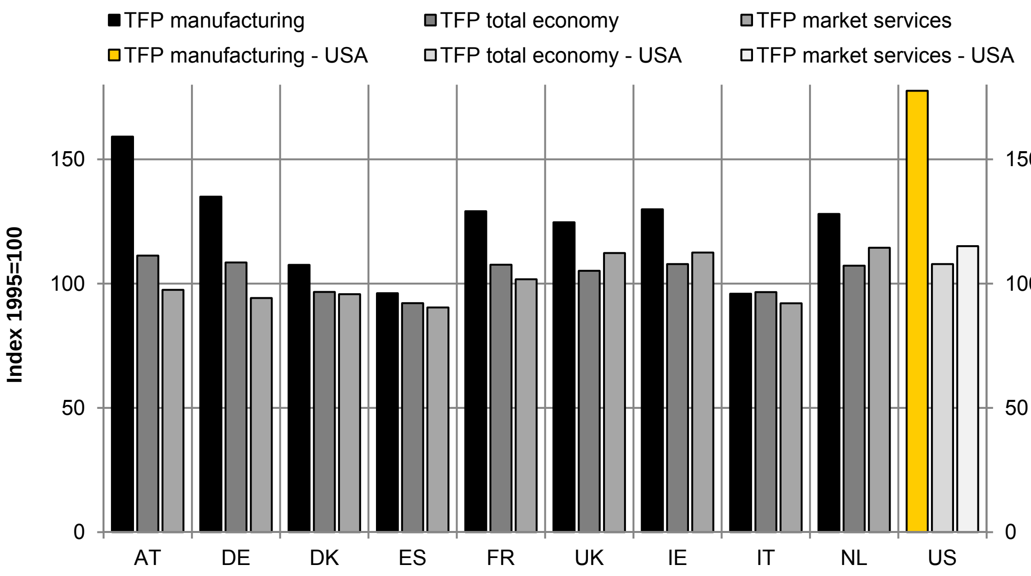
9 An alternative way to sell services internationally is by establishing a foreign subsidiary (Mode 3 of cross-border services trade in WTO terminology).

10 The relationship between innovation and productivity at the industry or sectoral level is blurred by the fact that in the case of product innovations the productivity gains (depending on market structures) may not accrue to the innovating industry but to downstream industries sourcing cheaper inputs or inputs of higher quality. By contrast, productivity gains from process innovation typically accrue in the innovating sector though it may spread to other sectors later on.

which actually did not experience any TFP growth between 1995 and 2007. The result remains unchanged if TFP growth in manufacturing is compared to TFP growth in the market services sector instead of the total economy. Hence, the superior TFP growth trajectory in the manufacturing sector between 1995 and 2007 is not due to low productivity performance in typically low productivity services such as health care or personal services.

Figure 4

Comparison of total factor productivity (TFP) growth in the manufacturing sector, the total economy and market services, 1995-2007



Source: EU KLEMS, wiiw calculations.

TFP growth in the manufacturing sector also exceeds that of the total economy in the United States[11].

The reason for higher productivity growth in the manufacturing sector is partly related to technological aspects of manufacturing (increasing returns to scale, externalities, learning effects)[12]. An additional reason is that manufactures, because they are more tradable compared to services, are exposed to fiercer international competition that sets further incentives to increase productivity. This does not exclude the possibility of high productivity pockets within the services sector which is of course a very heterogeneous sector, comprising a number of high productivity industries such as telecommunications.

An implication of these differentiated patterns of TFP developments is that in the longer term prices of manufactures will decline relative to services leading to a lower share of

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11 In the case of the United States, however, real productivity growth of manufacturing may be overstated due to strongly decreasing price deflators in the electronic equipment industry.

12 Another issue is the problem of measuring and comparing TFP across industries, but lacking alternatives this analysis relies on the best data source available which is the EU KLEMS database.

manufactures in value added in nominal terms. Therefore a declining value added share of the manufacturing sector per se is not a reason for concern but the logical consequence of a European manufacturing sector that is constantly becoming more efficient.

To sum up, the comparison of TFP growth rates supports the view that the manufacturing sector is not only the most important source of innovation and technological progress but also the sector where innovations and new technologies are primarily implemented and turned into productivity growth.

1.6 Does manufacturing offer higher wages in Europe?

A final argument in the context of a manufacturing imperative is that the manufacturing sector is capable of providing a large amount of well-paid jobs (Rodrik, 2012). This claim is typically put forward in the context of emerging economies but it could also be relevant for the cohesion countries among the Member States.

From a theoretical perspective, the argument that the manufacturing sector offers higher wages is typically based on the argument that the production of manufactures is characterised by imperfect competition (e.g. due to learning effects or static economies of scale in production), combined with imperfect inter-industry labour mobility within a country[13]. For the EU-27, however, there is no evidence for higher wages in manufacturing compared to the services sector – neither for the general wage level, nor for wages by educational attainment. Considering the EU as a whole, hourly wages have been lower in the manufacturing sector (EUR 13.39) than in the services sector (EUR 14.34)[14]. At the level of EU Member States the results are mixed, with manufacturing wages being higher in some EU-15 countries but wages in the services sector being higher in all Central and Eastern European Member States as well as Malta and Cyprus (EU-12). The same comparison but taking the educational attainments of workers into account suggests that generally wage differentials between the services and the manufacturing sector are small. The finding that given the level of education wage differentials are not very large is in line with the results found for other countries, such as the United States (McKinsey Global Institute, 2012).

Overall, for the EU-27 there seems to be no wage advantage for manufacturing workers and – as will be further explored in the next section – in the current situation there can be no question of the European manufacturing sector providing new ample employment opportunities.

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[13] From a theoretical perspective differences in wages between industries will always depend on some limitations to inter-industry labour mobility. Differences in wages can be motivated by a number of economic models, e.g. a specific-factor model of trade. The differences in wages between industries depend on a number of factors including the capital intensity or whether one looks at the short or the long run.

[14] This result is based on 2010 Eurostat data of hourly gross earnings of employees working in companies with 10 or more employees.

1.7 Conclusion

The renewed interest in the manufacturing sector since the outbreak of the economic crisis of 2008 may be well-founded despite the sector's declining role in the economy in relative terms. The ever tighter inter-linkages between the manufacturing sector and the increasingly dominant services sector in the EU economy imply that – even if small in relative terms – a thriving manufacturing base is nevertheless indispensable for a number of reasons. First of all, manufacturing firms still play a prominent role when it comes to business R&D. Secondly, the European manufacturing sector was a significant driver of total factor productivity (TFP) growth over the past two and a half decades, outpacing TFP growth of the total economy. Finally, the tradability of manufactures and the carrier function they fulfil for the domestic services sector imply that an internationally competitive manufacturing sector is also highly relevant for Member States' export performance.

2. Structural Change in the EU Economy and resulting Challenges for Manufacturing Industries

2.1 Introduction – General observations on structural shifts in the EU economy

A general feature of the European economy (and advanced economies in general) is the structural shift to the services sector. This shift is observable for both value added and employment and has been discussed in Chapter 1. The mirror image of the 'move into services' in Europe is a decline in the relative importance of manufacturing industries (Table 1) for which there is a whole series of explanations.

As shown in Section 1, productivity growth in the European manufacturing sector outpaces productivity growth in services and the economy in general.

This is a major reason why relative prices of manufactures decline relative to those of services. As a consequence, the nominal value added share of manufacturing declined by 4.2 percentage points between 1995 and 2011 (and by 5.3 percentage points between 1995 and 2009) as shown in Table 1. For comparison, the relative decline in real terms was more moderate, amounting to 2.6 percentage points between 1995 and 2009 (see for example also Aiginger, 2007). In real terms, the value added share of the EU manufacturing sector is higher than in nominal terms amounting to 17.5% in 2009. The share of the manufacturing sector in terms of employment declined to a similar extent as the nominal value added share (4.3 percentage points between 1995 and 2009).

This suggests that technological progress which lies behind the changes in relative prices is mainly labour-saving.

A second – globally relevant – factor for the observable structural trend are rigid demand structures characterised by low price elasticities of demand and high income elasticities for some services, e.g. education, tourism, health, cultural activities (see Baumol, 1967). This factor may help to explain why the relative importance of manufacturing in value added terms is smaller in the EU than in the global economy and the shift out of manufacturing has been more pronounced over the last two and a half decades[15].

Table 1

Nominal and real valued added shares and employment shares in the EU and the global economy 2009 and 2011 (in %); changes 1995-2009 and 1995-2011 in p.p.

	EU-27						World					
	Nominal value added		Real value added		Employment		Nominal value added		Real value added		Employment	
Industry	2011	change 1995-2011	2009	change 1995-2009	2009	change 1995-2009	2011	change 1995-2011	2009	change 1995-2009	2009	change 1995-2009
Primary Industries	**2.7**	**-1.21**	**3.1**	**-0.79**	**5.9**	**-3.73**	**9.6**	**3.29**	**4.9**	**0.22**	**32.2**	**-8.76**
Manufacturing	**15.8**	**-4.24**	**17.5**	**-2.55**	**15.6**	**-4.33**	**17.2**	**-2.43**	**18.3**	**-1.53**	**15.2**	**0.20**
Food	1.9	-0.54	2.0	-0.45	2.2	-0.46	2.4	-0.20	2.1	-0.40	1.9	-0.20
Textiles	0.5	-0.55	0.6	-0.43	1.1	-1.04	0.8	-0.27	0.8	-0.25	2.6	0.29
Leather	0.1	-0.09	0.1	-0.11	0.2	-0.20	0.1	-0.02	0.1	-0.04	0.5	0.15
Wood	0.3	-0.15	0.4	-0.11	0.6	-0.21	0.4	-0.13	0.3	-0.15	1.0	0.27
Pulp & Paper	1.2	-0.64	1.5	-0.38	1.1	-0.42	1.1	-0.53	1.3	-0.37	1.0	0.22
Ref. Petroleum	0.3	0.00	0.3	-0.04	0.1	-0.06	0.9	0.27	0.7	0.04	0.1	-0.02
Chemicals	1.7	-0.39	2.2	0.12	0.8	-0.30	1.8	-0.17	2.0	0.06	0.8	-0.11
Plastics	0.7	-0.20	0.9	0.00	0.8	-0.04	0.7	-0.15	0.7	-0.11	0.9	0.28
NM Minerals	0.6	-0.34	0.7	-0.24	0.7	-0.23	0.7	-0.15	0.7	-0.19	0.9	-0.37
Metals	2.4	-0.29	2.2	-0.53	2.3	-0.40	2.4	-0.23	2.2	-0.48	1.3	-0.24
Machinery	2.0	-0.14	1.9	-0.30	1.7	-0.42	1.5	-0.20	1.7	-0.14	1.1	-0.19
Electrical Eq.	1.7	-0.56	2.6	0.27	1.7	-0.30	2.3	-0.18	3.3	0.78	1.4	0.22
Transport Eq.	1.7	-0.18	1.8	-0.16	1.4	-0.13	1.6	-0.36	1.9	-0.16	0.9	-0.01
Manufacturing n.e.s.	0.6	-0.17	0.6	-0.20	1.0	-0.12	0.5	-0.11	0.5	-0.12	1.0	-0.09
Electricity, gas, water	**2.4**	**-0.29**	**2.2**	**-0.48**	**0.8**	**-0.25**	**2.1**	**-0.20**	**2.2**	**-0.28**	**0.5**	**-0.02**
Construction	**5.9**	**-0.10**	**4.8**	**-1.19**	**7.2**	**0.16**	**5.5**	**-0.38**	**4.4**	**-1.48**	**6.9**	**1.36**
Services	**73.2**	**5.84**	**72.4**	**5.01**	**70.5**	**8.15**	**65.6**	**-0.29**	**70.1**	**3.07**	**45.1**	**7.22**

Note: Industry classification based on NACE Rev. 1.1. Food=15t16; Textiles=17t18; Leather=19; Wood=20; Pulp & Paper=21t22; Refined Petroleum=23; Chemicals=24; Plastics=25; Non-Mineral Metals=26; Metals=27t28; Machinery=29; Electrical equipment=30t33; Transport equipment=34; Manufactures n.e.s.=36t37.

Source: WIOD, wiiw calculations.

Notably, the structural shift out of manufacturing (both in the EU and globally) encompasses basically all manufacturing industries implying that the aggregate decline in the value added share of manufacturing is the result of broad and general trends and not the result of some individual industries in difficulties[16]. Against the background of these general

[15] This may be linked to the fact the income elasticity-triggered shifts towards services are important in advanced economies whereas middle-income countries use manufacturing as ‘escalator activities’ (Rodrik, 2012) and hence make efforts to shift resources (out of primary industries) into manufacturing. The fact that many other advanced economies are in the same situation as the EU supports this interpretation as does the inverted U-shaped relationship between income level and the relative importance of the manufacturing sector in the economy that is found empirically.

[16] Exceptions to this are the chemicals industry and the electrical equipment industry in the EU when regarding real value added.

structural trends at the global and European level, important changes in the global economy such as the emergence of new players in the arena of international production and trade and the growing importance of ideas, skills and technology for international competitiveness, European manufacturing faces (at least) four major challenges.

2.2 Preserve the industrial commons in Europe and a broad manufacturing base

The introductory discussion made clear that the shift out of the manufacturing sector per se, even if it is more pronounced in the EU-27 than in the global economy, need not be a reason for serious concern. More disturbing, however, is the fact that the manufacturing sector is not only shrinking in relative terms but also in absolute terms when employment is considered. Over the period 1995-2009 almost 5 million jobs were lost (Table 2) of which 2 million jobs were shed since 2008. From 2009 to 2011 manufacturing employment in the EU-27 went down by another 1 million jobs[17].

To some extent the loss of manufacturing jobs may be counterbalanced by new jobs created in services sectors providing intermediate services to the manufacturing sector. As shown in Section 1, the intermediate services sourced by the manufacturing sector from the services sector increased between 1995 and 2011. However, these intensified interlinkages can explain only a minor part of the reduction in manufacturing employment in the EU.

An important explanation for the negative employment developments in European manufacturing is the increase in productivity that – as mentioned before – tends to be labour-saving[18]. In addition the structural shifts within the manufacturing sector are going in the direction of a mild but persistent shift towards more technology-intensive industries (chemicals, machinery, electrical equipment and transport equipment) which also tend to be less labour-intensive. These 'advanced industries' also registered negative employment trends between 1995 and 2009 (with the exception of the transport equipment industry) but job losses were more pronounced in the low-tech industries (3.5 million) which accounted for 70% of total losses in manufacturing employment.

This mild trend towards advanced manufacturing industries reflects international specialisation patterns of EU Member States because in general technology-intensive industries offer more possibilities for building comparative advantages by product differentiation and quality aspects. At the same time low-technology-intensive industries still accounted for almost 40% of manufacturing employment in 2009. Overall, the EU manufacturing sector shows itself rather well-diversified. Ideally, the structural upgrading should proceed at a

17 Development 2009-2011 based on Eurostat data.

18 This has to be considered in conjunction with the structures of price and income elasticities of demand which tend to work against compensating demand shifts towards relatively cheaper manufactures.

moderate pace in order to ensure that – as is currently the case – the manufacturing base in the EU remains broad, encompassing all industries. In low-tech and medium-low-tech industries this will require a high degree of specialisation within these industries and the occupation of niche markets. Existing evidence suggests that many European firms follow such a 'premium strategy' within their respective industry. Within industries and product categories featuring a low degree of complexity, European firms typically operate in the top quality segments (Reinstaller et al., 2012)[19].

Table 2

Employment developments within the manufacturing sector, EU-27, 1995-2009

	1995		2009		changes 1995-2009	
industry	nb. of jobs (in '000)	share	nb. of jobs (in '000)	share	nb. of jobs (in '000)	shares in p.p.
low-tech	17,257	43.1	13,795	39.3	-3,462	-3.78
medium-low tech	3,778	9.4	3,493	10.0	-285	0.52
metals	5,419	13.5	5,155	14.7	-264	1.16
chemicals	2,258	5.6	1,864	5.3	-394	-0.33
machinery	4,227	10.6	3,786	10.8	-441	0.23
electrical eq.	3,958	9.9	3,758	10.7	-200	0.83
transportation eq.	3,142	7.8	3,235	9.2	93	1.37
Manufacturing	**40,038**	**100.0**	**35,084**	**100.0**	**-4,954**	

Note: Value added price deflators for the electrical equipment industry of Finland, France, Sweden, Japan, South Korea and the USA replaced by respective German deflation in each year. Industry classification based on NACE Rev. 1.1. Low-tech: Food=15t16, Textiles=17t18, Leather=19, Wood=20, Pulp & Paper=21t22, Manufactures n.e.s.=36t37; medium-low-tech: Refined Petroleum=23, Plastics=25, Non-metallic mineral products=26; Metals=27t28; Chemicals=24; Machinery=29; Electrical equipment=30t33; Transport equipment=34;

Source: WIOD, wiiw calculations.

