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Boosting Regional Competitiveness in Turkey

Strengthening the Spatial Dimension in the Sector Strategies of Turkey

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Foreword

Regions play an increasingly important role in OECD economies. They are responsible for delivering policies that directly affect citizens' lives and the business environment. Accordingly, it is essential that policy makers and practitioners understand their economies and benchmark them with the most appropriate tools. The growing importance of regional and local policy makers also makes it ever more important to efficiently co-ordinate national and regional policies.

With wide disparities in the economic development of its regions, Turkey is among the OECD countries now taking an active interest in regional development policies and regional competitiveness. In 2006, its Ministry of Development put in place 26 development agencies (DAs). Four years later they were fully operational. They carry out research, analysis and economic planning at the regional level, administer grant programmes directed at enterprises and educational institutions, and promote local investment through investment support offices (ISOs). The recently created DAs are expected to deliver all-important regional economic development policies, while finding their place in the Turkish policy and institutional environment.

Against that background, the OECD conducted its project, Boosting Regional Competitiveness in Turkey, to improve regional and sectoral competitiveness policies and to make co-ordination between development agencies, the Ministry of Development and other relevant institutions more effective. The OECD implemented the 22-month project (from November 2014 to September 2016), cofinanced by the European Union and Turkey, in close collaboration with the Ministry of Development.

Project activities included primary and secondary data collection and analysis, together with numerous missions, workshops and training courses covering all 26 regions of Turkey and in Ankara. In total, the project team was able to collect input from more than 600 participants. Project activities comprised four thematic components, plus a crucial capacity-building component that cut across all four. The four substantive components were:

- Component 1. Measuring, benchmarking and monitoring competitiveness in the regions through a tailored set of indicators.
- Component 2. Identifying dominant and dynamic sectors in the country's 26 NUTS II regions through a standardised framework.
- Component 3. Enhancing co-ordination between central institutions and development agencies.
- **Component 4. Strengthening the spatial dimension in national sector competitiveness strategies.**

In line with the project's four-component structure, its findings are examined in four thematic reports. This publication is the final report on Project Component 4, which aims to develop an approach that better incorporates the spatial dimension in national sector strategies. It is hoped that further analyses and policy discussions can build on the findings of this report and explore other facets of the complex interaction between national and regional institutions and agencies in Turkey.

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Acronyms and abbreviations

BEEPS	Business Environment and Enterprise Performance Survey
CAGR	Compound Annual Growth Rate
CE (marking)	Conformité Européenne (European Conformity)
CEFIC	European Chemical Industry Council
CIS	Commonwealth of Independent States
DA	Development Agency
EBRD	European Bank for Reconstruction and Development
EIS	Entrepreneur Information System
EPCA	European Petrochemical Association
EU	European Union
EUR	Euro
EXIMBANK	Turkish Export Promotion Bank
FDI	Foreign Direct Investment
FIC	Foreign Investment Certificate
GAP	Güneydoğu Anadolu Projesi (Southeastern Anatolia Project)
GDP	Gross Domestic Product
GVC	Global Value Chain
İŞKUR	Turkish Labour Agency
ISO	Istanbul Chamber of Commerce
ISPAT	Republic of Turkey, Prime Ministry Investment Support and Promotion Agency
JMO	Chambers of Geological Engineers
KOSGEB	Small and Medium Business Development and Support Administration of Turkey
LQ	Location Quotient
MAKFED	Turkish Machinery Federation
MKEK	Turkish Machinery and Chemical Industry Institution
MoD	Republic of Turkey, Ministry of Development
MoE	Republic of Turkey, Ministry of Economy
MoENS	Republic of Turkey, Ministry of Energy and Natural Resources
MoSIT	Republic of Turkey, Ministry of Science, Industry and Technology
NACE	Nomenclature of Economic Activities
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
OIZ	Organised Industrial Zone
R&D	Research and Development
SME	Small and Medium-sized Enterprise
TCMA	Turkish Chemical Manufacturers Association
TDZ	Technology Development Zone
TEPAV	Economic Policy Research Foundation of Turkey
TIM	Türkiye İhracatçılar Meclisi (Turkish Exporters Assembly)
TKB	Turkish Development Bank
TOBB	Union of Chambers and Commodity Exchanges of Turkey
TRY	Turkish Lira
TÜBİTAK	Scientific and Technological Research Council of Turkey
TÜPRAŞ	Türkiye Petrol Rafinerileri A.Ş. (Turkish Petroleum Refining Corporation)
TURKSTAT	Turkish Statistical Institute
TVET	Technical and Vocational Education
USD	US Dollar
VAT	Value Added Tax

Executive Summary

This report is a case study on how to better integrate the spatial aspects of economic development into national strategies prepared and implemented by central public institutions. More specifically, it examines how national manufacturing sector strategies prepared by the Ministry of Science, Industry and Technology (MoSIT) of Turkey could strengthen their focus on the spatial development of industrial sectors.

Closely co-ordinating national and regional policies is an essential part of successful regional development, particularly in regions where market failures are more prominent and the need for government intervention is greater. One possible way to strengthen co-ordination is by better integrating spatial aspects in the design of national strategies. Concretely, enhancing the regional dimension in the national manufacturing sector strategies could help Turkey's central public institutions tailor their approach to regions' strengths and needs as well as set tangible and clear targets and objectives adapted to regions. A strengthened regional dimension would also pave the way for closer alignment between central and regional institutions' policies. Consequently, national sector strategies would be better placed to play their expected role in helping Turkish manufacturing to retain its competitiveness and successfully move towards higher value activities against the backdrop of increasing competition from emerging economies.

Drawing on the cases of the machinery and chemical industries, this report presents a 10-step methodology for strengthening the spatial dimension of Turkey's national manufacturing strategies. The methodology comprises three parts. The first focuses on bolstering existing regional analyses and introducing additional ones based on the available data - in Steps 1 to 6. The second part, Steps 7 and 8, seeks to improve coherence between different regional- and national-level policies. Finally, Part 3 aims to clarify the strategic direction for regional stakeholders by increasing private sector involvement and defining regional objectives - Steps 9 and 10.

Table. **A 10-step methodology**

A. Intensify analyses	**1**	Identification of the sector-specific factors behind firm location choices
	2	Increased use of regional data
	3	Introduction of analyses of product groups and value chains
	4	Consideration of foreign direct investment and foreign enterprises
	5	Examination of clusters
	6	Mapping of R&D activities and regional availability of skills
B. Improve coherence	**7**	Alignment with other national policies
	8	Alignment with regional plans and/or sector reports
C. Clarify direction	**9**	Validation by regional private sector stakeholders
	10	Breaking down overall targets and objectives
Monitoring and evaluation		

The methodology does not claim to be a universal approach to integrating the regional dimension into national sector strategies. Against Turkey's current economic and policy background, it seeks, rather, to offer MoSIT a new perspective. The methodology could enhance co-ordination between national government and local stakeholders, which might, in turn, lead to more advanced methodologies and frameworks for effectively incorporating the regional dimension in upcoming national strategy planning cycles. This report will certainly not end the debate but will help steer it.

Introduction

Manufacturing was one of the main drivers of the rapid growth of the Turkish economy during the last decade. From the early 2000s, the country's manufacturing sector grew on average by 12% per year. It stagnated briefly during the global economic crisis in 2009, before rebounding quickly thereafter and being instrumental in the recovery of the economy as a whole. In 2014, the share of manufacturing in Turkey's gross domestic product (GDP) was 25% with a size of almost TRY 30 billion, and its share in Turkey's total exports of goods and services stood at 94% (ISPAT, 2014a).