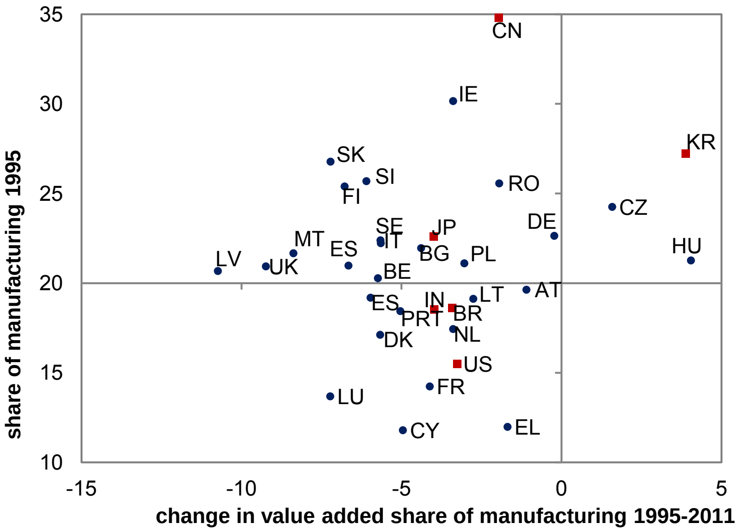
Maintaining a broad and well-diversified manufacturing base in Europe is important for at least two reasons. First of all, it makes industry-specific negative shocks less disastrous for the EU economy. Secondly, it avoids the loss of manufacturing capabilities that are hard to develop again once they have been entirely lost. Manufacturing capabilities specific to particular industries – even if they are low-technology industries – may at a later stage turn out to be important inputs for fast growing new products. It is argued that the United States has made this experience in several industries such as shoe production where the entire supply chain has been lost (Helper et al., 2012). Maybe more importantly is the case of thin-film-deposition which has moved out of the US and to South East Asia together with the semiconductor production but turned out to be important for producing solar panels. Hence, it is argued that the lack of required skills and capabilities in this domain is one of the reasons why the US has fallen behind in the fast growing solar industry (Pisano and Shih, 2009). This constitutes a classical example of the erosion of parts of the industrial commons.

19 See also Chapter 1 of this Report.

Having stressed the diversification of the EU manufacturing sector and the specialisation into the premium segments within industries it is also important to note that there is a high degree of heterogeneity across Member States. Figure 5 illustrates this heterogeneity with respect to the value added share of manufacturing and changes thereof between 1995 and 2011. While this is an imperfect indicator of the role of the manufacturing sector for the economy, the cross-country comparison still indicates which countries may have reason to be worried about their industrial commons. There is cause for concern either because the value added share of manufacturing is declining very strongly – as in the case of the United Kingdom or Latvia – or because it has already been very low initially (i.e. in 1995) as in the case of France or Greece.

Figure 5

Developments of the value added share of manufacturing (nominal) across EU Member States and selected competitor countries, 1995-2011



Source: WIOD, wiiw calculations.

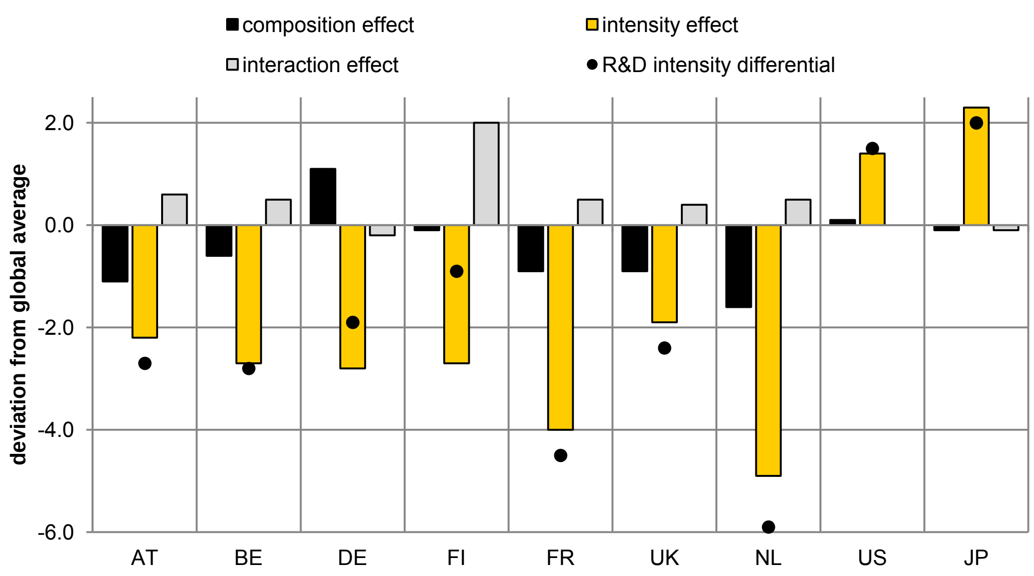
In principle, a declining share of the manufacturing sector in the economy's value added may be of little concern in Member States that score high in the complexity of their manufacturing output – in terms of the exclusivity and the degree of diversification of the underlying capabilities (e.g. Finland or the United Kingdom) because they are potentially left with a high-powered manufacturing sector (see Section 1) but it should be monitored closely in countries such as Latvia or Malta which rank further down in the complexity of their production structure among EU countries (see Reinstaller et al., 2012). The same is true for countries such as Greece or Cyprus, which are among the Member States with the smallest manufacturing base. In contrast, there is a set of countries including Germany, Austria and a number of Central and Eastern European countries that have maintained a rather high value added share of manufacturing. This highlights the fact that there is quite some dispersion among Member States when it comes to the development of the manufacturing sector, a topic which will be further elaborated in one of the next sections.

2.3 Remain at the technological frontier to defend competitive positions

The gap between the EU and the United States with regard to innovation activities of firms has been a concern for European policy-makers for decades. Indeed, the comparison of R&D intensity in the manufacturing sector as an indicator of the intensity of innovative activity, measured as the business expenditure of manufacturing firms on R&D relative to manufacturing value added, suggests that European manufacturing firms are less inclined to invest in R&D than their peers in the US or Japan.

Figure 6

Decomposition of differences in manufacturing R&D Intensity in EU Member States, the US and Japan, average 2007-2008



Note: R&D intensity is Business expenditure on Research and Development in per cent of value added. Global average is the average of the nine countries. R&D intensity differential is the difference of the manufacturing-level R&D intensity to the mean of the nine countries. Methodology following Eaton et al. (1998). Industry classification based on NACE Rev. 1.1. For industry groupings for decomposition see Appendix.

Source: WIOD, OECD ANBERD, wiiw calculations.

These differences in the R&D intensity at the manufacturing level can be split into a composition effect which reflects differences across countries in the industry structure and an intensity effect which reflects differences in the R&D intensity at the level of manufacturing industries as well as an interaction effect (see Eaton et al., 1998). This decomposition shows that the differences in the R&D intensity of firms across EU Member States and US and Japanese firms at the manufacturing level are mainly driven by the intensity effect (Figure 6). The industry structure (composition effect) plays a role in some Member States but is never the primary factor[20].

[20] The relative importance of the composition effect and the intensity effect in such a decomposition exercise depends on the level of aggregation of the industries. A more detailed industry break-down would assign greater importance to the composition effect.

This gap in R&D activities of the manufacturing sector in the seven EU Member States shown is partly compensated by higher public R&D expenditure in these countries but the fact remains that the R&D intensity in the seven EU Member States shown in Figure 6 is only 62% that of the United States.

At the same time it seems that the concern about a deterioration of relative positions in advanced manufacturing industries vis-à-vis the US and other economies at the technological frontier should be limited to the electrical components industry. In all other advanced manufacturing industries the market shares in global value added exports of the EU are still much higher than those of the US (Figure 7). The EU is still the world's largest exporter of chemicals, machinery and transport equipment with the latter two constituting the major strongholds of European manufacturing. Despite a 6 percentage points decline in its market share of global value added exports between 1995 and 2011[21], the EU is still accounting for more than a third of global machinery valued added that is exported, putting it far ahead of the United States[22] (for the concept of value added exports see Box 1). The EU-27 also has considerable export market shares in low-technology industries such as the food industry or the pulp and paper industry which supports the claim that EU firms often occupy premium segments within industries to remain internationally competitive. An example for such high-quality specialisation in low-technology sectors is the production of protective textiles or extra-long hardened rail tracks. Figure 7 suggests that EU firms are more successful in this type of specialisation than their US rivals.

2.4 Adjust to competitive pressures from emerging economies

Figure 7 not only shows the competitive positions of the EU-27 as measured by shares in global value added exports in comparison to the major competitor among advanced economies – the United States, Japan and South Korea – but also in comparison to the large emerging economies, Brazil, China and India. With regards to competition from these economies it is equally true that technological leadership and quality upgrading have become increasingly important to shield off competition from emerging economies. Given the structural upgrading in emerging economies, competitive pressures from these countries are not limited to low-technology-intensive industries but are also felt in advanced manufacturing industries where emerging economies have also gained a foothold. Brazil, India and China all considerably increased their market shares in global value added exports of manufactures. However, it is the outstanding performance of China, whose market share quadrupled between 1995 and 2011, which basically drives the reshuffling of competitive positions in the global economy.

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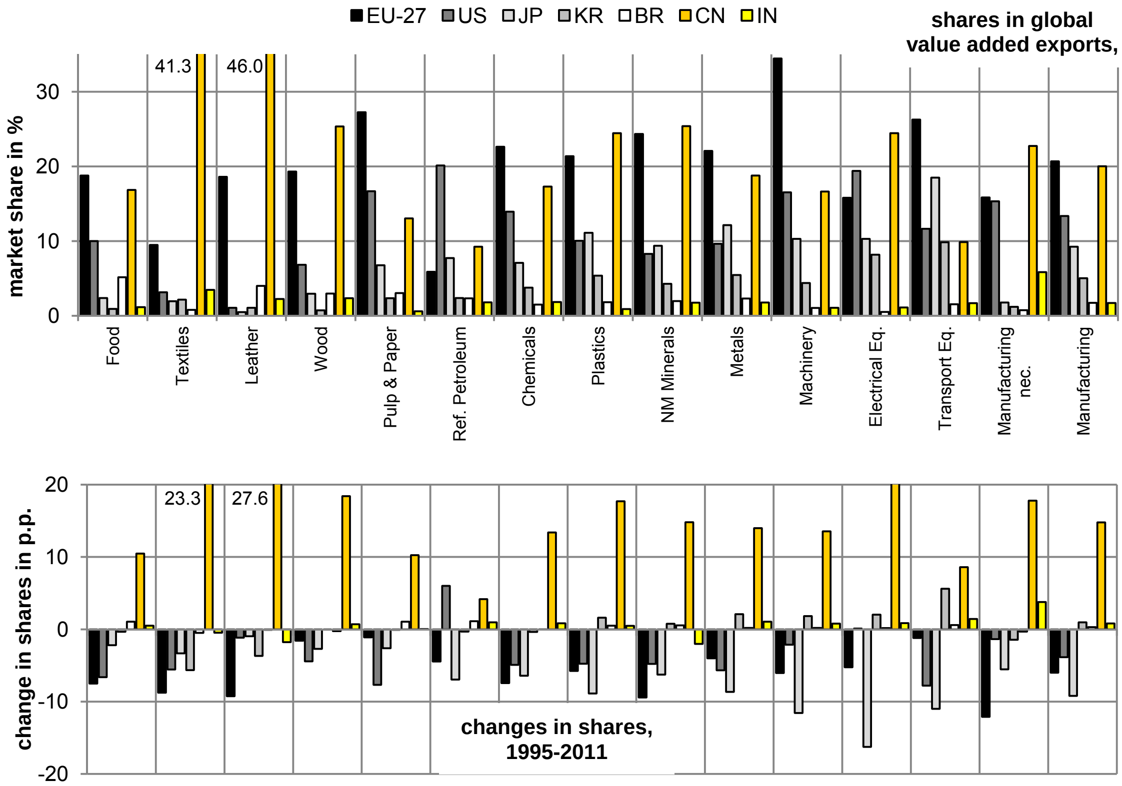
[21] These figures exclude intra-EU value added exports.

[22] These figures exclude intra-EU value added exports.

Figure 7

Shares in global value added exports of manufactures (in %), 2011 (upper panel) and changes thereof (in p.p.), 1995-2011 (lower panel), extra-EU exports



Note: Industry classification based on NACE Rev. 1.1. Food=15t16; Textiles=17t18; Leather=19; Wood=20; Pulp & Paper=21t22; Refined Petroleum=23; Chemicals=24; Plastics=25; Non-metallic mineral products=26; Metals=27t28; Machinery=29; Electrical equipment=30t33; Transport equipment=34; Manufactures n.e.s.=36t37. Global market shares in value added exports and changes thereof exclude intra-EU value added exports.

Source: WIOD, wiiw calculations.

By 2011 China had almost caught up with the EU-27 in terms of value added exports of manufactures, with both economic blocs having a market share of about 20%. The rise of China to a first class exporter of manufactures is also documented by the fact that it gained export market shares across all industries with extremely strong positions in the export of textiles and leather but also in the electrical equipment industry. While China is still specialised in the relatively more labour-intensive stages of production within the electrical equipment industry, the impressive gains in market shares also reflect a remarkable upgrading of industrial structures. The same holds true for other industries and also other emerging economies, e.g. the Indian pharmaceutical and automotive industries.

A factor that facilitated the structural upgrading in emerging economies is the relative ease of international technology transfer in a global economy (through trade, FDI, labour mobility in the high-skill segment of the labour force and knowledge diffusion). This is particularly true for the manufacturing sector because the required technology and industrial know-how are to a large extent embodied in physical products which makes them more prone to imitation.

This facilitates the technological upgrading in the manufacturing domain. Therefore emerging economies such as China do not only have large export market shares in low-tech and medium-low-tech industries (where they can be expected to possess comparative advantages due to lower labour costs) but also increasingly so in more technology-intensive industries.

Box 1

Why is it important to look at value added exports?

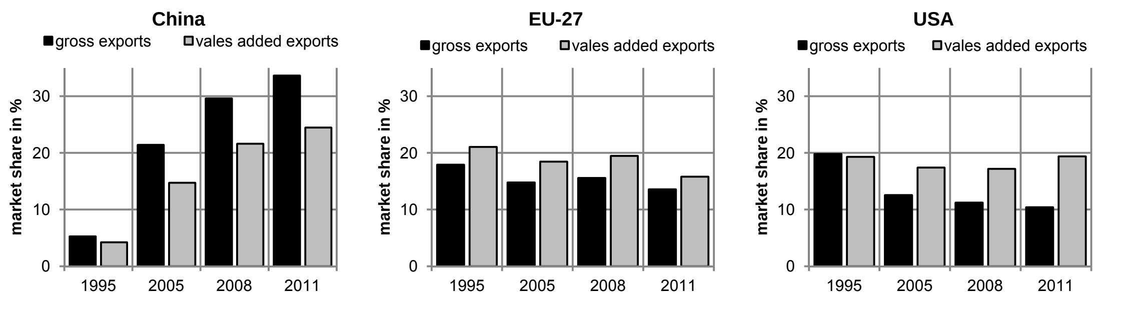
International trade has not only expanded spectacularly over the past 25 years, it has also become increasingly complex. One important dimension in this complexity is the fact that the specialisation patterns have become more granular. Supported by declining trade costs the ever finer specialisation on individual components of a product or steps in the production process – also referred to as fragmentation of production – makes the analysis of trade flows more demanding. International fragmentation of production heightens the importance of trade in intermediate goods. This in turn poses some difficulties for traditional trade statistics which record trade flows according to a gross concept thereby inflating trade figures.

One possibility to adjust gross export flows for imported intermediates is provided by global input-output statistics. This Report relies on the World Input-Output Database (WIOD) which provides such statistics for a set of 40 countries including EU Member States. The WIOD is used to calculate the value added exports at the industry level for each country or country groups. These value added exports only capture the value added that is generated domestically in the production of goods that are destined for export (see Johnson and Noguera, 2012; Stehrer, 2012) but exclude foreign value added associated with imported intermediates.

The figures below illustrate that the differences between gross exports and value added exports can be quite significant, particularly in industries that are characterised by intensive intra-industry trade such as the electrical equipment industry. According to gross exports, China's market share in the electrical equipment industry for example rose from 5.27% in 1995 to 33.6% in 2011. Looking at value added exports, China's market share still shows a positive trend but reached only 24.5% in 2011. While this is still a spectacular development, the resulting difference between China's market share in gross exports and value added exports is equal to about 7 percentage points in 2011.

Figure B1

Differences between market shares in gross exports and value added exports in the electrical equipment industry, 1995-2011



Source: WIOD, wiiw calculations.

For the EU and the United States the opposite is true. The EU's share in global value added exports in the electrical equipment industry is 2.2 percentage points higher than in terms of gross exports in 2011 and in the US the difference reaches even 9 percentage points. The figures above also indicate that the difference between gross exports and value added exports has increased between 1995 and 2011 which is due to the emergence of international production networks and more fragmented global production.

In the presence of international production sharing the value added exports probably give a more accurate picture of export market shares of the trading partners involved.

The mirror image of the entry of China and other emerging economies into the global trade arena is a decline in market shares in the EU, the United States – both lost about a fifth of their export market shares between 1995 and 2011 – and Japan, whose market share was halved. Even if the gains in market shares of China will level off in the coming years as wages rise and the technology gap narrows[23], that country will remain a major competitor. Arguably, competition may even become fiercer as the catch-up process of major emerging economies such as China, India and Brazil continues and these countries expand their skills and capabilities in the manufacturing domain.

In any case, the shifts in competitive positions discernible in Figure 7 suggest that the EU's losses of export market shares in manufacturing were primarily due to the integration of emerging markets into the global economy and just to a lesser extent due to competition from other advanced economies with the exception of South Korea, which made substantial inroads into the production and export of transport equipment (mainly the automotive industry).

Given these trends in market shares in global value added exports, further shifts towards these emerging economies can be expected.

From a European perspective, however, the rise of China and other emerging economies does not only constitute a formidable competitive challenge but also means new and enlarged markets. Equally important is the fact that the benefits from new export opportunities and the potential costs of a deteriorating international competitiveness are not equally distributed across EU Member States. This leads to another main challenge for European manufacturing which consists of the agglomeration of manufacturing activities.

[23] Gains in market shares in Chinese value added exports in manufactures seems to have levelled off somewhat since the mid-2000s although they continued to increase (by 4.2 percentage points between 2007 and 2011 compared to 5.3 percentage points between 2002 and 2006).

2.5 Handling the agglomeration tendencies within the EU

Competitive pressures from emerging economies will be felt most strongly in low-tech and medium-low-tech industries because of the lower wage costs. As was shown the low-tech industries in the EU are the most vulnerable ones and the losses of export market shares of EU Member States were most pronounced in these industries. As a consequence, the EU Member States with a remaining strong specialisation in low-tech and medium-low-tech industries, i.e. some of the Southern periphery countries (e.g. Greece, Cyprus) or the Baltic countries and Bulgaria and Romania, which also have less complex production structures than most other Member States, will be most affected by the competition from low-wage destinations. This is one of the reasons why the intra-European convergence process has been partly derailed. At least, the Member States that form part of the intra-European 'convergence club' have been narrowed down to those countries which have had the most dynamic catch-up performance since 1995, i.e. the five Central and Eastern European countries (CEEC-5) including the Czech Republic, Slovakia, Hungary, Poland and Slovenia. These five countries together with Germany and Austria form a sort of emerging Central European manufacturing core which accounts for an increasing share of the EU's total exports. Between 1995 and 2011, the Central European manufacturing core increased its share in total extra-EU value added exports of the EU-27 by more than 7 percentage points, from 37% to more than 44% (Table 3)[24].

Table 3

Export market shares (in %) and changes thereof (in p.p.) in manufacturing value added exports of EU Member States, 1995-2011. Extra-EU exports only

	1995		2011		change 1995-2011	
	global market share (in %)	share in EU-27 exports (in %)	global market share (in %)	share in EU-27 exports (in %)	global market share (in p.p.)	share in EU-27 exports (in p.p.)
Benelux Countries	1.92	7.20	1.28	6.17	-0.64	-1.03
Germany and Austria	9.25	34.67	7.90	38.20	-1.35	3.53
CEEC-5	0.58	2.18	1.25	6.06	0.67	3.88
France and Italy	6.70	25.09	4.38	21.19	-2.31	-3.90
Nordic Countries	2.45	9.20	1.52	7.36	-0.93	-1.84
Baltic Countries	0.05	0.17	0.09	0.42	0.04	0.25
Bulgaria and Romania	0.14	0.51	0.22	1.07	0.09	0.56
United Kingdom	3.99	14.95	2.16	10.44	-1.83	-4.50
Ireland	0.39	1.47	0.63	3.03	0.24	1.57
Southern Europe	1.22	4.58	1.25	6.06	0.03	1.48
EU-27	26.7	100.0	20.7	100.0	-6.0	0.0

Note: Industry classification based on NACE Rev. 1.1. CEEC-5=Poland, Czech Republic, Slovakia, Slovenia, Hungary; Nordic Countries=Denmark, Finland, Sweden; Southern Europe=Greece, Spain, Portugal, Cyprus, Malta. Global market shares in value added exports and changes thereof exclude intra-EU value added exports.

Source: WIOD, wiiw calculations.

[24] For comparison, the combined share of the seven countries in the total EU-27 population amounted to 31% in 2011; their share in the EU's total GDP was about 28%.

This concentration tendency is driven by agglomeration economies and the benefits of international production sharing among Central European economies where German and Austrian firms benefited most strongly from a well-trained, highly skilled workforce and a relatively low wage level (by EU standards) in the neighbouring Central and Eastern European countries. The latter in turn benefited from technology transfers and structural upgrading which was strongly driven by foreign direct investment by firms from other Member States.

Offshoring implies that part of the value added created by EU firms is generated in low-cost locations. Fortunately, from a European perspective, the offshoring activities of EU multinationals were predominantly regional in scope, meaning that labour-intensive parts of the production process were re-located to the Central and Eastern European Member States, which also still have relatively low labour costs by EU standards. It is worth mentioning that offshoring does not predominantly affect labour-intensive industries (as opposed to advanced manufacturing industries) but the dividing line is rather the skill level of employees with low-skill (though often medium-paid) jobs in manufacturing being more prone to offshoring. This points towards a major role for education and training of the labour force, in particular in high-wage countries, in order to remain an attractive location for manufacturing activity.

The documented concentration of manufacturing in a number of Central European countries poses a serious challenge to the European integration process. It is of utmost importance for the EU to find a possibility to successfully counter the current agglomeration forces in manufacturing that were reinforced by the Single Market. The alternative would be to accept the concentration of manufacturing activity in a certain part of the EU as a type of specialisation according to comparative advantages. Given the role of the manufacturing sector for the entire economy and the important inter-linkages discussed in Section 1, this type of specialisation pattern may have severe implications for innovation activities and the general economic development of economies that remain outside the manufacturing core.

The next section will investigate the effects of industrial policies in the form of state aid, innovation support and support for vocational training systems in the EU and how they can help in meeting the challenges that have just been identified.

3. industrial policy measures in the European Union

Few people will doubt that the main responsibility for mastering the challenges that lie ahead of the European manufacturing sector rests with firms. Another question is whether the EU and its Member States have fully exploited the potential of industrial policies to support firms in mastering these challenges and ensuring a strong manufacturing base in Europe.

After a brief overview of industrial policies at the Union level and by Member States, this section provides a quantitative analysis of state aid by EU Member States which remains an important policy measure. Since research and development (R&D) is a key aspect in EU policy and directly linked to the challenges of European manufacturing, this section also investigates the impact of public support for R&D on innovation activity and innovation output at the firm level. Finally, it takes a look at the role of initial vocational training, which is a type of 'soft' industrial policy and an important element of the industrial commons for the competitiveness of the European manufacturing sector.

3.1 Introduction – Industrial policies at the Union level and by Member States

With the Maastricht Treaty the EU anchored its industrial policy approach in primary law, stipulating that the 'Union and the Member States shall ensure that the conditions necessary for the competitiveness of the Union's industry exist'[25]. However, defining industrial policy in a very broad sense encompassing framework measures, the EU had a major industrial policy objective long before the Treaty of Maastricht which was the creation of the Single Market. Part of the Common Market and later the Single Market project were the competition rules. The particularity of the EU competition rules is that in addition to the control of anticompetitive behaviour of firms (rules on the abuse of a dominant position and collusion and later merger control), the European Commission was also empowered to control the state aid provided by EU governments. Until today this is a quite unique feature in competition rules.[26] The control of state aid of sovereign governments is obviously a delicate issue and the European Commission has shown a large degree of pragmatism in this respect (Doleys, 2012). In the field of state aid the Commission also tried to shift state aid of Member States from sector-based schemes to horizontal objectives such as aid to small and medium-sized enterprises (SMEs) or R&D aid, aid for employment and training of employees. The European Commission's preference for horizontal state aid is motivated by the belief that horizontal aid is less distortive to competition than sectoral aid (Friederiszick et al., 2006) and that it contributes to the Commission's own market-correcting or redistributive policy goals and is therefore linked to an objective of 'common interest' (Blauberger, 2008)[27].

[25] Article 173.1 of the Treaty on the Functioning of the European Union (TFEU).

[26] Only EFTA has a comparable competition authority.

[27] For the various types of horizontal state aid there exist so-called block exemptions. These block exemptions specify a number of criteria that aid programmes must fulfil (e.g. maximum subsidy amount typically expressed in percentage of eligible costs). If the criteria are fulfilled the aid programme is considered to be compatible with stat aid rules. The block exemptions constitute a major simplification of the state aid procedure as they exempt eligible aid programmes from the requirement of prior notification and Commission approval. For Member States this means that they are able to grant aid that meets the conditions laid down in these regulations without the formal notification procedure. However, ex post information sheets on the implemented aid have to be submitted.

While at the Union level the focus remained at general framework conditions, there were also early attempts to implement a kind of technology policy (Owen, 2012). Initiatives in this respect had started in the 1970s and industrial policy in the form of support for research gained momentum in the 1980s, nurtured by the perceived gap between the research and innovation activity in the EU and that of the main competitor countries – the United States and Japan. Over time, the support for R&D, innovation and technology provided out of the EU budget has become quite substantial, leading prominent economists to conclude that at the EU level industrial policy is essentially R&D policy (Van Pottelsberghe, 2007).

The EU's ambitions in the field of industrial policy have intensified in the aftermath of the economic crisis of 2008 with the focus largely remaining on framework measures and innovation. Hence, in the EU's new growth strategy, the Europe 2020 strategy adopted in 2010, the 'Innovation Union' figures prominently among the flagship initiatives (European Commission, 2010b). Moreover, the 2020 strategy also confirms the horizontal industrial policy approach of the EU. In its industrial policy communication from 2010 the European Commission further specifies some of the key aspects of the industrial policy strategy defined in the Europe 2020 strategy, but this policy communication also proposes a fresh approach to industrial policy that complements its market-oriented horizontal approach with sector-specific elements. The Commission characterises its approach as 'bringing together a horizontal basis and sectoral applications' (European Commission, 2010a, p. 4). The mentioning of sectoral application of horizontal measures seems to take into account the claim that infrastructure and other public inputs tend to be highly context-specific, calling for a sector-specific definition of industrial policy (Hausmann and Rodrik, 2006). In the specification of the sectoral dimension of industrial policy, the European Commission identifies the development of clean and energy-efficient vehicle technologies as a priority area for industrial policy. The Commission's update of the industrial policy communication from October 2012 (European Commission, 2012a) contains six priority action lines which aim at improving the competitiveness of European manufacturing.

These priority lines highlight once more the importance of new technologies for a thriving manufacturing sector. At the same time these action lines, which include markets for advanced manufacturing technologies for clean production, key enabling technologies and bio-based products as well as increasing resource efficiency and investment in low-carbon economy, clean vehicles and vessels and smart grids, are directly or indirectly related to the protection of the environment and the mitigation of climate change.

The topic of environmental protection and climate change seems to have become a key element in the formulation of the EU's industrial policy.

The priority action lines are accompanied by a number of additional objectives, such as the establishment of a European patent, and rather new elements such as the call for green public procurement, a demand-side policy instrument which has for a long time not figured among the main concerns in the context of industrial policy.

Box 2

Lessons from industrial policy in the United States

The United States does not have an explicit industrial policy or industrial strategy. Nevertheless the involvement of the US government in shaping the US economic structure may be stronger than is commonly thought and has a strong R&D and technology component. For decades the United States has, without calling them as such, conducted industrial policies at the 'meso-level', consisting mainly (though not exclusively) of 'soft' industrial policy measures focusing on the forging and coordination of R&D networks in specific industries (Wade, 2012).

Another long-standing and in many instances related element of US industrial policy is the US defence ministry including its many agencies. The role of the US defence ministry is twofold. First of all, it accounts for a substantial amount of research with important spin-offs for commercial use. Secondly, and maybe more importantly, in many technology-intensive industries US firms benefited strongly from military procurement policy which provided the necessary demand for new, technologically advanced products, thereby helping them to move down quickly the learning curve and reaping dynamic economies of scale (Pollin and Baker, 2009).

The coordinative industrial policy of the United States manifests itself in the numerous national, state and local agencies that run programmes aimed at establishing networks in specific industries. The role of the government or the respective agency in these programmes is not just to provide subsidies but to act as initiator and steward of networks between firms, research institutions and universities. Famous examples of such agencies include the National Institute of Standards and Technology (NIST) and the Advanced Research Projects Agency (ARPA). The task of the latter, for example, was to form a network of US semiconductor producers and to encourage the consortium to pool resources and capacities in R&D and (pre-competitive) manufacturing in order to re-enter the production of semiconductor equipment which had been shifted to Japan (Wade, 2012). ARPA also provided financial incentives but first of all it had to ensure free-riding behaviour within the network (Cohen, 2006) and that the consortium did not break apart in particular at times when the business cycle was up and firms were earning high profits making them less inclined to cooperate (Wade, 2012)[28]. ARPA also initiated and heavily contributed to the development of the internet, a project that required little new basic research but large investments in applied research. In fact the scope of the project and the long time horizon involved makes it unlikely that such an innovation would have come up by private initiative alone (Pisano and Shih, 2009). This highlights the point that such projects require a long-term commitment.

According to Pisano and Shih (2009) the great advantages of public support for collaborative research are *(i)* that the resources are leveraged because the results from R&D efforts are spread across a larger group of firms and institutions, and *(ii)* the creation of research networks (consisting of people from academia and industry) which feed into the creation of industrial commons.

[28] The success of such initiatives is disputed and Langlois and Steinmueller (1999), for example, argue that SEMATEC fell short of the initial expectations. Nevertheless, even these authors credit the US government with providing a credible signal and commitment to guide the strategic orientation of the domestic semiconductor industry.

The second major element in the US industrial policy is the role of the defence ministry. The important role of the US defence department and its agencies in funding R&D has already been mentioned. However, public funding and incentives for R&D typically target basic research and applied research but not commercial R&D[29]. While applied research is important to bridge basic research and the commercialisation of innovations, i.e. turning innovations into marketable products, it may not be sufficient. This is where public procurement and the state as customer for new products and technologies come into play. For decades US companies in high-tech industries, including military and commercial aircraft, nuclear energy, computer and semi-conductors and space industries, have benefited from military-related procurement (Pollin and Baker, 2009; Langlois and Steinmueller, 1999). Pollin and Baker (2009) argue that the funding of R&D alone would not have turned the new technologies into commercial successes. Rather it required the existence of guaranteed markets for the newly developed technologies which provided the necessary demand for first-mover firms to invest in the commercialisation of the technologies and quickly move down the learning curve in the production of new products. The essential aspect in this context is that new products do not have to pass the market test immediately but can be further developed and enhanced in a sort of protected area. Evidently, this procurement strategy was not always highly efficient and there is evidence of waste (e.g. in the form of non-competitive and cost-plus contracts for firms). However, it proved to be capable of fostering the creation of comparative advantages of often newly established US firms – which were often spin-offs from the collaborative R&D projects.

The importance of modern infrastructure in the form of smart grids pointed out in the European Commission's communication has been made visible by the establishment of the Connecting Europe Facility (CEF) which has been allocated a budget of EUR 50 billion for the period 2014-2020 in the recent multiannual financial framework negotiations (European Commission, 2012b). The CEF is intended to co-finance projects in three sectors: energy infrastructure, broadband infrastructure and transport infrastructure. It is also linked to the EU's plans for Trans-European Networks (TENs). This infrastructure initiative may point towards an increased awareness of demand-side components in the formulation of EU industrial policy though the magnitude of the pledged amounts may still be considered too low.