Turkey has been regarded as an attractive location for manufacturing, partly due to its favourable geographical position with its proximity to large markets like the European Union (EU), the Middle East, and the Commonwealth of Independent States (CIS). However, its competitiveness is currently being challenged in certain manufacturing sectors and it faces growing competition, particularly from China and other emerging countries.

Adapting to the new challenges has consequences for the industrial geography of Turkey. As wages rise in the most developed regions, certain industrial activities have relocated to benefit from lower production costs. Policy makers may therefore need to develop policies tailored to regions and consider accompanying the relocation of some manufacturing activities in order to retain and boost Turkey's competitiveness. A prerequisite for developing these policies is a better grasp of spatial development of manufacturing activities and how it has been affected by the country's recent economic growth and public policies.

In order to shed light on the current spatial trends of manufacturing activities, and to explore the different factors and constraints affecting their spatial development, it is crucial to carry out a spatial analysis of Turkey's manufacturing sectors. Only then can the clear links between policies and location choices of manufacturing sectors be better understood and more effective policies with a clear spatial direction formulated accordingly.

This report aims to contribute to better incorporating the regional dimension in national sector strategies. Part 1 introduces the methods and data sources used to that end. Parts 2 and 3 then illustrate the spatial analyses and trends of the manufacturing sectors chosen as pilots - namely the machinery and chemical industries - and discuss the opportunities and challenges pertaining to those industries' short- to medium-term spatial development in Turkey. Finally, Part 4 draws on the analyses undertaken in the two pilot industries to set out a 10-step methodology designed to assist the Ministry of Science, Industry and Technology (MoSIT) - and other regional and national institutions concerned, - in strengthening the regional dimension in national sector strategies.

Chapter 1

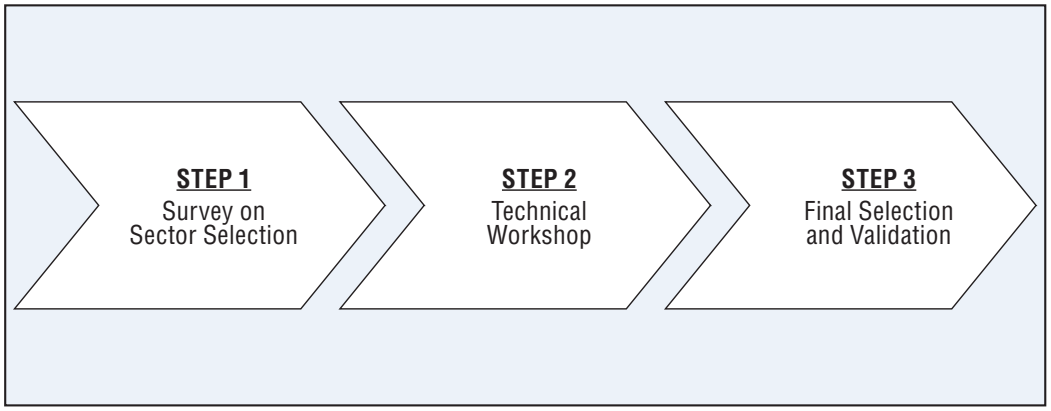
Project methodology and data sources

1.1. Pilot sector identification

At the outset of the project, Boosting Regional Competitiveness in Turkey, two pilot manufacturing sectors were chosen to better concentrate the effort on spatial analyses and develop a methodology which would also be applicable to other manufacturing sectors. The sector selection did not, by any means, aim at choosing the most competitive or promising manufacturing sectors of Turkey.

Selecting the two pilot sectors entailed a three-step procedure illustrated in Figure 1.

Figure 1. **Sector selection approach**



Step 1 consisted of an initial survey in April 2015 amongst the relevant Turkish ministries and their affiliated organisations.[1] In Step 2, the consolidated survey results were further discussed at a technical workshop held on 20 May 2015, in Ankara. The workshop brought together over 40 representatives of various Turkish ministries, including the Ministry of Development (MoD), the Ministry of Economy (MoE) and Ministry of Science, Industry and Technology (MoSIT), as well as some public affiliated institutions such as the Small and Medium Enterprises Development Organisation (KOSGEB). The participants provided their feedback and recommendations on the two pilot sectors to be selected for comprehensive spatial analysis. In the last step, the OECD, together with the MoD, consolidated survey results and feedback received from the technical workshop participants and selected the machinery and chemical sectors as the two pilot manufacturing sectors (See Annex B for criteria used to select the two pilot sectors).

The OECD project team then analysed the current status, along with the spatial trends, of Turkey's machinery and chemical industries. Eventually, building on the results and main findings of these analyses, a 10-step methodology was developed with the objective of strengthening the regional dimension in MoSIT's national sector strategies.

1.2. Data sources

The quantitative data pertaining to the two industrial sectors were mainly gathered from MoSIT's Entrepreneur Information System (EIS) Database. The EIS provides annual series on firms, employment, turnover and exports by economic activity and by region and province. The EIS Database consolidates data on the economic activities of firms available in the administrative records of different public institutions, such as the Turkish Statistical Institute (TurkStat), the Customs and Trade Ministry of Turkey and the Revenue Administration. Complementary sources, such as TurkStat for export data and the MoE's records for investment data, were also used when necessary.

As for qualitative data, input was mainly collected from the regional workshops that were organised between November 2015 and June 2016 in Turkey's 26 NUTS II regions (see Annex C for more details on the regional workshops). The objective of these regional workshops was to gather up-to-date information on the current situation of the machinery and chemical industries in the regions visited by the OECD project team, and discuss the expected regional developments in these sectors in the short to medium term. During the sessions, regional stakeholders - comprising public and private sector, civil society and academia - were asked for their views on the binding constraints and policy options for fostering the development of the machinery and chemical industries in their respective regions. In addition, due to possible discrepancies between official data and the reality on the ground, the OECD team double-checked the accuracy of the quantitative data whilst complementing them with qualitative information.

The main outcomes and lessons learnt from the regional workshops were instrumental in developing a methodology to enhance the policy formulation pertaining to spatial development and better incorporate the spatial dimension in national strategy documents. The outline of the developed methodology was presented at the technical workshop held on 25 May 2016 in Ankara. Subsequently, comments made, as well as feedback received at the workshop were factored into the final methodology.

1.3. Relevant OECD work

The OECD has specifically worked on and explored in detail two topics relevant to this report - namely regional development and industrial policy.

Regional development

Experience in OECD countries has shown that the design and implementation of regional development policies is an important complement to national strategies. In the past, regional development policies typically aimed to reduce regional disparities by means of large-scale infrastructure development and by attracting inward investment, using subsidies, tax breaks and similar instruments to influence firms' location decisions. However, such policies generally yielded mixed results, at best, and rarely seem to have helped lagging regions catch up, despite the allocation of significant public funding (OECD, 2012). Aware of the need for a new approach, OECD work on regional development has increasingly stressed the need to promote the competitiveness of all regions, with special emphasis on opportunity rather than disadvantage or need for support. This paradigm shift in regional development policies (Table 1) has focused attention on many of the key concerns of the project - such as the integration of policy strategies across sectors, effective multi-level governance, and a focus on the identification and mobilisation of regions' endogenous assets.