The industrial policy approach at the Union level is highly relevant for the industrial policies implemented by Member States. The interdependence between policies at the EU level and the Member State level is most obvious in the field of competition policy including state aid where the Commission is in charge of controlling the activities of Member States. But the two layers are also linked by the fact that most of the financing of projects out of EU funds has to be co-financed by Member States.

Partly owed to frustrations with disappointing outcomes of active state aid policy, and at later stages also induced by a strengthening of state aid rules by the Commission, there

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29 In the European Commission's Framework for state aid to R&D these basically refer to fundamental research, industrial research and experimental development.

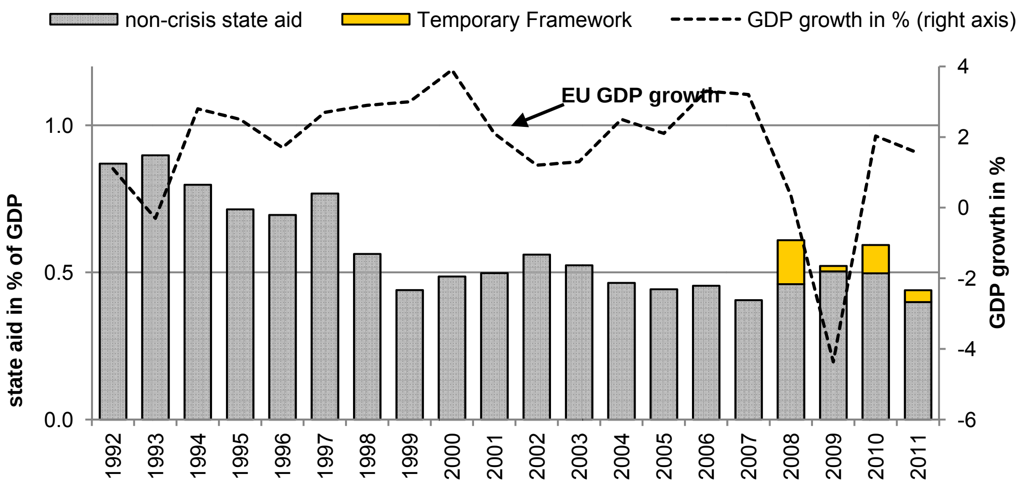
was a marked shift in industrial policy which implied greater emphasis on market-oriented measures such as changes in product and labour market regulations and privatisations which has been described as a weakening of the 'interventionist priors' in the literature (Wade, 2012). The cutback of direct state interventions such as state aid that began in the 1980s continued throughout the 1990s and until the years up to the crisis. An indication of this is the decline in state aid provided by Member States as shown in Figure 8.

During the 1980s state aid to industry and services provided by EU Member States amounted to approximately 2% of EU GDP and went down to about 1% in the following decade (European Commission, 2011). The general downward trend in the provision of state aid in the EU continued until 2007 where it reached an all-time low of 0.4% of GDP.

State aid also has a counter-cyclical component, i.e. the amount of state aid spent increases in times of recessions. This was also the case in the economic crisis of 2008. As shown in Figure 8, state aid increased to 0.6% in 2008, which is still a very low amount by historical standards but represented a 50% increase from the year before. These figures include the state aid granted under the Temporary Framework which consisted of a temporary adjustment of the state aid rules and was intended to encourage investment and ease the access to finance for firms facing tightening credit conditions. It was targeted at the real economy.[30]

Figure 8

State aid to industry and services in the EU-27, 1992-2011, in % of GDP



Note: Figures exclude crisis-related aid to the financial sector. The value for France in 1997 excludes the EUR 18 billion state aid to Crédit Lyonnais. Amounts refer to the aid element (or gross grant equivalent in the case of guarantees and loans) contained in the state aid measure.

Source: European Commission State Aid Scoreboard, Eurostat, wiiw calculations.

[30] Crisis-related aid measures to the financial sector were subject to a different set of rules and the amounts involved were much higher, reaching 1.9% of EU GDP in 2008 and 2.9% of GDP in 2009. These amounts are not included in Figure 8.

De facto, the Temporary Framework led to a temporary relaxation of the state aid rules[31].

The Temporary Framework expired by the end of December 2011. In the period 2008-2011 about EUR 4.8 billion of state aid (0.04% of EU GDP) was paid out under the Temporary Framework, mainly in the form of subsidies and direct grants (European Commission, 2012c). The Temporary Framework was open to all industries and sectors but de facto the majority of the aid was allocated to car producers which were hit hard by the crisis due to the crisis-related slump in car sales.

Due to the crisis, state aid by Member States went up to 0.5%-0.6% of GDP in the years 2008-2010 but in 2011 the amounts returned to 0.44% of the EU's GDP, which equals the pre-crisis levels of aid intensity. Neglecting the crisis-related state aid, the amount of state aid in 2011 was back to the 2007 level. These very low figures are interesting for a number of reasons. First of all, it shows that the amount of state aid provided by Member States has become relatively small. Secondly, the renewed interest in industrial policy both at the Member State and the EU level so far does not show up in a substantial increase in state aid figures. Thirdly, the impact even of small amounts of state aid is potentially very large. The total of state aid measures of the 27 Member States sums up to just EUR 4.8 billion over the period 2008-2010 but it comprised a large number of measures including multi-billion loans to car producers. The aid element implied in such measures seems to be very low but they can nevertheless have a great impact on individual companies (in particular when the state aid comes in the form of rescue aid) but also on the market outcome in the industry[32]. So the leverage of state aid measures may be quite high. This means, on the one hand, that even low amounts of state aid (or more precisely aid measures containing low aid elements) may distort competition and create further problems such as the build-up of overcapacities as a result of postponed structural adjustment within an industry. On the other hand, it also means that EU governments have a great potential to affect market outcomes and also the position of EU companies in global competition without large fiscal implications.

The next sections analyses the use of state aid by EU Member States in more detail by investigating the relationship between various types of state aid on the one hand and competitiveness and value added of the manufacturing sector on the other hand.

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31 The measures of the Temporary Framework included the possibility to grant direct subsidies to individual firms up to an amount of EUR 500,000; the provision of state guarantees at reduced premia; additional interest-rate support for loans financing investments in green products; and the possibility for official export credit agencies (ECAs) to provide cover for short-term transactions which were previously considered to be 'marketable risk'.

32 Note that so-called de minimis aid provided by Member States is not included in the state aid figures because de minimis aid need not be notified to the Commission. De minimis aid represents all aid measures with an aid amount below EUR 200,000 (this threshold applies since December 2006 when it was raised from EUR 100,000 to EUR 200,000).

3.2 Quantitative assessment of state aid and export orientated manufacturing

A three-step regression analysis strategy is implemented with the objective to quantitatively assess in what way different types of state aid provided by EU Member States impact on the export-oriented manufacturing sector in the EU. The strategy follows recent empirical literature on the development of the internationally competitive manufacturing sector. The three base specifications (see appendix for details) deal with the explanation of extra-EU export shares (following Aghion et al., 2011), value added per capita in export-orientated manufacturing (following Haraguchi and Rezonja, 2011) as well as real value added growth of export-oriented manufacturing industries (following Rajan and Subramanian, 2011).

3.2.1 Extra-EU export share

The first regression model builds on the approach by Aghion et al. (2011). This model tries to explain the overall share of extra-EU manufacturing and services exports of the individual EU Member States in total EU exports with the help of a sectoral state aid indicator as well as a proxy for financial development. The regression also controls for non-linearities and interactions in order to see whether explanatory variables are substitutes or complements. The rationale of this estimation exercise is to find out whether state subsidies can act as a promoter of international competitiveness, especially in those cases where access to private finance is limited.

The original specification is modified by analysing specifically Member States' shares in total extra-EU manufacturing exports. Apart from private credit a number of additional variables were added: the government effectiveness rank to control for institutional quality, the wage share in value added as a (crude though easily available) proxy for competition as well as the import weighted tariff rate as an indicator of trade protection.

The main effects of total state aid as well as total horizontal aid are statistically insignificant (Table 4). Among horizontal state aid sub-groups, R&D aid seems to be an option for those countries with a low governance rank as indicated by the significantly negative coefficient of the aid-governance interaction (see Appendix Table A.6 for regression results)[33]. Here the main effect is insignificant and the coefficients of the interaction terms between aid and the wage share and aid and the tariff rate are negative.

[33] For an overview of selected categories of state aid see Box 3.

Table 4

Commerce, export and internationalisation aid and competitiveness
Dependent variable: Member States' share in total extra-EU exports

Specification	(1)	(2)	(3)	(4)
internationalisation aid	0.024 ***	0.020 ***	0.025 ***	0.022 ***
	(0.005)	(0.006)	(0.008)	(0.006)
internationalisation aid²	-0.001	-0.001	0.000	-0.001
	(0.001)	(0.002)	(0.001)	(0.001)
loans to GDP	0.071			
	(0.072)			
loans to GDP²	-0.269 ***			
	(0.033)			
loans to GDP * internationalisation aid	-0.009			
	(0.007)			
governance		0.437		
		(0.356)		
governance²		-0.105		
		(0.981)		
governance * internationalisation aid		0.142 ***		
		(0.017)		
wage share			0.179	
			(0.422)	
wage share²			2.224	
			(1.957)	
wage share * internationalisation aid			0.108 **	
			(0.045)	
tariff rate				0.071
				(0.040) *
tariff rate²				-0.026
				(0.030)
tariff rate * internationalisation aid				0.066 ***
				(0.012)
R^2	0.993	0.990	0.989	0.990
adjusted R^2	0.992	0.988	0.987	0.989
Observations	373	380	341	391

Note: Standard errors appear in parentheses. *, **, ***indicate statistical significance at the 1%; 5% and 10% level respectively. Regressions include country and year fixed effects as well as a constant term which are not reported. The standard errors are robust. All the data was logarithmised (observations of the value zero were changed to 0.01 in order to make the taking of logarithms possible) and centred in order to make the estimated coefficients interpretable.

Source: WIOD, European Union State Aid Scoreboard, Eurostat, UNCTAD-TRAINS, World Bank's Worldwide Governance Indicators (WGI) database.

As shown in Table 4, the main effect of commerce, export and internationalisation aid (henceforth 'internationalisation aid') is positive and significant at the 1% level throughout all the four presented specifications (1)-(4). Using specification (2) as an example, the interpretation of the results obtained is the following. If the average EU country (with respect to average government effectiveness) doubles its internationalisation aid, its share in total extra-EU manufacturing exports would increase by 2% (these are not percentage points though). Although this effect appears to be tiny, given the generally very low levels of internationalisation aid, the result is not negligible. In recent years the average annual internationalisation aid expenditure by Member States has been at about EUR 10 million only. The other positive and significant result in this specification is the interaction term between internationalisation aid and the governance effectiveness rank. This implies that for instance Finland, which has the highest rank of governance effectiveness in the sample, would increase its export share by 5% in the case of a doubling of internationalisation aid. On the other side, the country with the lowest governance effectiveness rank in 2011, Romania, would see its export share shrink by almost 6% after a doubling of state internationalisation aid (for governance effectiveness ranks of Member States see Annex Table A.5). Hence in countries with a very low governance effectiveness rank such as Romania, Bulgaria, Greece or Italy, additional internationalisation aid might actually be counterproductive and measures to improve general governance of much higher priority.

Regarding additional interaction effects, more internationalisation aid is correlated with even higher export shares in countries with a higher level of domestic competition (i.e. a higher wage share or, in other words, a smaller profit share, such as in the Nordic and core EU countries), as can be seen from specification (3). Finally, countries with both more internationalisation aid as well as more tariff protection have on average also higher extra-EU export shares (see specification (4)). Also the effects of sectoral state aid that directly targets the manufacturing sector were analysed. The EU average for this aid category was oscillating between some EUR 120 million and EUR 20 million between 2007 and 2011. In none of the estimated specifications did the conditional main effect of manufacturing aid appear to be significantly different from zero (see Table A.7). However, countries with a governance rank above average can gain in export shares when increasing manufacturing aid spending. Countries with a wage share above average are in fact losing export shares when raising sectoral aid for manufacturing. Hence this type of aid is an option for countries that lack competition.

Box 3

Categories of state aid in the European Union

Non-crisis state aid granted by the Member States to industry and services broadly splits into two types: horizontal and sectoral state aid.

The concept of horizontal aid, which is aid that is not granted to specific sectors of the economy, derives from the Treaty. It leaves room for the Commission to make policy choices whereby state aid can be considered compatible with the internal market if it provides effective support for common policy objectives. Most prominent is aid earmarked for research, development and innovation, safeguarding the environment, and fostering energy saving and promoting the use of renewable energy sources; those categories are followed by regional development, aid to SMEs, job creation and the promotion of training (European Commission, 2012b).

Research, development and innovation: R&D&I has been placed at the heart of the Europe 2020 Strategy as one of its flagship initiatives because of its potential to contribute to strengthening the competitiveness of the EU economy and to ensure sustainable growth, with a target of spending 3% of EU GDP on R&D by 2020.

Environmental protection: State aid in that area can include aid measures, such as to support energy saving and waste management or to improve production processes, that pursue a direct benefit to the environment.

Regional development and cohesion: The aim of regional aid is to develop the economic, social and territorial cohesion of a Member State and of the EU as a whole. The Commission encourages Member States to grant regional aid on the basis of multi-sectoral schemes which form part of a national regional policy.

Commerce, export and internationalisation aid: This is a less used measure that however showed some importance in the quantitative analysis. It consists of a number of different aid measures such as the promotion of brand image or sales networks but also officially supported export credit to the extent that they contain an aid element.

State aid earmarked for specific sectors, or sectoral aid includes a number of measures targeting for instance: Rescue and restructuring of firms in difficulty; Shipbuilding; Steel industry; Coal; Land transport; Maritime transport; Aviation; Agriculture; Fisheries and aquaculture.

These first results suggest that most types of state aid are not capable of increasing the average EU Member State's export share. Internationalisation aid is a notable exception in this respect. Moreover, the export share improving effectiveness of state aid items in most cases depends on a high level of governance effectiveness in the respective EU Member State. In this respect R&D aid seems to be an exception. Higher export shares are correlated with both, low governance effectiveness and high R&D aid spending. Interaction results between various aid items and domestic competition measured by the wage share in value added as well as trade protection measured by the import weighted average tariff rate are mixed. In some cases a larger wage share and higher tariffs seem to be supportive (e.g. internationalisation aid) while in other cases the opposite holds true (e.g. total horizontal aid). In the case of state aid directly targeting the manufacturing sector, the average EU Member State cannot gain in export shares from increasing spending. This is only possible in cases where at the same time government effectiveness is above average and domestic competition is below average, with high profit and low wage shares in value added.

3.2.2 Value added per capita

In a second attempt the methodology put forward in Haraguchi and Rezonja (2011) and earlier, similar work is applied to the provision of state aid by EU Member States. The aim here is to better specify the relationship by adding more control variables and to test for the determinants of the single manufacturing industries' importance separately with the help of a model that tries to explain the real value added per capita of the respective manufacturing sector.

Table 5

State aid and value added per capita – export orientated industries
Dependent variable: manufacturing value added per capita of export industries

Specification	(1)	(2)	(3)	(4)
per capita GDP	1.537 ***	1.455 ***	1.343 ***	1.615 ***
	(0.206)	(0.191)	(0.199)	(0.182)
per capita GDP²	0.443 ***	0.483 ***	0.458 ***	0.491 ***
	(0.086)	(0.090)	(0.083)	(0.087)
population density	-4.376 ***	-4.305 ***	-5.095 ***	-4.416 ***
	(1.026)	(1.030)	(0.949)	(0.981)
resource endowment	-0.006	0.008	-0.035	0.003 ***
	(0.046)	(0.047)	(0.041)	(0.047)
energy saving aid	0.009			
	(0.008)			
regional aid		0.023 ***		
		(0.007)		
risk capital aid			-0.027 ***	
			(0.005)	
training aid				0.008 *
				(0.004)
R²	0.969	0.969	0.972	0.969
adjusted R²	0.964	0.964	0.968	0.964
Observations	286	286	286	286

Note: Standard errors appear in parentheses. *, **, ***indicate statistical significance at the 1%; 5% and 10% level respectively. Regressions include country and year fixed effects as well as a constant term which are not reported. The standard errors are robust.

Source: European Union State Aid Scoreboard, Eurostat, UN Comtrade.

Table 6

State aid and value added per capita – domestically orientated industries
Dependent variable: manufacturing value added per capita of domestic industries

Specification	(1)	(2)	(3)	(4)
per capita GDP	0.773 ***	0.779 ***	0.831 ***	0.848 ***
	(0.113)	(0.118)	(0.127)	(0.105)
per capita GDP²	-0.225 ***	-0.202 ***	-0.212 ***	-0.186 ***
	(0.054)	(0.053)	(0.051)	(0.054)
population density	-1.694 ***	-1.701 ***	-1.720 ***	-1.738 ***
	(0.399)	(0.388)	(0.437)	(0.373)
resource endowment	-0.007 ***	-0.007	-0.013	-0.002
	(0.029)	(0.028)	(0.027)	(0.030)
energy saving aid	0.009 **			
	(0.005)			
regional aid		0.008		
		(0.006)		
risk capital aid			0.001	
			(0.004)	
training aid				0.006 **
				(0.002)
R²	0.979	0.978	0.978	0.979
adjusted R²	0.975	0.975	0.974	0.975
Observations	286	286	286	286

Note: Standard errors appear in parentheses. *, **, ***indicate statistical significance at the 1%; 5% and 10% level respectively. Regressions include country and year fixed effects as well as a constant term which are not reported. The standard errors are robust.

Source: European Union State Aid Scoreboard, Eurostat, UN Comtrade.

Explanatory variables are the per capita gross domestic product, population density and natural resource endowment as well as different types of state aid per capita. In order to check for robustness of the estimated results, additional variables such as the private loans to GDP indicator have been included but the main results do not change very much. Moreover in the regression approach the individual manufacturing industries have been aggregated in two groups – export-oriented industries and industries focusing on the domestic market, based on an exportability measure.

The main findings are reported in Table 5 and Table 6. The level of export-oriented as well as domestically oriented manufacturing value added per capita is not affected by sector-specific manufacturing aid.

It is rather a few categories of horizontal aid that show signs of correlation[34], but different ones for the two subgroups of manufacturing sectors. For the export-oriented manufacturing sector (Table 5) specifically regional aid is positively correlated with the value added level. Somewhat surprisingly, risk capital aid rather targets those economies that have lower levels of per capita export-oriented value added. These aid categories are not significant in the case of the domestically oriented manufacturing sector (Table 6). Here, increased spending on environment and energy saving aid as well as training aid is correlated with a higher level of value added per capita. One explanation might be that regional aid is more likely to be absorbed by large, internationally operating firms, while environment and energy saving aid can more easily be absorbed by domestically operating smaller firms.

3.2.3 Real growth

The third approach to test for the effects of state aid on the internationally competitive manufacturing sector of the EU aims at explaining real value added growth. Here an equation that was inspired by related work on international aid, Dutch disease and deindustrialisation by Rajan and Subramanian (2011) is estimated. However, in the context of state aid granted by Member States, the aid expenditures are expected to have some positive effects. The average annual real growth rate of manufacturing value added by industry and country is being explained by the initial manufacturing share in order to control for convergence and, most importantly, an interaction term of state aid as a share of GDP and a manufacturing sector-specific exportability dummy variable. The aim of this is to check in what way public subsidies influence the growth of the export-oriented manufacturing sector in Europe.

The growth analysis has shown that horizontal aid is positively correlated with real value added growth among EU export-oriented manufacturing sectors during the 2000s (Table

[34] Results are shown for a selected number of horizontal aid categories.

7). Sectoral manufacturing aid did not prove to yield a significant result. Among the individual categories of aid within horizontal aid mixed results are found. While internationalisation aid as a share of GDP was spent a lot by countries with shrinking export industries, aid for environment and energy saving was spent mainly by countries with a booming export sector. Also due to the fact that the endogeneity problem could not be dealt with here, comments on causality cannot be made. Rather the situation during the 2000s is described.

Table 7

State aid and value added growth
Dependent variable: average manufacturing real value added growth, 2000-2010

Specification	**(1)**	**(2)**	**(3)**	**(4)**
initial share of industry	-0.367 ***	-0.304 ***	-0.359 ***	-0.295 ***
	(0.079)	(0.071)	(0.077)	(0.071)
horizontal aid	17.944 ***			
	(5.872)			
internationalisation aid		-348.43 ***		
		(133.8)		
energy saving aid			28.606 ***	
			(9.172)	
SME aid				-48.079 *
				(25.65)
R^2	0.513	0.492	0.531	0.487
adjusted R^2	0.439	0.414	0.460	0.408
Observations	243	243	243	243

Note: Standard errors appear in parentheses. *, **, ***indicate statistical significance at the 1%; 5% and 10% level respectively. Regressions include country and industry fixed effects as well as a constant term which are not reported. Internationalisation aid is aid for commercialisation,

Source: European Union State Aid Scoreboard, Eurostat, UN Comtrade.

3.2.4 Conclusion

The main findings of the tripartite analysis of state aid and export-oriented manufacturing are the following. Regarding extra-EU manufacturing export shares of Member States, internationalisation aid appears to be one of the few support items that has a positive main conditional effect. However, in the case of internationalisation aid as well as sectoral manufacturing aid, a positive interaction effect with governance effectiveness is found. Thus for a number of countries with very low ranks of government effectiveness, internationalisation aid or sectoral aid to manufacturing might actually be counter-productive. Nevertheless there is also a group of countries with high export shares, high R&D aid spending but also with low levels of governance effectiveness. Thus there are different strategies towards higher extra-EU export shares depending on institutional conditions.

With regard to the per capita levels of the export-oriented manufacturing sector in the EU-27 countries, one can observe that economies with large sectors have specialised in regional aid activities while those with small sectors rather invest in risk capital aid in order to boost the size of their export industries. Similarly there are also different strategies among Member States with booming export-oriented manufacturing sectors and those that experienced a slump. In terms of real value added growth of export industries one can see that environment and energy saving aid as a share in GDP was spent a lot by Member States whose export industries were rapidly growing during the 2000s and internationalisation aid was rather spent by Member States with a lot of shrinking export-oriented manufacturing industries. Both, in terms of value added level as well as growth, sectoral manufacturing aid did not yield any significant results.

3.3 Support for R&D – Making public R&D funding more effective

Innovation has been placed at the heart of the Europe 2020 agenda as one of the main drivers of economic growth. In a globalised world, innovative ideas and products stimulate exports and sales in general, thereby securing growth and future jobs (Harrison et al., 2008). As the EU-27 is still behind other major economies when looking at simple innovation indicators such as overall R&D expenditures, the impact of innovation policies on firms' innovative behaviour has been a major concern of policy-makers.

A fertile environment for innovative activities is characterised by a number of preconditions, such as a good business environment, sound institutional background, strong legislation and execution of intellectual property rights, a good quality of tertiary education and sufficient human resources in the respective research field. While these critical success factors are an essential part of each innovation system, another main component consists of financial innovation factors. Substantial financial resources are a prerequisite for the success of an innovation project and the predominant factor of failure (Rubenstein et al., 1976; Page, 1993; Canepa and Stoneman, 2008). Acquiring external funding for R&D is harder and usually more costly compared to ordinary investment. The reasons are capital market imperfections resulting from asymmetric information and moral hazard problems: investors are usually much more in the dark and their ability to judge the progress and prospect of innovation projects is rather limited in comparison with conventional projects (Arrow, 1962; Myers and Majluf, 1984). The high cost of external capital due to this lemon's premium for R&D projects makes internal funds preferable over external sources of finance (Himmelberg and Petersen, 1994). As a result, around 87% of firms finance innovation projects with internal funds (Spielkamp and Rammer, 2009).

If an innovation is successful, a further problem arises as the innovating firm is unable to appropriate all the benefits of its R&D efforts. Labour mobility and other factors are responsible for the diffusion of knowledge, which makes it again less attractive to invest in R&D. Given the existence of such market failures, public intervention is essential to overcome the resulting underinvestment in innovative activity.

In order to foster innovation, many studies have pointed out the importance to support small and start-up firms (see Hall and Lerner, 2009 for a literature overview). Due to their very limited internal funds, they have to rely more on external funding than their larger competitors, which gives them a comparative disadvantage. Especially 'small and start-up firms in R&D-intensive industries face a higher cost of capital than their larger competitors' (Hall, 2002; Canepa and Stoneman, 2008).

The way countries deal with these external funding problems of firms still differs greatly across countries in the EU. Venture capitalists are more active in Scandinavian and Anglo-Saxon countries and public funding is on average more pronounced in EU-15 countries compared to the EU-12 countries. When looking at the different settings, an essential question that arises is about the effectiveness of public innovation support. In this section, the effects of public innovation support will be evaluated and the investigation will show whether there is evidence for crowding out of private R&D investment.

Box 4

The four step matching procedure

1. Restriction of the sample to the innovative firms of interest: either all innovative firms, or a subsample of firms with respect to size, country or industry affiliation
2. Estimation of probability of a firm to receive public funding depending on the following observable characteristics: size based on employment and turnover, country and industry affiliation, exporter status, a dummy for multinationals and domestic enterprise groups as well as information on R&D cooperations and preconditions for R&D (estimated at a previous stage)
3. Matching of firms that receive public support with firms that have a similar probability of getting public funds but do not receive them. Firms are only matched with other firms in the same country and employment size class (small: less than 50 employees, medium: between 50 and 250, large: more than 250). Firms that have no similar counterpart are excluded from the sample using a threshold for the maximum allowed difference.
4. The average treatment effect can now be calculated as the mean difference of the matched samples.

To that end, the effect of public funding on the R&D intensity and innovation output is estimated, using data from the Community Innovation Survey (CIS)[35]. Innovation output will be measured in terms of innovative sales and patent applications.

A major problem that the analysis faces is a possible selection bias. Neither the fact that a firm applies for funding nor the fact that it receives public support can be considered random. Firms receiving public support are, for example, more often exporting firms, which are

[35] Following to the Community Innovation Survey, public funding or public innovation support is defined as credits or deductions, grants, subsidised loans, and loan guarantees for innovative activities. The support may come from three authorities: the EU, national governments and regional authorities.

likely to be more productive as well. Moreover, firms in higher-tech industries and those participating in R&D cooperations are more often supported as well as firms which are larger in terms of turnover. Thus, selection clearly has to be taken into account to be able to produce credible results.

In the analysis, matching techniques are applied to control for this selection bias. According to a number of observable characteristics, each firm that receives public support is matched with a firm that does not. The two groups – the treatment group, i.e. those firms that do receive public support, and the control group – should then be similar according to the considered observable characteristics.

Hence, one can then estimate the treatment effect on firms that receive public support. The complete procedure is an extended version of the one found in Czarnitzki and Lopes-Bento (2013) and is explained in Box 4. The results shown in Table 8 to Table 10 indicate that for the full sample, public funding has considerable effects on the R&D input as well as output. The average R&D intensity in the treatment group is 1.6% higher than in the control group (Table 8). The probability of firms to apply for a patent (patent application propensity) increases by 8.4% through public funding (Table 9) and the share of innovative sales is on average 3.1% higher for firms that received public funding (Table 10).

Table 8

R&D intensity

R&D intensity	Treated	Control	Difference	T-stat
All firms	0.033	0.017	0.016	13.46 ***
EU-15 firms	0.035	0.018	0.017	13.23 ***
EU-12 firms (CIS4)	0.024	0.013	0.011	3.81 ***
EU-12 firms (CIS5)	0.024	0.012	0.013	4.48 ***
Small	0.041	0.019	0.022	10.25 ***
Medium	0.027	0.014	0.014	7.69 ***
Large	0.029	0.019	0.010	4.66 ***
High-tech	0.069	0.036	0.033	6.27 ***
Medium-high-tech	0.041	0.025	0.016	5.97 ***
Medium-low-tech	0.019	0.011	0.009	4.41 ***
Low-tech	0.020	0.013	0.007	3.22 ***
Food processing	0.015	0.006	0.008	2.23 **

Note: The stratified sample overall contains all CIS4 EU-27 countries; the number of treated firms in each sample is: full sample: 5152, EU-15: 4338, EU-12: 814 (CIS4), 954 (CIS5), Small: 2090, Medium: 1827, Large: 1235, Domestic enterprise groups: 1580, Foreign enterprise groups: 411, High-tech 633 firms, Medium-high-tech: 1447, Medium-low-tech: 1131, Low-tech: 902, Food processing: 441. ***, ** and * denote tests being significant at a 1, 5 and 10% level, respectively.

Looking in more detail at geographic aspects, one is able to observe that the R&D intensity as well as the patent application propensity of EU-15 firms is way above the one of EU-12 firms. The difference in the patent application propensity is also not an effect originating from the firm size distributions as firms in the matched sample are on average larger in the

EU-12 and thus should have a higher patent application propensity. However, public funding has had a significantly positive effect in both country groups. The effects are quite different for the other innovation output measure – the share of innovative sales. This share is overall found to be larger in the EU-12 due to faster product upgrading, but the results indicate no effect of public funding on the commercialisation phase in this region. This finding is also rather stable over time when looking at different measurement waves (CIS4 and CIS5).

Table 9

Patent application propensity

Patent application propensity	Treated	Control	Difference	T-stat
All firms	0.303	0.219	0.084	7.54 ***
EU-15 firms	0.323	0.234	0.089	7.03 ***
EU-12 firms (CIS4)	0.192	0.138	0.054	2.62 ***
EU-12 firms (CIS5)	0.158	0.108	0.050	3.00 ***
Small	0.193	0.128	0.066	4.59 ***
Medium	0.284	0.201	0.082	4.62 ***
Large	0.516	0.399	0.117	4.09 ***
High-tech	0.404	0.288	0.117	3.38 ***
Medium-high-tech	0.435	0.317	0.117	5.08 ***
Medium-low-tech	0.249	0.195	0.055	2.55 **
Low-tech	0.121	0.127	-0.007	-0.35
Food processing	0.163	0.091	0.073	2.51 **

Note: The stratified sample overall contains all CIS4 EU-27 countries; the number of treated firms in each sample is: full sample: 5152, EU-15: 4338, EU-12: 814 (CIS4), 954 (CIS5), Small: 2090, Medium: 1827, Large: 1235, Domestic enterprise groups: 1580, Foreign enterprise groups: 411, High-tech 633 firms, Medium-high-tech: 1447, Medium-low-tech: 1131, Low-tech: 902, Food processing: 441. ***, ** and * denote tests being significant at a 1, 5 and 10% level, respectively.

Table 10

Share of innovative sales

Share of innovative sales	Treated	Control	Difference	T-stat
All firms	0.232	0.201	0.031	4.11 ***
EU-15 firms	0.222	0.188	0.033	4.04 ***
EU-12 firms (CIS4)	0.288	0.269	0.019	1.09
EU-12 firms (CIS5)	0.285	0.277	0.009	0.57
Small	0.225	0.198	0.027	2.19 **
Medium	0.233	0.190	0.042	3.55 ***
Large	0.244	0.222	0.022	1.37
High-tech	0.336	0.249	0.087	3.84 ***
Medium-high-tech	0.261	0.220	0.041	3.04 ***
Medium-low-tech	0.178	0.166	0.012	0.83
Low-tech	0.200	0.190	0.010	0.60
Food processing	0.173	0.149	0.024	0.92

Note: The stratified sample overall contains all CIS4 EU-27 countries; the number of treated firms in each sample is: full sample: 5152, EU-15: 4338, EU-12: 814 (CIS4), 954 (CIS5), Small: 2090, Medium: 1827, Large: 1235, Domestic enterprise groups: 1580, Foreign enterprise groups: 411, High-tech 633 firms, Medium-high-tech: 1447, Medium-low-tech: 1131, Low-tech: 902, Food processing: 441. ***, ** and * denote tests being significant at a 1, 5 and 10% level, respectively.

Source: Community Innovation Survey (CIS), waves 4 and 5, wiiw estimations.

These results suggest that there is potential to improve the targeting of public support in the EU-12 and to make it more effective. Especially in the EU-12, and irrespective of the actual objectives of the support programmes, de facto governments end up providing innovation support more often to larger firms than to their smaller competitors. Given the substantial evidence that especially small firms face considerable financial problems due to asymmetric information problems, they should be the primary target of public funds.

In order to increase support of small firms, a special targeting of the grants is one possibility to improve the allocation of public funds – other initiatives could include information campaigns about credits, deductions and subsidised loans for new entrepreneurs. As problems lie mainly in the commercialisation phase, fostering venture capital investment would be another starting point.

Interesting results also emerge from the investigation of effects along the dimension of firm size. Very pronounced effects of public support on R&D input as well as output can be found for small firms and medium-sized enterprises (SMEs). SMEs usually lack sufficient internal funds and thus supporting them is vital in order to have a competitive market with strong entrants that are able to fill world market niches and produce innovative products. Effects on patent application rates are especially pronounced for larger firms. At the same time, no significant effect of public support on the share of innovative sales can be found for large firms. One reason for this finding is that large firms often split research and production facilities geographically and thus output affects may be generated in other subsidiaries.