Table 1. **A paradigm shift in regional policies**

	Traditional regional policies	New paradigm
Objectives	Balancing economic performances by temporary compensating for disparities	Tapping under-utilised regional potential for competitiveness
Strategies	Sectoral approach	Integrated development projects
Tools	Subsidies and state aid	Soft and hard infrastructure
Actors	Central government	Different levels of government
Unit of analysis	Administrative regions	Functional regions
→	Redistribution from leading to lagging regions	Building competitive regions by bringing together actors and targeting key local assets

Source: OECD (2009a), How Regions Grow: Trends and Analysis, OECD Publishing, Paris.
http://dx.doi.org/10.1787/9789264039469-en

OECD work on the implementation of this regional policy paradigm has thrown the spotlight on a number of other key lessons that are relevant to Turkey:

- **The key drivers of growth vary according to a region's level of development**. Although some factors - human capital, above all - appear to be critical for all types of regions, their relative importance can still vary across levels of development. When it comes to human capital, reducing the share of low-skilled people in the workforce probably matters more for a region's growth than increasing the share of the highly skilled. Human capital development strategies that focus too much on the "high end" may overlook the real challenges (OECD, 2013a).
- **Rural is not synonymous with decline.** Over the long run, rural regions in the OECD have tended to more or less match the growth performance of urban and intermediate regions. However, it is noteworthy that the predominantly rural ones generally been over-represented among both the best-performing and worst-performing regions. In other words, variation in performance for this group is far greater, which suggests specific challenges (OECD, 2016f).
- **The barriers to growth of rural and urban regions can differ substantially.** Rural regions most often face challenges associated with connectivity, difficulty in achieving critical mass and attracting human capital. By definition, they are unlikely to flourish in activities where agglomeration benefits or cluster economies are particularly substantial. Urban areas, by contrast, are more likely to grapple with bottlenecks associated with congestion and weak innovation capacity.
- **Specific policy challenges arise where urban and rural meet**. In recent years, OECD and non-OECD countries have paid increasing attention to the development of more effective governance arrangements for managing urban-rural linkages and thus facilitating more integrated approaches to territorial development. While such issues are typically addressed at a lower level than the NUTS II region - and are thus beyond the scope of this report - Turkish development agencies (DA) may benefit from considering the challenges and the potential associated with the effective management of urban-rural linkages in their planning (OECD, 2013b).

Industry, territory and globalisation

OECD work on industry and productivity aims to help governments find new ways to enhance their economies' competitiveness and move up the value chain in a world where production is highly fragmented into global value chains. To that end, the OECD's work focuses on identifying the right policies and structural reforms to foster new areas of potential growth, and encourage job creation and innovation. In addition, OECD has also conducted in-depth sectoral analyses on steel and shipbuilding. The Turkish shipbuilding industry was comprehensively studied in 2011 (Box 1).

Some more recent OECD work has addressed the implementation of industrial policies and the use of monitoring and evaluation tools to better assess their impact. Papers by Warwick and Nolan (2014) and Warwick's *Beyond Industrial Policy* (2013) could be cited as examples. Both works underscore the need of governments to discover and elicit more information about the constraints that markets face in order to design more effective industrial policies.

Certain OECD work on industry has also examined the interrelations between industrial policy and regional development. Examples are the 2013 and 2014 editions of *Perspectives on Global Development* (*Industrial Policies in a Changing World* [2013a] and *Boosting Productivity to Meet the Middle-Income Challenge* [2014a]). Both reports effectively drew on the OECD members' experience of industrial policies, particularly the lessons learnt by these countries. They explain in detail the recurrent mistakes in regional development and industrial policy practice in recent decades. These two documents indicate a number of most pertinent characteristics that regional, as well as industrial policy design and implementation should follow:

- First, regional and industrial policies should no longer be centred only on redistribution to compensate poorer regions for the higher cost of investment. Instead, governments should identify the potential comparative advantages of each region and consequently provide public goods to help exploit untapped resources.
- Second, isolated success stories can happen in any region which, therefore, should push national governments to look for the particular competitive edges of each territory. Regional authorities, for their part, should nurture a friendly business environment with special emphasis on the promotion of entrepreneurship and the creation and survival of new firms.
- Third, it is impossible to put into effect the above two recommendations fully and efficiently without a certain degree of regional and/or local devolution.
- Finally, national authorities have a role to play in supporting clusters in order for the economy to later reap the benefits of agglomeration.

Analyses of the chosen pilot manufacturing industries and the development of the 10-step methodology drew on the approach behind the above-mentioned body of research and its main findings.

Box 1. **The Turkish shipbuilding industry**

Shipbuilding, currently one of the most promising industrial sectors in Turkey, underwent a period of adjustment in the 1980s and 1990s, when Turkish shipyards struggled to complete their infrastructure investments and comply with advancing shipbuilding technology. In the last years, however, they have managed to tap into niche markets. This, in turn, has resulted in a several-fold increase in building and export capacity, as well as a diversified product portfolio.

Nonetheless, the Turkish shipbuilding industry remains too reliant on a small niche market - small tanker ships. Accordingly, the OECD suggested that the shipbuilding sector could benefit from increased government support, which would in turn enable local shipyards to match prices and other conditions offered by shipbuilders in countries with greater governmental support. Whilst state support did exist in Turkey to a certain extent, few measures directly targeted the shipbuilding industry, hence having a limited impact in practice.

In addition, the OECD also advised Turkish shipbuilders to continue to focus on their current strengths whilst, at the same time, seeking to expand their product markets - particularly so in other niche markets where the Turkish shipbuilding industry can tap into its existing expertise. Likewise, the technological base of the sector is recommended to be strengthened through greater R&D, better capabilities to improve productivity, and a continuous improvement of the skill base of the workforce.

Source: OECD (2011a), The Shipbuilding Industry in Turkey, https://www.oecd.org/Turkey/48641944.pdf.

Chapter 2

The machinery sector in Turkey

2.1. Sector scope

In this report, the machinery sector comprises all the products listed under Division 28 of the second revision of the Statistical Classification of Economic Activities in the European Community, known as NACE Rev.2. It was developed by Eurostat (2008) to harmonise classification in the European Community and is currently used by TurkStat in all national and regional accounts and various statistics.

Division 28 distinguishes between the manufacture of general- and special-purpose machinery (Table 2). "General-purpose machinery" is used in a wide range of economic activities and refers to power-related machinery like engines and turbines, while "other general purpose machinery" takes in ovens, lifting and handling equipment, tools, etc. "Special-purpose machinery" includes the products used in a very specific area, and this group relates to "agriculture and forestry machinery" and machinery with industrial applications, i.e. "metal forming machinery and machine tools". Another heading under Division 28 is "other special-purpose machinery" (sub-heading 28.9), which relates to the manufacture of equipment that does not necessarily have an industrial purpose, such as "automatic bowling alley equipment".

In the NACE Rev.1, arms and ammunition and domestic appliances (dishwashers, refrigerators, etc.) were listed under machinery and equipment. However, they were left out from this category under the revised classification of NACE Rev.2.

Unless stated otherwise, all the statistics and data pertaining to the machinery sector in this report are drawn from Division 28 in NACE Rev.2. Using this classification was also crucial to consistency, since the MoSIT and MoD are adopting it in their sector strategies and reports.

Table 2. **Classification of machinery products in Division 28 of NACE Rev.2**

28 Manufacture of machinery and equipment n.e.c.	
28.1	**Manufacture of general-purpose machinery**
28.1.1	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
28.1.2	Manufacture of fluid power equipment
28.1.3	Manufacture of other pumps and compressors
28.1.4	Manufacture of other taps and valves
28.1.5	Manufacture of bearings, gears, gearing and driving elements
28.2	**Manufacture of other general-purpose machinery**
28.2.1	Manufacture of ovens, furnaces and furnace burners
28.2.2	Manufacture of lifting and handling equipment
28.2.3	Manufacture of office machinery and equipment
28.2.4	Manufacture of power-driven hand tools
28.2.5	Manufacture of non-domestic cooling and ventilation equipment
28.2.9	Manufacture of other general-purpose machinery
28.3	**Manufacture of agricultural and forestry machinery**
28.3.0	Manufacture of agricultural and forestry machinery
28.4	**Manufacture of metal forming machinery and machine tools**
28.4.1	Manufacture of metal forming machinery
28.4.2	Manufacture of other machine tools
28.9	**Manufacture of other special-purpose machinery**
28.9.1	Manufacture of machinery for metallurgy
28.9.2	Manufacture of machinery for mining, quarrying and construction
28.9.3	Manufacture of machinery for food, beverage and tobacco processing
28.9.4	Manufacture of machinery for textile, apparel and leather production
28.9.5	Manufacture of machinery for paper and paperboard production
28.9.6	Manufacture of plastics and rubber machinery
28.9.9	Manufacture of other special-purpose machinery

Source: EuroStat (2008), the European Classification of Economic Activities, http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN.

2.2. The machinery sector in Turkey

History

The contemporary machinery industry in Turkey made an important step in the 1950s, when previously military facilities were reorganized by the state under the name of "The Machinery and Chemical Industry Institution" (MKEK). The objective of this state enterprise was to produce the machinery and equipment required by the Turkish Armed Forces and to satisfy the essential needs of the civilian industry. Accordingly, most of the initial investment in the machinery industry was carried out by the state, particularly in defence-related machinery. That being said, other public facilities, too, were established at the time to repair machines and produce simple machinery for public factories related to the sugar refining, cement and steel construction industries (Dalgakıran et al., 2014).

In the early 1960s, with the introduction of the first incentive system in Turkey, investors could import the required machinery and equipment without having to pay tax or duty. Therefore, while most of the other manufacturing sectors had to compete with tax-free imported goods only once the customs union between Turkey and the EU came into effect in 1995, machinery industry sector was subject to intense competition even during its infant stage of development. Partly affected by this regulation, growth in the machinery sector was relatively limited and the sector could take off during only in the early '90s (Ergin, 1998).

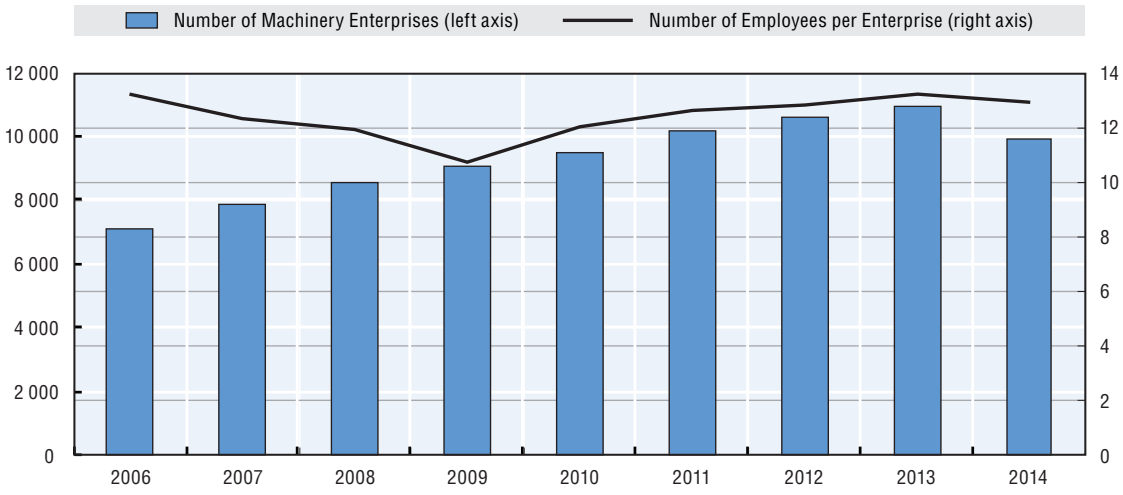
At the turn of the century, the Turkish machinery sector started harmonising with EU legislation and machinery directives and the "CE" marking became mandatory for machinery products within the European Economic Area, which included Turkey. The greater integration of the Turkish machinery industry in the EU market has arguably enhanced its competitiveness of the sector.

Industry structure

A growing number of enterprises operate in the machinery sector

According to the MoSIT's database of "Enterprise Information System", there were a total of 9 881 registered enterprises operating in the machinery industry in 2014 - roughly 4.8% of all registered companies in manufacturing (Figure 2). If a registered firm has more than one operational workplace, in other words production facilities, these workplaces are counted as separate enterprises[2] to better reflect the spatial dimension of manufacturing activities. On average, the number of machinery enterprises grew 6.3% per annum between 2006 and 2013 and it is not yet clear whether the sharp fall in the number of machinery enterprises in 2014 was a one-year phenomenon or the beginning of a longer trend of contraction. Furthermore, machinery enterprises have grown size since 2009 - albeit at a relatively small rate.

Figure 2. **The number of machinery enterprises and employees per enterprise in Turkey, 2006-2014**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

In 2014, close to 35% of all machinery enterprises were involved in the production of "machinery of other general purpose", whereas the lowest number of enterprises operated in the "metal forming machinery and machine tools" sub-group. Currently, private firms dominate the sector, although there are still a small number of state-owned firms - catering to, predominantly, machinery needs of the defence and the sugar industries.

SMEs dominate the machinery sector

The Turkish machinery sector is characterised by small companies which account for the bulk of employment. In 2013, 80% of the total machinery enterprises had less than 10 employees, whereas only 3.7% more than 50 employees. The dominance of small firms is not coincidental. Unlike, for example, the automotive industry, where economies of scale are particularly crucial, machinery industry is not suitable for mass production. This is partly because of the demand for customised products that are tailored to the needs of buyers.

The low share of medium and large-sized enterprises is much more pronounced in the Turkish than in the EU machinery sector. In 2010, according to Eurostat data, 10.2% of all EU machinery enterprises had more than 50 employees - over three times more than in Turkey at the time. Besides, average employment per enterprise has been steadily increasing in the EU, whilst the number of enterprises tends to fall due mainly to mergers and acquisitions.

From 2009 to 2013, the percentage of Turkish machinery firms employing at least 50 gradually increased (Table 3) - a significant trend since, at the same time, the number of firms also grew constantly. It might be argued, therefore, that there is a slow trend of Turkish machinery enterprises getting bigger in terms of number of employees, and a possible early indication of sector consolidation. Nonetheless, the small scale of firms in the machinery sector remains an ongoing issue which MoSIT also highlighted as a major problem in its latest Industry Strategy Report for 2015-18.