The most striking results were obtained with respect to the industry affiliation of firms. On the one hand, the analysis shows that especially innovation projects in higher-tech industries benefit strongly from public funding. This can be seen from the significant and large effects on both the patent application propensity and the share of innovative sales.

Publicly funded firms in high- and medium-high-tech industries exhibit an 8.7 and 4.1 percentage points higher increase in the share of innovative sales, respectively and an 11.7 percentage points higher application rate for patents.

On the other hand, the results indicate strong crowding out effects of public funding in lower-tech industries, especially with respect to innovation output measures. The finding is not an effect of lower-tech EU-12 firms, which overall exhibit no significant effects of public funds on the share of innovative sales, but can be found for lower-tech EU-15 firms as well. A possible explanation for this result is that innovation projects in these industries take place in an environment which is changing less rapidly than the one of high-tech industries. Thus, there is on average less risk and asymmetric information attached to innovation projects in low-tech industries. Banks and other financial intermediaries can thus better evaluate them. Innovation market failures are therefore expected to be less pronounced in traditional industries and thus there is also less need for public funding. This is especially true for larger firms, which can either rely on internal funding or have easier access to external funding e.g. from banks. The finding also indicates that the increased innovation support via the Rural Development Policy, which is part of the European Common Agricultural Policy, has no or very small effects on innovation output.[36] It might thus be more desirable to reallocate these innovation funds to a broader support of competitiveness, as it is planned in the budget for the period 2014-2020.

3.4 Initial vocational training and the importance of medium-skilled labour for European manufacturing

Manufactures are highly tradable and international competition has become increasingly fierce. For regions with high wage levels such as the EU this implies that it becomes increasingly difficult for Member States to compete successfully in international markets solely on the basis of prices – even if the higher wages are related to higher labour productivity. Hence, there is a need for product differentiation and quality upgrading. Nevertheless, high wages must still be supported by high productivity, and essential determinants for labour productivity are the skills and capabilities of the workforce.

Investment in skills is also relevant in the context of globalisation and offshoring which feature among the main concerns in the recent literature on industrial policy (Naudé, 2010a; Naudé, 2010b; Warwick, 2013). According to the new economic geography literature, firms in high-wage countries will locate production in a low-wage country if the differences in production costs outweigh the potential agglomeration externalities at home (Mayer, 2004). Production is kept in the home country as long as labour productivity at home is sufficiently high for compensating the wage advantage of low-wage destinations. Hence, high-wage countries may remain attractive locations for production in a series of industries if they manage to compensate or over-compensate higher wage costs by higher labour productivity[37].

For this trade-off between wages and productivity, which governs the location decision of a firm that considers offshoring its production facilities (or parts thereof), the source of the differences in the labour productivity between the home country and the potential offshore location is important. If high labour productivity is the result of advanced technology and high capital intensity, firms may still find the offshoring option attractive because they have

[36] 'Food processing' was analysed separately, as firms in this industry exhibit by far the highest support rate with respect to EU funds.

[37] A particularity of the offshoring debate in the EU is that most of the offshoring activity takes place between Member States and hence that Member States take the position of both offshoring and destination country. The general offshoring pattern in the EU is that firms from the EU-15 offshore labour-intensive parts of production to Central and Eastern European Member States due to lower labour costs there.

access to their own technology irrespective of the location of production. What may make a difference are the above-mentioned agglomeration externalities and above all the skills and capabilities of the local workforce that cannot be transferred to the offshore destination.

Therefore a well-trained (medium-skilled) workforce in high-wage countries is also highly relevant with regards to production location. As a consequence, if one assumes that EU Member States are interested in attracting some production activity in order to maintain a manufacturing base and keep the industrial commons intact, the skills embodied in people become even more essential. Investment in skills and capabilities should start as early as possible in the working life of people. This attributes great importance to initial vocational training, i.e. the training of workers at the beginning of their professional career. Ideally, firms engage in the training of young people. This approach has several advantages (see also Box 5).

Box 5

The dual system in Germany

An essential feature of vocational education and training in Germany is the so-called dual system. Under the dual system the initial vocational training takes place at two different places, a company and a vocational school. Typically, the initial vocational training period under the dual system is three years (Hippach-Schneider et al., 2007) and young people can start their training immediately after completion of compulsory education with no additional requirements. Trainees learning under the dual system enter a private-law vocational training contract (Lehrlingsvertrag) with a company. The actual training takes place mainly in that company where trainees typically spend 3-4 days per week but supplemented with 1-2 days training at a part-time vocational school (Hippach-Schneider et al., 2007). The in-company training of apprentices is monitored by the relevant autonomous industrial bodies (Chambers). These bodies also control the quality and suitability of enterprises and the training personnel. Upon completion of the vocational training course, trainees have to pass an examination (Lehrabschlussprüfung) and receive their certificate.

The dual system is an institutional arrangement the primary function of which is to guarantee the supply of well-trained skilled workers. Binding requirements in the training directives by the Federal Government ensure a uniform standard concerning the training quality. As a consequence people completing an initial vocational training programme for one of the 344 training occupations have the necessary qualifications and competences to practise an occupation as a skilled worker (Facharbeiter). The German government actively supports the in-company training of young people in the framework of the dual system. This means that the government aims at increasing the supply of training places. Examples are the Federal Ministry of Education and Research's 'Jobstarter' Programme which supplements the 'apprenticeship pact' of 2004 between the Federal Government and the employers' association of German industry[38] (Hippach-Schneider et al., 2007).

It is often argued that the German vocational training system for skilled workers is one of the major strong points in Germany's industrial policy that to a large extent takes the form of Ordnungspolitik,

[38] Nationaler Pakt für Ausbildung und Fachkräftenachwuchs in Deutschland.

the German variant of general framework polices. The fact that skilled workers are to a large extent trained within companies means that workers from the very beginning of their vocational training gain practical on-the-job experience but at the same time they also receive formal education at vocational schools. Since the cost for vocational training has to be borne by the companies themselves (with public incentives for offering vocational training or disincentives for companies not doing so) the investment in skilled workers in the dual system is also more likely to be aligned with demand in industries. This is because firms in declining industries with no need for additional personnel are less likely to offer initial training places. The fact that the in-company training takes place in a framework of well-defined qualification criteria and that actual training is also monitored ensures that trainees receive high-quality education and training. Another advantage of the dual system is that young people learning in companies acquire highly specialised skills needed in the particular company with which they have their training contract. This specialised knowledge is important in industries that build on incremental (and partly non-codified) in-house knowledge such as the automobile or the machinery industry (Bock-Schappelwein et al., 2013).

Figure 9

Relationship between initial vocational training and relative wages of medium-skilled workers

Note: The share of firms providing initial vocational training includes firms with 10 employees or more. Wage data in 2010. Data for initial vocational training is the average of 2005 and 2010. Wage ratio of medium-skilled workers is the ratio between wages (gross earnings) of workers in ISCED groups 3 and 4 and average wages in the respective Member State. Data for Greece not available.

Source: Eurostat, wiiw calculations.

First of all, it increases the probability that the training is in line with the skills demanded in the economy. This is because expanding firms are more likely to take on apprentices. Secondly, in-company training is more practically orientated and in many cases also more specific. This latter aspect is important for firms producing in niches and industries with incremental technological progress. This is an argument in favour of in-company vocational training.

Interestingly, in a European context there is indeed a positive correlation between the share of firms that provide initial vocational training and the wage of medium-skilled workers relative to the country average (Figure 9)[39]. In general, firm participation in initial vocation training is much higher in the EU-15 than the EU-12 and it is mainly the former group of countries where a positive relationship of in-company training on relative wages of medium-skilled workers is observable. With close to 50% of firms providing initial vocational training, this share is highest in Germany and Austria which both have long-established in-company vocational training programmes (the 'dual system').

This is an important aspect for two reasons. First of all, to the extent that higher wages of medium-skilled workers reflect higher productivity, the engagement of firms in initial vocation training may indeed support labour productivity. Second, it also means that practically-oriented institutionalised initial vocational training systems and the resulting supply of medium-skilled workers[40] does not lead to lower wages of this group of workers.

The medium-skilled segment of the workforce has a particular relevance for the manufacturing sector. Importantly, to the extent that high wages of medium-skilled labour reflect high productivity, the higher wage costs need not necessarily have a detrimental effect on the competitiveness of the manufacturing sector. Table 11 examines the relationship between changes in the value added share of the manufacturing sector (2002-2011) in EU Member States and the relative wages of workers with different educational attainment, controlling for the general wage level and the initial share of manufacturing. The regressions are run separately for the educational attainment levels[41].

A first result is that the wage level is negatively correlated with the value added share of manufacturing. This negative coefficient is found across the regressions for the different educational groups and reflects the fact that several EU-12 countries still have low wage levels in an EU comparison but were successfully building up manufacturing capacity.

The negative coefficient of the general wage level is also in line with various theories of offshoring (e.g. Grossman and Rossi-Hansberg, 2008; Baldwin and Robert-Nicoud, 2010), reflecting a situation where the trade-off between efficiency gains from lower wage costs in offshore destinations and coordination costs of offshoring leads to the offshoring of a sub-

39 Workers completing initial vocational training programmes are classified as medium-skilled workers which correspond to groups 3 and 4 in the International Standard Classification of Education ISCED (upper secondary and post-secondary but non-tertiary education).

40 For example, in Germany as well as in Austria, the share of medium-skilled workers in the total workforce (59% and 64% respectively in 2011) is higher than the EU-27 average.

41 Educational attainment levels according to the International Standard Classification of Education (ISCED).

set of tasks. The result would fit the general intra-EU pattern, i.e. firms from the EU-15 off-shoring parts of manufacturing production to Central and Eastern European Member States thereby benefitting from lower labour costs[42]. That would imply that generally in the EU-27, countries with a higher wage level experienced a stronger shift out of manufacturing, despite some notable exceptions.

The most interesting results are the large variance in the coefficients of the wage ratio (the wages of the respective group of workers relative to the general wage level) across the educational groups and the coefficients of the interaction terms between the country-level wage and the relative wages of the educational groups. High relative wages of the two low-skill groups are negatively correlated with the value added share of manufacturing in a country. In contrast, the opposite result is found for medium-skilled workers. This result can be interpreted as indicating that higher wages of medium-skilled workers do not impede the expansion of the manufacturing sector. A general explanation for that result would be that relatively high wages of medium-skilled workers can be matched by labour productivity. In this constellation, high wages paid to medium-skilled workers do not impede a country to maintain a competitive manufacturing sector but could actually support the expansion of the manufacturing sector[43]. This is in line with the suggestion that high-wage countries are well advised to take the ‘high road’ to international competitiveness in manufacturing (see e.g. Helper et al., 2012) which implies specialisation in advanced manufacturing that require specific and sophisticated skills and capabilities.

Interpreting the result in the context of offshoring, the positive coefficient of the wage ratio of medium-skilled workers would indicate that the trade-off between wage differentials across countries and coordination costs is such that firms find it more profitable to not off-shore the tasks performed by medium-skilled workers.

The fact that relatively high wages of medium-skilled workers are positively correlated with changes in the value added share of the manufacturing sector in EU Member States but the opposite is true for low-skilled workers could indicate that the wage-to-productivity ratio is more competitive (i.e. lower) in the medium-skilled than in the low-skilled segment of workers. This could indicate that the potential to match higher wages with higher productivity is smaller in the segment of low-skilled worker[44].

42 Certainly, there are other explanations for the negative correlation between the value added share of the manufacturing sector and the wage level, apart from offshoring. One of them is the generally high income elasticity of services as discussed in Section 2.

43 This is also true for the group of workers with first stage of tertiary education, programmes which are practically oriented and occupationally specific (ISCED 5B). While these are obviously not trainees this group has by definition enjoyed practically-oriented and occupation-specific education. The effect for this group is positive but smaller in magnitude than that for the medium skilled workers.

44 Institutional factors such as the wage bargaining process may be relevant for the ratio between wages and productivity across different types of workers.

Finally, the coefficient of the interaction term between relative wages and the general wage level is positive for the group of the medium-skilled workers (but not for the low-skilled workers). This suggests that the higher the general wage level in a country, the stronger is the positive correlation between relatively high wages of the medium-skilled workers and the change in the value added share of manufacturing. In other words, in particular high-wage countries need a specialisation in skill-intensive manufacturing (which typically goes hand in hand with capital intensity) and investment in the supply of skilled workers. An initial vocational training system in which firms are actively integrated by providing in-house vocational training to young people is one of the approaches that could help achieve a high productivity level of medium-skilled workers. Incentives provided by the government to build such a vocational training system for the training of young people is an example of a soft industrial policy. It is a soft form of industrial policy because it does not require large sums of subsidies for particular firms or industries and hence does not impede free and fair competition.

Table 11

The effect of relative wages on changes of the manufacturing base

Dependent variable:	Change in the value added share of manufacturing between 2002 and 2011					
	ISCED levels 0 &1	ISCED level 2	ISCED levels 3 & 4	ISCED level 5A	ISCED level 5B	ISCED level 6
initial manufacturing share	-0.0606	-0.1218 *	-0.0716	-0.0738	-0.0785	-0.0984
	0.056	0.063	0.047	0.068	0.058	0.1
wage ratio	-11.3124 ***	-16.1105 ***	7.6757 *	1.4924	3.1630 *	-1.1824
	4.162	3.276	4.427	1.55	1.654	2.097
wage ratio x wage level	-0.9539 **	0.0517	2.4746 ***	0.0046	0.4743 **	-0.1555
	0.399	0.539	0.732	0.213	0.218	0.214
wage level	-0.1884 ***	-0.1056 ***	-0.0830 *	-0.1068 *	-0.1152 **	-0.2454 *
	0.055	0.038	0.046	0.058	0.049	0.131
constant	-1.7436	-0.1897	-1.4603	-1.2703	-1.0180	-2.0528
	1.136	1.279	0.886	1.103	1.099	1.227
F	6.16	10.74	8.73	5.73	6.98	4.21
R^2	0.376	0.403	0.297	0.226	0.283	0.387
R^2-adj.	0.302	0.342	0.239	0.157	0.217	0.292
Obs.	39	44	53	50	48	31

Note: Wage data is from the LFS waves 2006 and 2010. Initial manufacturing share is the value added of manufacturing in 2002. Wage ratios are the wages (gross earnings) of the respective educational attainment group relative to the country average. Wage level is country level average wage normalised by the EU average. The educational attainment levels are defined as follows: levels 0-1=Pre-primary and primary education; level 2=Lower secondary or second stage of basic education; levels 3-4=Upper secondary and post-secondary non-tertiary education; level 5A=First stage of tertiary education, programmes that are theoretically based/research preparatory or giving access to professions with high skills requirements; level 5B=First stage of tertiary education, programmes which are practically oriented and occupationally specific; level 6=Second stage of tertiary education leading to an advanced research qualification. The relative wage data is normalised to the sample average. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level, respectively.

Source: Eurostat, Eurostat Labour Force Survey (LFS), WIOD, wiiw calculations.

4. Conclusions – What kind of EU industrial policy to respond to the challenges for European manufacturing

4.1 Introduction

Industrial policy is designed to improve the growth process (in a quantitative and qualitative manner) through an impact upon economic structure (see also Pack and Saggi, 2006). This could be done by impacting economic structure in terms of the composition of activities or industries, or by influencing the directions in which technologies develop and also, within industries, by affecting the distribution of enterprises and plants showing different performance characteristics. There is also the influence which economic policy can have on the distribution of economic activity in geographic space and thus industrial policy has an interface with regional policy. The impact of industrial policy on economic activity may take place directly (e.g. through direct support of particular types of industries, firms, technologies) or indirectly (through framework conditions such as the way financial markets operate or the legal and administrative system or the quality of educational and training institutions).

The other goal – apart from growth – is external 'competitiveness', which means that industrial policy would pay particular attention to the development of the tradable sector (in all the dimensions mentioned above: composition of activities and industries; within-industry composition; technologies and product quality).

Furthermore, industrial policy has to be attentive to the different needs of countries and regions at different levels of economic development.

The challenges for EU manufacturing in its current phase are great, especially given the deep economic crisis which has affected the EU economy since 2008; the impact of this crisis has turned out to be greater than in other advanced economies which have used their policy space more efficiently than European policy-makers.