Table 3. **Distribution of machinery enterprises by number of employees, 2009-13**

(% of total)

Number of employees	2009	2010	2011	2012	2013
1-9	80.9	80	79	78.5	79
10-19	8.8	8.6	9	9.2	8.9
20-49	7.5	8.1	8.5	8.8	8.3
50 -249	2.5	2.9	3.1	3.2	3.3
>250	0.3	0.4	0.4	0.4	0.4
Total	100	100	100	100	100

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database.

Compared to other manufacturing sectors, the machinery sector is characterized by a relatively high manufacturing depth, which is defined as the value added which the company itself contributes to the manufacture of a product (ISPAT, 2014b). The high manufacturing depth is chiefly attributable to demand for highly customised products that require close co-operation between end customers and internal departments during the engineering and design phases of machinery products.

In order for the machinery enterprises to be able to respond to specific and increasingly sophisticated customer demands, they need to invest in the most up-to-date technologies and develop unique high-technology products (Foresight, 2013). Therefore, the mostly of small family-run enterprises that typify the current structure of the Turkish machinery industry are unlikely to be able to fulfil the capital requirements

of high-technology manufacturing. Previous OECD studies reconfirm that enterprise size is positively correlated with innovation - in other words, micro-firms, on average, report less innovation activities (OECD, 2009b). The unusually small size of machinery enterprises in Turkey is repeatedly highlighted in the strategy documents of MoSIT and MoD as one of the major problems in the sector.

There is a limited number of very large firms specialised in machinery production

The highly fragmented production structure in the machinery sector could be further confirmed in the list of Turkey's top 1000 industrial enterprises, drawn up annually by the Istanbul Chamber of Industry (ISO) according to the net sales of the enterprises. In the 2014 edition, the majority of the biggest companies were in the petrochemical, automotive, and steel and iron industries. Only 23 firms[3], whose main operational area was defined as machinery manufacturing, made it into the list. It is worth noting, nevertheless, that both the rankings and the number of machinery enterprises improved compared to the previous year, when there were only nine firms in the top 500 (Table 4).

Table 4. **Turkey's largest machinery enterprises, 2014**

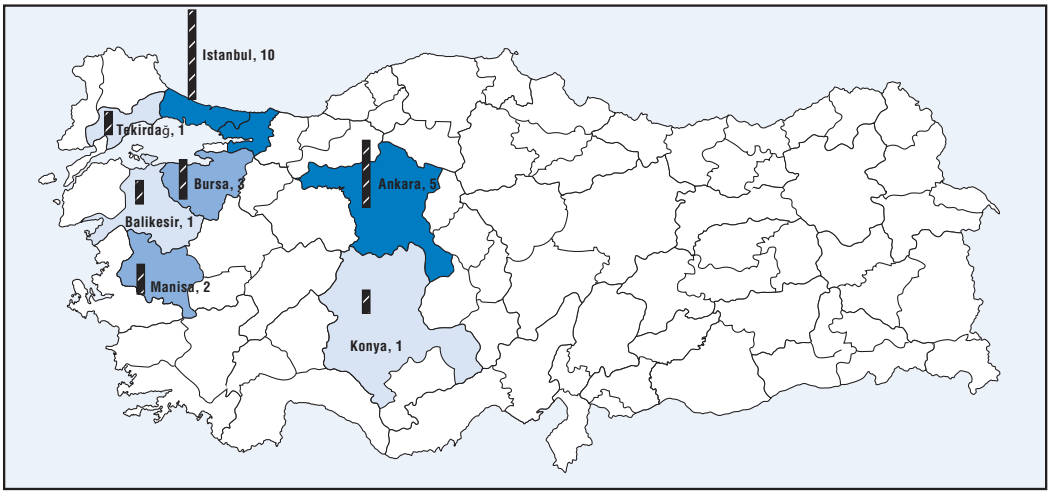
2014 ranking	Name of enterprise	Operational area	Sales (TRY billion)
1	TÜPRAŞ (Türkiye Petrol Rafinerileri A.Ş.)	Petrochemicals	37.5
2	Ford Otomotiv	Automotive	10.5
3	Oyak-Renault	Automotive	8.8
4	Arçelik	Domestic appliances	8.5
5	EÜAŞ	Electricity generation	6.7
6	İçdaş Çelik	Steel and Iron	6.3
7	İskenderun Demir ve Çelik	Steel and Iron	6.2
8	Ereğli Demir ve Çelik	Steel and Iron	6.1
9	Tofaş	Automotive	6.0
10	Aygaz	Petrochemicals	5.7
(…)			
24	Türk Traktör ve Ziraat Makineleri	Machinery	2.7
148	(Not disclosed)	Machinery	(Not disclosed)
165	Hidromek	Machinery	0.6
196	Federal-Mogul	Machinery	0.6
231	Tümosan	Machinery	0.4

Source: Istanbul Chamber of Industry (2014a), "Türkiye'nin 500 Büyük Sanayi Kuruluşu" (Turkey's 500 Biggest Manufacturing Companies), Istanbul Chamber of Industry, www.iso.org.tr/news/ici-announced-the-icis-Turkeys-top-500-industrial-enterprises-2014-survey-results/.

According to the sales made in 2014, Türk Traktör ve Ziraat Makineleri A.Ş., which is specialised in "agricultural machinery", was the leading company in the machinery sector with 2.7 billion TRY worth of sales. In addition, Türk Traktör was also the only machinery firm to make it into the top 100 in the ISO List. It was followed by an undisclosed firm in Istanbul and Hidromek, which produces construction machinery.

The ISO list also revealed that, in 2014, the biggest machinery enterprises were based in seven provinces, namely Istanbul, Ankara, Bursa, Manisa, Konya, Balıkesir and Tekirdağ (Figure 3). However, it needs to be underlined that being registered in these provinces does not necessarily mean that all production takes place in those same provinces. On another note, 5 of the 23 biggest machinery enterprises were majority-owned by foreign investors.

Figure 3. **Spatial distribution of the largest machinery firms, 2014**

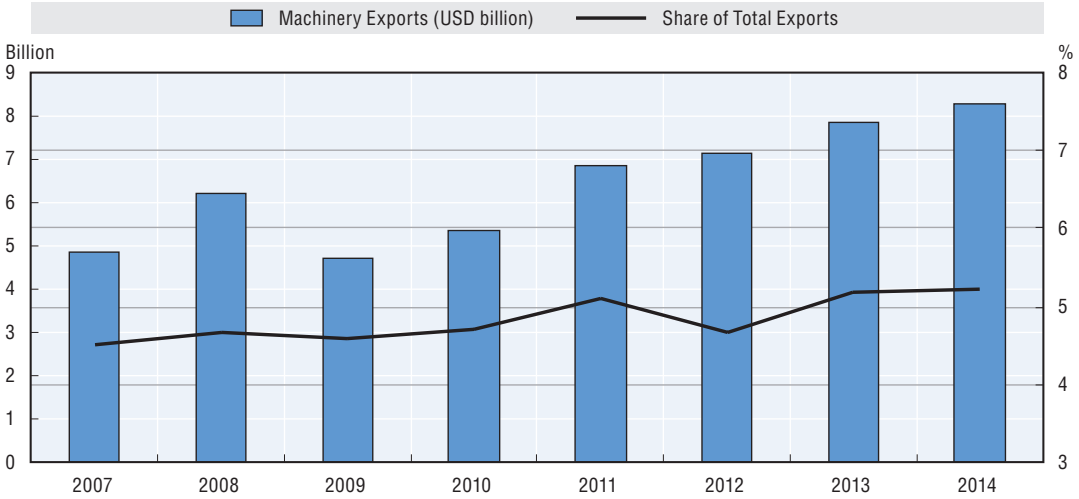


Source: Istanbul Chamber of Industry (2014a), "Türkiye'nin 500 Büyük Sanayi Kuruluşu" (Turkey's 500 Biggest Manufacturing Companies), Istanbul, http://www.iso.org.tr/news/ici-announced-the-icis-Turkeys-top-500-industrial-enterprises-2014-survey-results/; OECD analysis.

Trade and foreign direct investment performance

The Turkish machinery sector has shown a strong export performance in the last decade, and the machinery exports grew by close to 8% between 2007 and 2014. Exports fell only in 2009 during the financial crisis, however they rebounded strongly afterwards (Figure 4). In 2014, Turkey's machinery industry recorded exports of USD 8.3 billion, making it the world's 27th biggest exporter - ten places higher than in 2000.

Figure 4. **Turkey's machinery exports, 2007-2014**



Source: TurkStat Database; OECD analysis

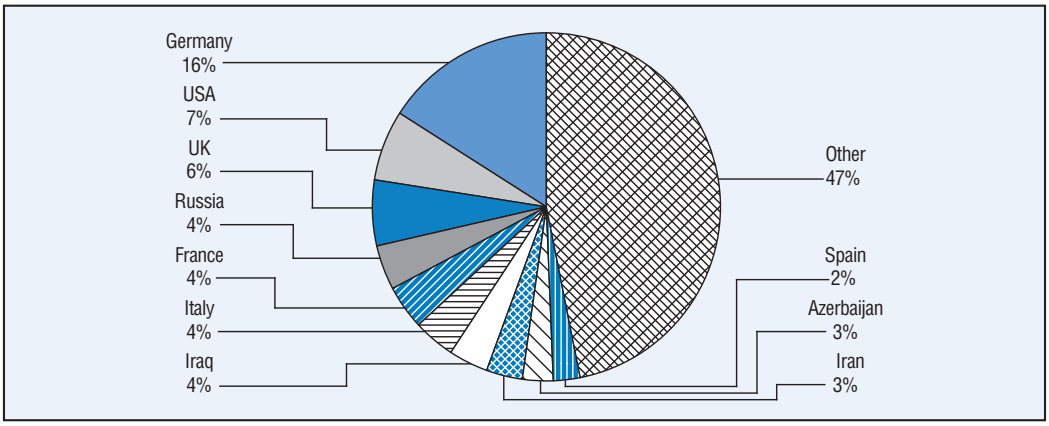
In 2013, machinery exports accounted for 5.3% of Turkey's total exports and ranked a close fifth behind the woven garments and accessories industry in NACE Rev.2 classification. With a share of 13.1%, the manufacture of motor vehicles and trailers was the leading export sector in Turkey.

Turkey exports to the world's main producers of machinery

The Turkish machinery sector is well integrated into the world trade, exporting to more than 200 countries worldwide. The top three markets for Turkish machinery exports are Germany, the United States and the United Kingdom (Figure 5). In 2014,

close to 30% of the total machinery products were exported to these three countries only. A large share of exports to countries with advanced machinery industries, such as Germany, the United States and Italy, may be seen as an indication of the growing competitiveness of the Turkish machinery industry in the world.

Figure 5. **Turkey's machinery exports by destination, 2014**



Source: TurkStat Database; OECD analysis

Turkey has set ambitious export targets for the machinery sector.

A study conducted by the Turkish Exporters' Assembly (with its Turkish acronym TIM) reveals that the Turkish machinery sector has an overall export target of USD 100 billion in 2023 (TIM, 2010). In order to achieve this target, machinery exports need to grow by almost 18% per annum over the period of 2008-2023, whilst increasing their share of Turkey's 2023 export targets to 20% and becoming the country's largest exporting sector. The largest export increases are projected for the metal forming and machine tool sub-sectors.

Although machinery exports are gradually claiming larger shares of Turkey's total exports, it needs to continue doing at a much faster rate than the other sectors in order to meet the ambitious target of 20% of Turkey's total exports by 2023.

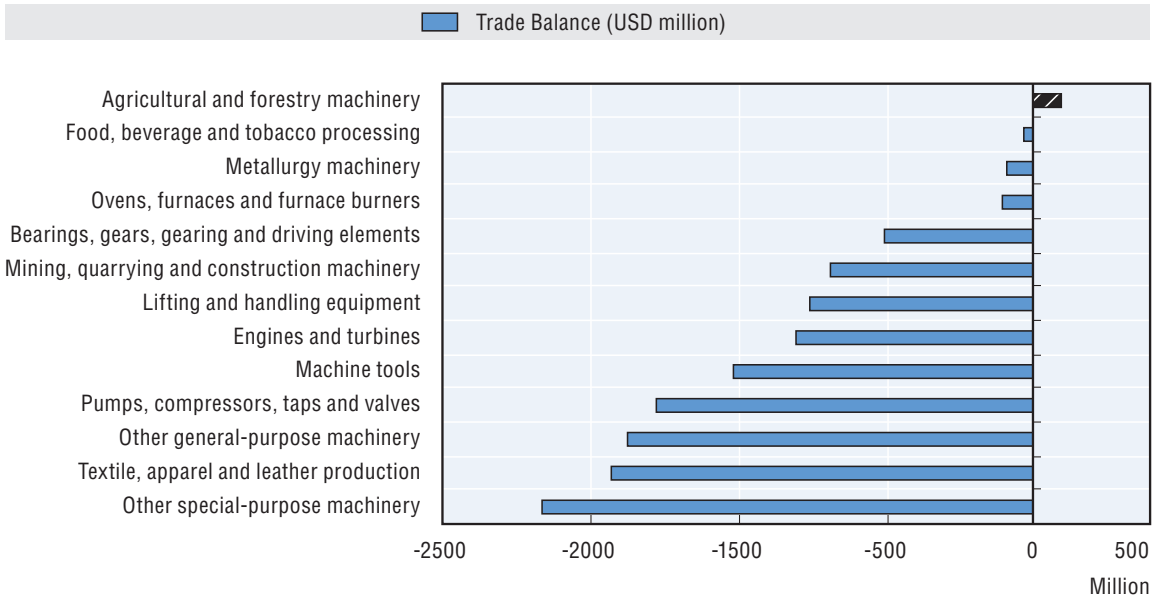
In addition, the TIM study identifies 38 countries as target markets for the machinery sector. Amongst them, a special attention is given to Russia, India and Brazil as new target markets. It is projected that the largest increases in exports will occur in those countries as demand for machinery products shifts to emerging countries.

Turkey has a large trade deficit in the machinery sector

Turkey has remarkably increased its exports in a relatively short span of time - by 2013, it was Europe's sixth biggest exporter in the machinery sector. However, the sector's dependence on imports is still high - the value of its exports is only 42% of the value of its imports. Notwithstanding that the trade deficit has shrunk by close to 15% since 2011, it still stood at USD 15 billion in 2014.

With the sole exception of agricultural and forestry machinery, Turkey has a trade deficit in all sub-branches of its machinery industry (Figure 6). The largest trade deficit is observed in the manufacture of textile, apparel and leather machinery sub-sector and power-related machinery e.g. pumps and compressors.