Apart from the challenges which emerged as a result of the financial and economic crisis, the analysis in this chapter has identified four major longer-term challenges for European manufacturing and thus for industrial policy:

(i) Preserve and develop the 'industrial commons' in Europe

(ii) Remain in the vanguard of economies that hold technological leadership at the global level and contribute to global challenges

(iii) Adjust to competitive pressures from emerging economies

(iv) Respond to the agglomeration tendencies of manufacturing activity in Europe

These challenges are discussed in turn.

4.2 The four longer-term challenges and the role of industrial policy

4.2.1 Preserve and develop the 'industrial commons' in Europe

In spite of longer-term trends in advanced economies of the manufacturing sector accounting for a shrinking share in value added and – even more so – in employment, there is a strong case for preserving a 'critical size' of manufacturing activities in European economies[45].

The arguments for such a 'critical size' are the following: firstly, manufacturing still accounts for a major part of innovation effort in advanced economies and this translates into above-average contributions to overall productivity growth and thus to real income growth. Secondly, manufacturing accounts in most European economies for a major share of the tradable sector and is thus important for Europe's position in international trade. Thirdly, there are very important 'backward linkages' from manufacturing to services which provide important inputs for manufacturing (in particular business services) and thus manufacturing has a 'carrier function' for services – which might otherwise be considered to have limited tradability – which in turn affects a country's global trading position. In the same direction goes the increased 'product bundling' of production and service activities in advanced manufacturing activities. This 'carrier function' – through international competitive pressure – has furthermore a stimulus effect for innovation and qualitative upgrading for service activities.

The maintenance of a competitive and diversified industrial base has been stated amongst others in the Europe 2020 strategy and the policy challenge could be seen as providing the right framework conditions and public inputs so that 'gaps' in the spectrum of industrial activities might not open up which could be deemed strategic in terms of the future development of industrial activity. 'Strategic' in this context means that such segments of industrial activity do or could (in future) exert important 'spillover effects' in terms of backward or forward learning processes in linked activities and also be providing important inputs for other activities which one might not want to entirely lose to imports. For these reasons – in combination with a good growth performance of the industry – the European Commission has recently announced an industrial policy strategy for electronics which are deemed essential nowadays for the whole industrial sector and the digital economy[46]. The policy initiative, which seems to have features of a sector-specific industrial policy, an innovation-orientated industrial policy and a cluster approach, envisages that the EU, Member States and regions should invest some EUR 5 billion in R&D and innovation for electronics. For decades the electronic industry has been the 'weak spot' among the advanced manufacturing industries of Member States. Nevertheless, also in electronics the EU excels in par-

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45 The distribution of such activity across the European space will be discussed under 4.2.4 below.

46 See speech by Commissioner Neelie at a press briefing on 23 May 2013.
See http://www.euractiv.com/specialreport-innovation-digital/eu-launches-industrial-strategy-news-519968.

ticular fields and is at the forefront in basic and applied research as evidenced by the electronic clusters in Dresden (Germany) and the cross-border cluster in Leuven-Eindhoven (Belgium/Netherlands).

Industrial policy at the EU level should ensure that Europe has a broad and diversified industrial structure which is well-equipped to be a major actor in the development of new areas of activity such as environmental technology. In this it is able to benefit from the diversified character of European industrial and demand structures and benefit from the pooling of resources. This encourages also innovations in existing areas in which Europe draws on its specific comparative advantages, be they based on traditions of production specialisation (fashion in France and Italy, high-quality mechanical engineering and transport equipment in Germany and in a number of the Central European economies, quality food production) or on a diversified pattern of private and public demand. The latter includes features of the 'European model' such as the strong position of public transport, of high-quality health services or linked medical devices and pharmaceuticals.

Furthermore, the preservation of the 'industrial commons' includes nurturing manufacturing-services inter-linkages and exploiting specialisation advantages of different European economies in this respect. State aid measures to support structural change and structural adjustment have so far been used predominantly at national levels and did not rely much on the coordinated use of state aid tools. In a highly integrated European economy, the preservation and development of 'industrial commons' should be seen as a joint responsibility because of strong externalities across the European economy. Such joint responsibility for 'industrial commons' includes rules for quality assurance and recognition of qualifications, supporting the mobility of skilled staff, learning from successful cluster policies, support for necessary transport and communications infrastructure.

Also in access to and development of external markets there can be quite strong economies of scale and scope which can be reaped through coordinated action at the European Union level. One of the important results in recent trade analysis is that there are significant entry barriers resulting from 'fixed costs' in international trade and internationalisation of production; this means that especially SMEs often are not able to reap the benefits of internationalisation. Reducing fixed costs involved in entering new markets, getting initial support in setting up production and marketing facilities there, strengthening the bargaining position with respect to local administrations would benefit particularly SMEs and allow widening the scope of internationalisation of European business. A well-tried instrument for external market access would be export risk guarantees and a fund for that purpose could be established at the European level. EU trade agencies could expand providing information and administrative support and specific European credit agencies could provide financing support to enter new markets or support complex, capital-intensive projects in difficult markets.

One of the robust results from the econometric research presented in Section 3.2 revealed the strong conditioning role which the 'quality of governance' has in leading to a beneficial or detrimental impact of various types of state aid instruments. EU policy has through its general policy of harmonising legal and administrative practice played an important role in encouraging the catching-up of countries in terms of quality of governance. The delegation of competition policy and the enforcement of Single Market rules at EU levels furthermore insert a top layer in enforcing certain administrative practices and thus contribute to positive results in the use of state aid tools.

It is important that conceptions of industrial policy support the 'structural change enhancing' rather than the 'structure preserving' side of industrial policies. So far the main push by EU competition policy has been to ensure that competition-distorting effects of state intervention are contained and put under strict control. As such interventions were mostly in support of well-entrenched incumbents, EU competition policy took on an important role to reduce the power of incumbents. However, industrial policy should go beyond that and play an active role in reducing entry barriers in four directions: supporting new firms, developing and marketing new products, moving into new markets or market niches.

The discussion of features of industrial policy in the United States (Box 2) has provided some lessons that can be drawn for European industrial policy. First of all, like in the US, the funding of collaborative research ranks high in the priority list of the EU's industrial policy (e.g. in the context of Framework Projects) and the cumulated support for R&D provided by Member States and EU institutions is at least comparable to those of the US. What seems to be lacking in the EU's R&D-oriented industrial policy is a sufficiently clear targeting of promising technology fields. Foresight studies tend to regard this lack of focus as a serious shortcoming of European science and technology policy and suggest a new 'airbus strategy' (European Commission, 2006) that supports developing technological leadership positions in key industries. Hence, a more targeted and focused R&D policy with a long-term public commitment is needed.

The second shortcoming of the EU's industrial policy is the neglect of demand-side industrial policy as an instrument to stimulate the commercialisation of innovation. There is a broad consensus that the existing gap between European research excellence and the development of marketable products is a major weak spot in Member States' innovation systems. The US military-related public procurement policy may serve as an example of how to remedy this shortcoming. As pointed out above, public procurement can provide the necessary incentive to invest in the development of marketable products. Such a public procurement strategy needs to be linked to the long-term R&D policy commitments described above. An essential requirement for such a long-term commitment is that the public funds invested in such research and the public money spent on government contracts serve a commonly accepted societal objective leading to broader welfare gains. In the US, for a long time this was the provision of a public good, i.e. national defence. Given the strong political commitment of the EU to environmental protection and the mitigation of climate change, a long-term industrial policy targeted at the development of 'clean' products and technologies could well form the base for a major industrial policy initiative. Importantly, such a strategy should not only include a long-term funding commitment for research but also needs a reliable source of demand that should be provided by public procurement of EU Member States and the EU itself.

The industrial policy strategy laid out in the European Commission's Industrial Policy Communication from October 2012 (European Commission, 2012a) seems to go in this direction as five of the six priority areas (priority action lines) defined in this Communication are somehow related to meeting the challenge of climate change and the degradation of the environment. It remains to be seen whether public procurement will have any role to play in the EU's policy initiatives for stimulating the commercialisation of innovations and the development of green and more resource-efficient products.

4.2.2 Remain in the vanguard of economies that hold technological leadership positions at the global level and contribute to global challenges

This issue has been much researched and forms the backbone of many policy initiatives (most prominently the *Lisbon Agenda*, followed up by the *Europe 2020 Agenda*) and one could say that this challenge has been at the forefront of discussions and the shaping of 'industrial policy' at EU levels for more than three decades. In the face of the challenge of technological competition particularly with the United States and more recently with a range of Asian economies which have become increasingly important centres (or prospective centres) of R&D activity, innovation policy has increasingly become the focus of industrial policy at the EU level.

Section 3.3 of this chapter contributed an evaluation of innovation policy in the way it is conducted at national and EU levels and comes out in favour of further efforts towards increased harmonisation of 'innovation systems' and the use of innovation policies across the Member States of the European Union. Attempts at the EU level have already gone in the direction to create an 'internal market for research', supporting the 'free movement of knowledge, researchers and technology, with the aim of increasing cooperation, stimulating competition and achieving a better allocation of resources and an improved coordination of national research activities and policies' (FREE, 2010). However, the empirical analysis conducted in Section 3.3 also shows that innovation policies conducted at EU, national and regional levels partly address different needs, such as support for large vs. small and medium-sized enterprises, national enterprise groups vs. multinationals, activities where the technological spillovers are more local vs. international. It was also found that there can be different instances of misallocation of resources in the way programmes are conceived at EU or national levels (e.g. the strong focus of EU level innovation support for the food industry which results from the high share of overall spending at EU level on agricultural support). The different focus is understandable as issues of asymmetric information and knowledge of spillover effects are perceived differently at local, national and EU levels and hence a clear view of division of tasks and use of resources on these different levels is important in the area of innovation policy as in many other areas.

An issue which has gained in prominence in the debate on industrial policy is the role which innovation policy should play in supporting the development of new technological trajectories or the switch towards alternative trajectories. This has gained prominence in the debate on climate change where 'lock-in effects', 'path dependency' and sunk cost advantages of incumbent technologies prevent the switchover towards environmentally more sustainable technological trajectories. Here is an important field for innovation policies and other aspects of industrial policy (such as training support in new technological fields or long-term financing arrangements) where EU-wide efforts and coordination will play a vital role (see Acemoglu et al., 2010; Aghion et al., 2010).

In the efforts to increase harmonisation and coordination at EU levels one should however be aware of potential 'innovation diversion effects' which may distort the interaction with important R&D centres in other global regions (this has been pointed out e.g. by Soete, 2009). This issue is particularly important as the share of R&D activity accounted for by emerging economies will grow and diversion effects of a too inward-looking policy of EU integration would prevent the efficiency-inducing interaction with such centres.

Finally, the data presented in this Report also show the strong dispersion in the intensity of R&D activity and also in the scale and nature of innovation policy instruments used across the EU which to a large extent reflects the different stages of development of the Member States (and regions) of the EU. This in turn reflects the fact that instruments and policies have to be employed differently to support innovation activity and technology developments in countries (and regions) close to the global technology frontier and in those which are further away from this frontier. One gets the impression that the current discussion of innovation policy and the strong shift towards innovation policy as the core element of industrial policy more generally in EU documents has an in-built bias towards recognising well the challenges of the more advanced economies but considers much less issues of technology dissemination and the development of absorption capacities in countries and regions further away from the frontier.

4.2.3 Adjust to the challenge of competitive pressure from emerging economies

The much enhanced position of emerging economies in the global economy and particularly in manufacturing production has been a striking feature of developments over recent decades and is likely to further increase in speed as a wider range of economies join the group of successful catching-up economies. It is a characteristic of manufacturing that products and processes can be more easily copied, and production processes can be more easily transferred than is the case in the more sophisticated service activities where tacit knowledge and reputation play a bigger role. Hence it looks as if international patterns of comparative advantage are moving in the direction of advanced economies giving up the dominating positions they used to occupy in industrial production and their comparative advantage is and has been moving towards the high-quality end of industrial production, the design and development end of new products and processes and towards tradable services. However, this Report has also pointed out that the trends and performances in this respect differ quite a lot across European economies (see e.g. the widely differing shares of manufacturing in Germany and Austria on the one hand and France, the Netherlands and the UK on the other). This definitely points towards degrees of freedom in the extent to which policies can shape the position of advanced economies with regard to the role which manufacturing can play in their economic structures and overall economic performance.

Furthermore, the era of globalisation with its liberalisation of trade and international investment flows, declines in transport costs and much improved logistics has given rise to a much more extensive division of labour in the form of ‘splitting up of the value chain’, ‘fragmentation’ and cross-border organisation of production networks. The implications can be two-fold: on the one hand, this may lead to a faster erosion of manufacturing production in advanced economies as many more production stages can be shifted towards lower-cost sites, but it may also, on the other hand, allow an exploitation of cost advantages in different production locations and an expansion of production in those fragments in which a country has or strengthens its comparative advantages. In this context, the Report has in Section 3.8.4 pointed towards the importance of educational training systems and particularly of the dual system of vocational training (prevalent in Germany and other Central European economies) which show that well-trained and well-paid ‘medium-skilled’ workers can play a very important role in maintaining and widening the range of production activity in manufacturing and in ancillary activities in which advanced economies (but also some of the middle-income regions of Central/Eastern Europe) can maintain a strong competitive position. The focus on medium-skill vocational training can also make a very important contribution to dealing with one of the major labour market problems associated with ‘globalisation’ and also the current crisis. The literature on globalisation points to the potentially detrimental impact ‘delocalisation’ can have on medium-skilled workers in advanced economies (the ‘polarisation’ hypothesis[47]); furthermore, the current crisis has increased dramatically the rates of youth unemployment. A very strong initiative on vocational training in the current context could thus tackle not only the challenge of too strong or too fast ‘delocalisation’ of manufacturing production but also address some of the most pressing labour market issues of our day.

[47] For an analysis of the polarisation hypothesis and the role of skill-biased technological progress and offshoring in Europe see Goos et al. (2010).

A feature which has also emerged from numerous studies on international production networks is that they are often more 'regionalist' rather than 'global' in character as distance continues to matter for transport costs and logistics. This is particularly the case in Europe where a continuous spectrum of wage rates, productivity levels and institutional differentiation at close quarters exists which does lend itself very well to a diversified pattern of locations of different production stages. As a result, one finds that the 'regionalist' aspect of cross-border production networks is very dominant in Europe (more dominant than in any other global region; see e.g. Stöllinger, 2011). The problem of production networks in European manufacturing, however, is that they are highly concentrated on sub-groups of countries (mainly in Central Europe). In fact, this has advanced to one of the most important challenges for industrial policy in Europe.

4.2.4 Respond to strong agglomeration tendencies in European manufacturing

The current crisis has brought to light the impact which persistent current account imbalances can have on the coherence and prospects of the whole European integration project. The fact is that in the pre-crisis period a significant number of EU economies experienced a structural shift in the balance between the tradable vs. non-tradable sectors which went along with strong capital inflows, over-valued real exchange rates, high lending to the private sector and an erosion of export capacities particularly in the manufacturing sector[48].

The 'manufacturing imperative' is particularly urgent in the range of lower- and medium-income economies in Europe which are '*structurally trade balance-constrained'*. This means that capacities in the export sector constrain the overall growth process in an economy under conditions in which restricted capital inflows impose current account constraints. Quite a few of the Southern European economies (Greece, Portugal, Spain, Cyprus) as well as in Eastern Europe and the EU's neighbourhood are currently in this situation following the impact of the financial and economic crisis. Furthermore, developments during the crisis have further hit the tradable sector in quite a few of these economies disproportionately.

In most middle-income economies (with the exception of countries with a very large tourism sector) manufacturing represents an even more dominant part of the tradable sector than is the case in more advanced economies. Hence a recovery of manufacturing is an absolute necessity to get out of a 'trade balance-constrained' situation. The analysis in this Report has also shown that a range of middle-income countries (such as the Czech Republic, Hungary, Poland, Slovakia) were very successful in becoming important locations for manufacturing production in Europe (as are many of the East and Southeast Asian economies). This experience proves that fast catching-up in manufacturing (and also em-

[48] For details see also the special section in Chapter 1 of this Report dealing with 'structural changes in Europe's periphery'.

barking on a significant technological and structural upgrading process) is feasible – and indeed can be very successful – in low- and medium-income countries. The other side of the coin, however, is that manufacturing production and the development of cross-border production networks show strong features of *agglomeration*, i.e. manufacturing activity is spatially concentrated. Hence without strong policy initiatives countering such tendencies, manufacturing will spatially remain concentrated in a limited range of economies (and even in particular regions in these economies) while other countries (or regions) will experience a withdrawal of manufacturing activity or a lack of further development of such activity.

Such spatial concentration might be desired if one judges the situation purely from a production efficiency point of view (exploiting economies of scale and the incentive to keep transport and logistics costs down in cross-border production networks). However, in a Union of European states in which compensating income transfers at a rather high level are unfeasible or politically undesirable, the erosion of export capacities and the continued 'trade balance-constrained' situation of a significant number of low- and middle-income countries and regions is unsustainable and will act as an enormous centrifugal force for the European integration process as a whole. Hence there is the need for an industrial policy which aims at a higher degree of spatial diffusion of manufacturing activity in Europe. This amounts to a 'manufacturing imperative' for many of the low- and medium-income countries and regions of Europe where manufacturing activity has either been in decline or been neglected. Arguably this is the most important of the challenges facing a resurgence of an industrial policy agenda in Europe.

In this context, Section 3.4 of this report has reported results from an econometric analysis on the effectiveness of state aid (in its various forms including internationalisation aid) with very mixed results (see also the recent careful study by Criscuolo et al., 2012 which attempts to test for causal effects of regional aid programme in the UK); this is a very preliminary analysis and much more research has to be done on this, learning from good and bad experiences. What emerged however as a robust result, is that governance and 'government effectiveness' indicators play a very important role whether industrial policy instruments have a beneficial or detrimental effect for an economy's performance. Industrial policy is not a panacea by itself to lift an economy from a bad 'trade balance-trapped' situation. There are important conditioning factors which determine its effectiveness. Particularly important is also the interaction with competition policy which can play an important complementary role to industrial policy (on this see also Aghion et al., 2012). The enforcement of competition policy at the EU level in combination with the use of industrial policy instruments at EU, national and regional levels could assure that good governance conditions are enforced and that industrial policy suffers less from the well-known political economy problems of capture by dominant incumbent interests.

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Appendix 1

Industry Lists and country abbreviations

Table A.1

Country abbreviations

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
ES	Spain
EE	Estonia
FI	Finland
FR	France
UK	United Kingdom
EL	Greece
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SK	Slovakia
SI	Slovenia
SE	Sweden
US	USA
JP	Japan
KR	South Korea
BR	Brazil
CN	China
IN	India

Table A.2

Industry classification with detailed advanced manufacturing industries

15t16	Food, Beverages and Tobacco	Low technology
17t18	Textiles and Textile Products	Low technology
19	Leather, Leather and Footwear	Low technology
20	Wood and Products of Wood and Cork	Low technology
21t22	Pulp, Paper, Paper , Printing and Publishing	Low technology
23	Coke, Refined Petroleum and Nuclear Fuel	Medium-low technology
24	Chemicals and Chemical Products	Medium-high and high technology
25	Rubber and Plastics	Medium-low technology
26	Other Non-Metallic Mineral	Medium-low technology
27t28	Basic Metals and Fabricated Metal	Metals
29	Machinery, nec	Machinery
30t33	Electrical and Optical Equipment	Electrical equipment
34t35	Transport Equipment	Transport equipment
36t37	Manufacturing, nec; Recycling	Low technology

Note: Based on NACE Rev. 1 industry classification.

Table A.3

Industry classification according to technology intensity

15t16	Food, Beverages and Tobacco	Low technology
17t18	Textiles and Textile Products	Low technology
19	Leather, Leather and Footwear	Low technology
20	Wood and Products of Wood and Cork	Low technology
21t22	Pulp, Paper, Paper , Printing and Publishing	Low technology
23	Coke, Refined Petroleum and Nuclear Fuel	Medium-low technology
24	Chemicals and Chemical Products	Medium-high and high technology
25	Rubber and Plastics	Medium-low technology
26	Other Non-Metallic Mineral	Medium-low technology
27t28	Basic Metals and Fabricated Metal	Medium-low technology
29	Machinery, nec	Medium-high and high technology
30t33	Electrical and Optical Equipment	Medium-high and high technology
34t35	Transport Equipment	Medium-high and high technology
36t37	Manufacturing, nec; Recycling	Low technology

Note: Based on NACE Rev. 1 industry classification.

Table A.4

Industry classification according to Eaton et al. (1998)

15t16	Food, Beverages and Tobacco	Labour-intensive / Chemical-linked
17t18	Textiles and Textile Products	Labour-intensive / Chemical-linked
19	Leather, Leather and Footwear	Labour-intensive / Chemical-linked
20	Wood and Products of Wood and Cork	Resource-intensive / Earth-linked
21t22	Pulp, Paper, Paper , Printing and Publishing	Resource-intensive / Earth-linked
23	Coke, Refined Petroleum and Nuclear Fuel	Resource-intensive / Earth-linked
24	Chemicals and Chemical Products	Chemicals
25	Rubber and Plastics	Labour-intensive / Chemical-linked
26	Other Non-Metallic Mineral	Resource-intensive / Earth-linked
27t28	Basic Metals and Fabricated Metal	Metals
29	Machinery, nec	Machinery
30t33	Electrical and Optical Equipment	Electrical equipment
34t35	Transport Equipment	Transport equipment
36t37	Manufacturing, nec; Recycling	Resource-intensive / Earth-linked

Note: Based on NACE Rev. 1 industry classification.

Appendix 2

Additional results from the quantitative analysis of state aid

Table A.5

Percentile ranks of EU Member States' governance effectiveness, average 1995-2011

AT	93.4
BE	93.8
BG	56.4
CY	91.5
CZ	81.5
DE	91.9
DK	99.5
ES	82.0
EE	84.8
FI	100
FR	88.2
UK	92.4
EL	66.8
HU	73.0
IE	89.1
IT	66.4
LT	72.0
LU	94.8
LV	72.5
MT	82.9
NL	96.7
PL	71.6
PT	78.7
RO	47.4
SK	76.3
SI	79.6
SE	98.6

Note: Percentile range (globally) is from 0-100. Higher percentiles indicate higher governance effectiveness.

Source: World Bank's Worldwide Governance Indicators (WGI) database.

Table A.6

Aid to research, development and innovation and competitiveness
Dependent variable: Member States' share in total extra-EU exports

Specification	(1)	(2)	(3)	(4)
R&D aid	-0.004	0.001	0.011	-0.013
	(0.018)	(0.022)	(0.026)	(0.020)
R&D aid²	-0.001	0.000	0.001	-0.004 *
	(0.002)	(0.002)	(0.003)	(0.002)
loans to GDP	0.035			
	(0.069)			
loans to GDP²	-0.253 ***			
	(0.035)			
loans to GDP * R&D aid	-0.002			
	(0.011)			
governance		0.454		
		(0.342)		
governance²		0.658		
		(0.964)		
governance * R&D aid		-0.134 ***		
		(0.033)		
wage share			-0.376	
			(0.401)	
wage share²			2.853	
			(2.276)	
wage share R&D aid			-0.248 ***	
			(0.061)	
tariff rate				-0.046
				(0.052)
tariff rate²				-0.081 ***
				(0.029)
tariff rate * R&D aid				-0.020 *
				(0.012)
R^2	0.992	0.989	0.988	0.988
adjusted R^2	0.991	0.987	0.987	0.986
Observations	373	380	341	391

Note: Standard errors appear in parentheses. *, **, ***indicate statistical significance at the 1%; 5% and 10% level respectively. Regressions include country and year fixed effects as well as a constant term which are not reported. The standard errors are robust. All the data was logarithmised (observations of the value zero were changed to 0.01 in order to make the taking of logarithms possible) and centred in order to make the estimated coefficients interpretable. R&D aid is aid to research, development and innovation.

Source: WIOD, European Union State Aid Scoreboard, Eurostat, UNCTAD-TRAINS, World Bank's Worldwide Governance Indicators (WGI) database.

Table A.7

Sectoral aid to manufacturing and competitiveness
Dependent variable: Member States' share in total extra-EU exports

Specification	**(1)**	**(2)**	**(3)**	**(4)**
manufacturing aid	0.002	-0.008	0.000	-0.004
	(0.006)	(0.007)	(0.007)	(0.006)
manufacturing aid²	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
loans to GDP	0.054			
	(0.070)			
loans to GDP²	-0.250 ***			
	(0.031)			
Loans * manufacturing aid	0.004			
	(0.008)			
governance		0.446		
		(0.362)		
governance²		0.889		
		(1.020)		
governance * manufacturing aid		0.071 ***		
		(0.023)		
wage share			-0.091	
			(0.399)	
wage share²			1.436	
			(1.983)	
wage share * manufacturing aid			-0.091 **	
			(0.044)	
tariff rate				0.007
				(0.042)
tariff rate²				-0.090 ***
				(0.032)
tariff rate * manufacturing aid				0.004
				(0.007)
R^2	0.992	0.988	0.988	0.988
adjusted R^2	0.991	0.987	0.986	0.986
Observations	373	380	341	391

Note: Standard errors appear in parentheses. *, **, ***indicate statistical significance at the 1%; 5% and 10% level respectively. Regressions include country and year fixed effects as well as a constant term which are not reported. The standard errors are robust. All the data was logarithmised (observations of the value zero were changed to 0.01 in order to make the taking of logarithms possible) and centred in order to make the estimated coefficients interpretable. Manufacturing aid is sectoral aid to manufacturing.

Source: WIOD, European Union State Aid Scoreboard, Eurostat, UNCTAD-TRAINS, World Bank's Worldwide Governance Indicators (WGI) database.

Appendix 3

Methodologies

Decomposition of manufacturing R&D intensity

The results for the decomposition of R&D intensities in Figure 6 are derived followings the approach of Eaton et al. (1998). The decomposition approach takes the following form:

$$R\&D_c^m - R\&D_w^m = \sum_i (va_{i,c} - va_{i,w}) \cdot R\&D_{i,w} + \sum_i (R\&D_{i,c} - R\&D_{i,w}) \cdot va_{i,w} + \sum_i (va_{i,c} - va_{i,w}) \cdot (R\&D_{i,c} - R\&D_{i,w})$$

where $R\&D^m$ denotes R&D intensity in the manufacturing sector and $R\&D_i$ denotes R&D intensity in industry *i*. Subscript *c* denotes countries and subscript *w* denotes the global average which for this purpose is the average of Finland, France, Germany, United Kingdom, Austria, Belgium and the Netherlands as well as the United States and Japan, i.e. the nine countries included in the decomposition exercise. The valued added shares of manufacturing are denoted by va.

Therefore the first term represents the composition effect, i.e. the differences in industry specialisation across countries and the second term captures the differences in the industry level R&D intensities. The last term is an interaction term between those two which has no particular economic interpretation.

Calculation of value added exports

The concept of value added exports used throughout the Report is that of Johnson and Noguera (2012). The value added exports approach requires global input-output data. For this chapter the world input-output database (WIOD) is used for this purpose. The WIOD contains information on 40 countries plus the rest of the world (ROW) for 35 industries. The global input-output table in the WIOD that summarises the inter-industry linkages is therefore of dimension 1435 x 1435.

The starting point for calculating value added exports (VAX) is the basic input-output identity

$$q = (I - A)^{-1} \cdot f$$

where q denotes a vector of gross output for each country and industry (i.e. of dimension 1435x1), A is a matrix of intermediate inputs per unit of gross output (of dimension 1435x1435) and f is a vector of final demand by country and sector and therefore again of dimension (1435x1). A final product, e.g. a car, is made of many other products produced in other industries maybe in other countries.

The calculation of VAX consists of decomposing the output vector *q* of each country *r* in $(q^{1,r} \quad q^{2,r} \quad \cdots \quad q^{N,r})'$ where $q^{1,r}$ denotes the output absorbed in country *r* that was sourced from partner country 1 and likewise for the other partner countries. The elements of q are also referred to as output transfers. These output transfers are in turn used to calculate the value added produced in a source country i and absorbed in another country r which constitutes the bilateral value added exports $(VAX_{i,r})$.

Bilateral value added exports are defined as $VAX_{i,r} = \frac{VA_i}{q_i} \cdot q_{ir}$, where $\frac{VA_i}{q_i}$ is the ratio of value added to gross output in country i and q_{jr} is the output produced in country i that is absorbed in j (see Johnson and Noguera, 2012). The global value added exports of country r (VAX_r) are obtained by summing up the bilateral value added exports for all partner countries. The market share of each country in global value added exports used in the text is then simply $\frac{VAX_r}{\sum VAX_r} \cdot 100$.

Quantitative analysis of state aid

Section 3.2 use three types of approaches to estimate the relationship between the provision of state aid by Member States and export market shares, value added and value added growth respectively. The empirical approaches are briefly outlined below.

Aghion, Boulanger and Cohen (2011) type equation: In its basic form the following panel data equation is being estimated:

$$lnEX_{it} = \beta_1 lnSA_{it} + \beta_2 ln^2SA_{it} + \beta_3 lnPC_{it} + \beta_4 ln^2PC_{it} + \beta_5 lnPC_{it} lnSA_{it} + \gamma_i + \delta_t + \varepsilon_{it},$$

where $lnEX_{it}$ represents the log of the overall share of extra-EU manufacturing and services exports of an EU Member State i in the sample to total EU exports in year t. The variable *SA* covers total sectoral state aid to industry and services (also all the other types and sub-groups of state aid are being controlled for) and *PC* is a proxy for financial development, measured by the ratio of private credit by deposit-taking banks and other financial intermediaries to GDP (similarly also indicators of governance, competition and tariff protection are being checked). The squared terms control for non-linearity and the interaction term checks whether the two explanatory variables are substitutes or complements. Finally, γ_i and δ_t are country and time fixed effects respectively, while ε_{it} is the error term and the β's are the coefficients to be estimated. The rationale of this estimation exercise is to find out whether state subsidies can act as a promoter of international competitiveness, especially in those cases where access to private finance is limited. While the original sample of Aghion, Boulanger and Cohen (2011) included EU-15 data for the years 1992-2008, here EU-27 data for the period 1995-2011 is exploited.

Haraguchi and Rezonja (2011) type equation: The following modified base-line equation is being estimated:

$$lnVA_{it}^{j} = \beta_1 lnDP_{it} + \beta_2 ln^2DP_{it} + \beta_3 lnPD_{it} + \beta_4 lnNR_{it} + \beta_5 lnSA_{it} + \gamma_i + \delta_t + \varepsilon_{it}^{j},$$

where $lnVA^j_{it}$ is the log of the real value added per capita of the respective manufacturing sector *j* in country *i* and year *t*. The variable *DP* accounts for the per capita gross domestic product, *PD* stands for population density and *NR* is an indicator for natural resource endowment. Following Haraguchi and Rezonja (2011), the modified natural resource proxy variable can be calculated as the ratio between exports and imports of crude natural resource commodities. The commodities included are those categorised under SITC Rev. 1 in Code 2 (crude materials, inedible, except fuels), 32 (coal, coke and briquettes), 331 (petroleum, crude and partly refined) and 3411 (gas, natural).

These three explanatory variables are seen as mostly exogenous for the specific sample analysed. Here, SA is state aid per capita, and the β's, γ_i and δ_t are defined as in the earlier equation. ε^j_{it} is the error term. The value added data was taken from Eurostat's intermediate ISIC aggregation Rev. 2. GDP and population density data stems also from Eurostat. Data for constructing the natural resource endowment indicator was taken from the Comtrade database. In the preferred regressions the single manufacturing sectors have been aggregated in two groups – export-oriented industries and industries focusing on the domestic markets, based on an exportability measure, in order to make the results better interpretable. In following Rajan and Subramanian (2011) the exportability of an industry is assumed if the respective industry has a ratio of exports to value added that exceeds the industry median. For each industry, the median ratio of exports to value added was calculated using data from all EU-27 countries. The industries above the median are manufacturers of petroleum products, chemicals, pharmaceuticals, electronics, machinery and cars. Those below are manufacturing food, textiles, paper, plastics, metals, electric and other equipment.

Rajan and Subramanian (2011) type equation: The basic equation estimated is the following:

$$MG_{ij} = \beta_1 IS_{ij} + \beta_2 SA_i ED_{ij} + \gamma_i + \zeta_j + \varepsilon_{ij},$$

where the MG_{ij} variable depicts the average annual real growth rate of manufacturing value added of industry *j* in country *i* over the period 2000-2010. A country- and industry-specific indicator of the initial manufacturing share (*IS*) is added to the regression in order to control for convergence. Most importantly an interaction term of state aid as a share of GDP (*SA*) and a manufacturing sector-specific exportability dummy variable (*ED*) is included as well. Similarly to the regression before and following Rajan and Subramanian (2011) the exportability dummy takes a value of 1 if the respective industry has a ratio of exports to value added that exceeds the industry median. For each industry, the median ratio of exports to value added was calculated using data from all the EU-27 countries. The aim of this regression equation is to check in what way public subsidies influence the growth of the export-oriented manufacturing sectors in Europe. All the data used has the same origin as in the second approach.

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