Figure 6. **Trade balance in Turkey's machinery sub-sectors, 2014**



Source: TurkStat Database, OECD analysis

The share of imported inputs is comparably low

According to the statistics from the Turkish Development Bank (TKB) and MoSIT, the machinery industry imports slightly more than 15% of all the inputs required in the production phase. Therefore, compared with some other manufacturing sectors like the automotive industry, its dependence on foreign suppliers is low. However, for certain machinery products that are most R&D-intensive such as turbines and engines, the share of imported input might go up to 50%. On average, the expansion of Turkey's machinery sector production would positively contribute to trade balance and current account if its reliance on domestic inputs were to continue.

Domestic trade for the Turkish machinery industry is dominated by intra-sectoral trade

In 2013, close to one-third of all domestic sales and purchases by Turkish machinery firms are made to and from other machinery firms in the country (Table 5). This large volume of intra-sectoral trade highlights the fragmented production in the machinery industry and reconfirms the prevalent use of domestic intermediate input. The strong linkages between machinery firms in Turkey might also strengthen clustering trends, which are analysed in greater depth in the following sections.

Concerning the inter-sectoral domestic trade, most sales of machinery products were made to the firms producing electrical equipment, closely followed by automotive firms, whereas Turkish machinery firms made their purchases, by and large, from the basic metals sector (Table 5). Although the usage of steel and iron is indispensable to the machinery industry, the end-customer sectors of machinery products vary according to the industrial composition of countries and internal markets. Turkey's relatively well-developed vehicle and domestic appliances industries explain the high demand for machinery products from the automotive and electrical equipment sectors.

Table 5. **Inter-sectoral domestic trade involving the machinery industry, 2013**

	Machinery sector domestic sales	Share	Machinery sector domestic purchases	Share
1	Machinery	28.4%	Machinery	27.3%
2	Electrical Equipment (NACE Rev. 2 Code: 27)	12.8%	Basic Metals (NACE Rev.2 Code:24)	22.5%
3	Automotive (NACE Rev. 2. Code: 29)	10.8%	Fabricated Metal Products (NACE Rev. 2 Code: 23)	14.0%
4	Fabricated Metal Products (NACE Rev. 2 Code: 23)	7.4%	Automotive (NACE Rev. 2. Code: 29)	9.7%
5	Food Products (NACE Rev. 2 Code: 10)	6.9%	Electrical Equipment (NACE Rev. 2 Code: 27)	6.8%
	Total share	66.4%	Total share	80.5%

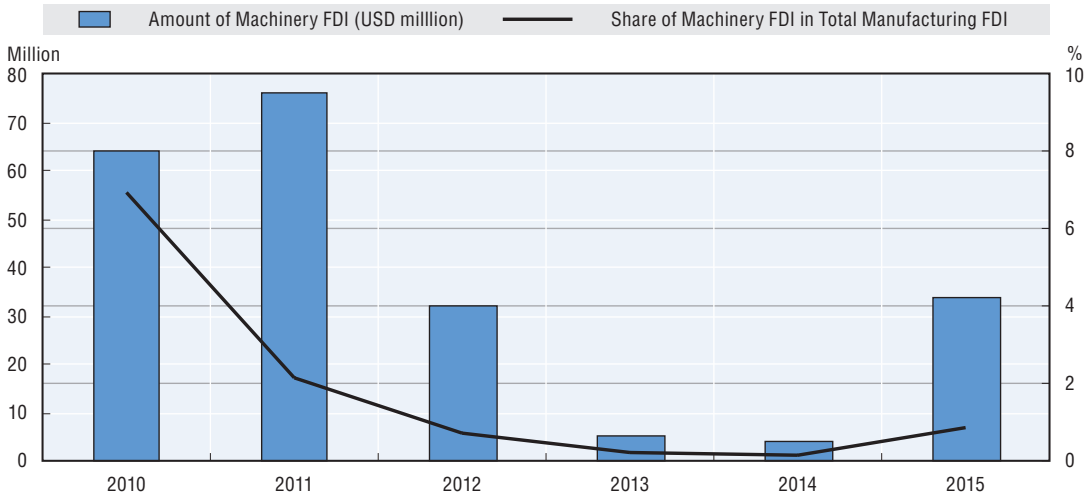
Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis

The Turkish machinery sector struggles to remain as the growth driver for overall manufacturing FDI

In the 2000s, Turkey witnessed a surge in inflows of foreign direct investment (FDI) to the machinery sector, in particular from East Asia and Europe. Companies like Huawei, Daikin, Foxconn or Alstom established production facilities which serve both domestic and regional markets (ISPAT,2014a).

According to the statistics published by the Central Bank of Turkey, growth in FDI in the machinery sector was 64% between 2005 and 2011. It far outstripped average growth in overall manufacturing FDI, which was around 27% for the same period. However, this positive trend in machinery sector FDI inflow during the first decade of 2000s seems to have radically reversed after 2011. Both the amount and the share of machinery sector FDI suddenly plummeted after 2012 (Figure 7). In 2014, it stood at USD 4 million, which equalled to, only, 0.1% of all FDI flowing into manufacturing in Turkey.

Figure 7. **FDI inflows in the machinery sector, 2010-2015**



Source: Ministry of Economy (2016), "Uluslararası Doğrudan Yatırım Verileri Bülteni – Haziran 2016" (Foreign Direct Investment Data Bulletin – June 2016), Ankara, www.ekonomi.gov.tr/portal/content/conn/UCM/uuid/dDocName:EK-226930; OECD analysis

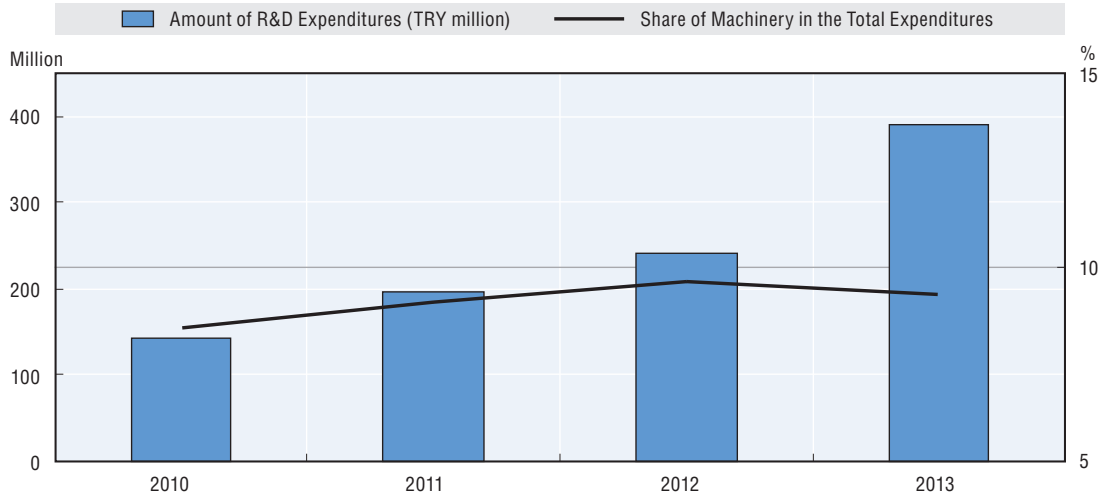
In January 2016, there were a total of 6 192 manufacturing firms with foreign capital operating in Turkey. Out of them, 512 firms stated that their primary operational area was the production of machinery and equipment - which equalled close to 8% of all manufacturing firms with foreign capital in Turkey. The highest number of manufacturing firms with foreign capital, 680 to be precise, operates in the chemical industry.

R&D and innovation

Turkish machinery firms intensify their R&D activities

There is a growing indication that, despite the prevalence of family-run micro-enterprises, the Turkish machinery industry is becoming more R&D intensive. Private sector expenditure on R&D activities has risen rapidly in a relatively short time (Figure 8). The machinery sector's share of R&D expenditures was close to 10% of all R&D expenditure in the entire manufacturing sector.

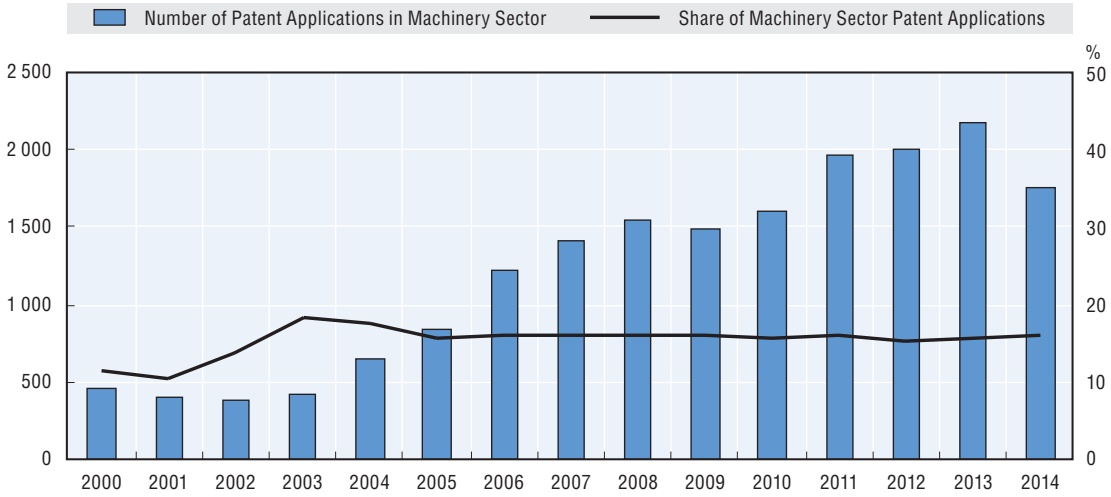
Figure 8. **Private sector R&D expenditure in the machinery sector, 2010-2014**



Source: TurkStat Database; OECD analysis

In parallel with the growing R&D expenditure, patent applications in the machinery sector demonstrated an upward trend during 2004-2013 (Figure 9). In 2014, the number of patent applications shrank for the first time since 2009, when the Turkish economy contracted by close to 5%.

Figure 9. **Patent applications in the machinery sector, 2000-2014**



Source: Turkish Patent Institute, www.tpe.gov.tr/TurkPatentEnstitusu/statistics/; OECD analysis.

The growing focus on R&D in the private sector has been boosted by the R&D Centre Support Programme, which MoSIT rolled out in 2009 with the purpose of encouraging R&D activities in manufacturing. Since the inception of the programme, 186 companies have received R&D Centre certificates and, as of January 2015, 165 R&D Centres were still operational. The largest number of these R&D Centres, roughly one-fourth of all, was carrying out their activities for the automotive industry. The machinery R&D Centres are presented in the Table below.

Table 6. **Machinery firms' R&D centres, 2015**

#	Name of R&D Centre	Location	Date of establishment
1	HIDROMEK	Ankara	2006
2	Hakkı Usta Oğulları	Aydın	2008
3	Baykal Machinery	Bursa	2010
4	Durmazlar Machinery	Bursa	2012
5	Ermaksan Machinery	Bursa	2011
6	Eti Machinery	Eskişehir	2011
7	Hisarlar Machinery	Eskişehir	2012
8	Sanko Machinery	Gaziantep	2014
9	Akım Metal Industry	Istanbul	2013
10	Repkon Machinery and Mould	Istanbul	2012
11	İzeltaş Izmir	Izmir	2012
12	Norm Civata Industry	Izmir	2014
13	CVS Machinery	Kocaeli	2014
14	Başak Agricultural Machinery	Sakarya	2014

Source: Ministry of Science, Industry and Technology, R&D Centres website, https://biltek.sanayi.gov.tr/sayfalar/argeDetay.aspx (accessed on 1 February 2016).

Sector strategies and policies

National policies encourage the development of the machinery sector

In the 10th Development Plan of Turkey prepared by MoD, one of the stated priorities is to encourage transformation in the manufacturing industry so that high value-added production and increased share of high-technology sectors in the economy are achieved. This transformation is highlighted as vital if Turkey is to improve its competitiveness and increase its share of world exports.

Although the 10th Development Plan does not single out the machinery sector as a manufacturing priority, it nevertheless sets an overall target; that is to provide support to the products and services which will enable custom-made, high-quality, and high-performance manufacturing in the machinery sector.

Sector-specific documents proliferated with the EU accession process

In ***Turkey Industry Strategy 2011-2014*** [2010], MoSIT commits itself to preparing sector-specific strategies. These strategies were considered as an initial step in boosting the competitiveness of Turkey's manufacturing sectors as part of the effort order to bring them on par with the EU standards. To achieve this, MoSIT benefitted from an EU-funded project that helped the Ministry to strengthen its administrative and technical capacity in the preparation of industrial strategies.[4]

The overarching strategy for the machinery sector was prepared by MoSIT for the first time in 2011 spanning a three-year period to 2014 (Box 2). As of 2016, the second three-year strategy document was still in preparation process although the draft document has been shared online in order to receive feedback from sector representatives. Apart from the strategy documents, MoSIT has also been preparing, since 2012, bi-annual machinery sector reports. They principally overview the latest developments in the industry and provide the most recent statistics.

However, MoSIT is not the only institution which has drawn up sector-specific documents. Occasionally with the financial support provided by the DAs, several provincial chambers of industry have published machinery sector reports in which they set out strategic directions for their regions and Turkey. One notable example is the machinery sector report published in 2010 by ISO as part of a project entitled "Enhancing the ISO Sector Strategies during the EU Accession Process".

Box 2. **Recommendations from the machinery strategy report of the Ministry of Science, Industry and Technology**

In its 2011-14 Machinery Strategy Report, MoSIT makes recommendations that can be arranged into five targets: i) Legal Arrangements and Structural Reforms, ii) Improvement of Financial Tools, iii) Qualified Human Resources, iv) Marketing, Foreign Trade and Promotion, v) R&D and Innovation. Although the action plan is composed of a long list of to-do items, MoSIT particularly underlines the need for increased support for R&D activities. Greater support is vital not only to improving the quality and, by the same token, the competitiveness of Turkish products in the long term, but also to starting to producing goods that have hitherto been supplied solely through imports, so giving rise to a trade deficit in the machinery sector and economy in general. In this regard, it has been also highlighted that the sector lacks a dedicated centre or technology institute.

As for challenges, access to finance is cited as the most pressing problem of the manufacturing sector. Without exception, all existing strategy reports point out that Turkish machine manufacturers struggle to compete internationally due to lack of export financing and domestically because there are no special credit schemes for purchasing of domestically produced machinery. In Turkey, there are up to now no specialised public financing programmes tailored to the needs of machine producers. Therefore, the majority of the reports call for the Turkish Export Promotion Bank (EXIMBANK) to open new lines of credit and financing and to allow companies to use their machinery and equipment assets as collateral in loan applications.

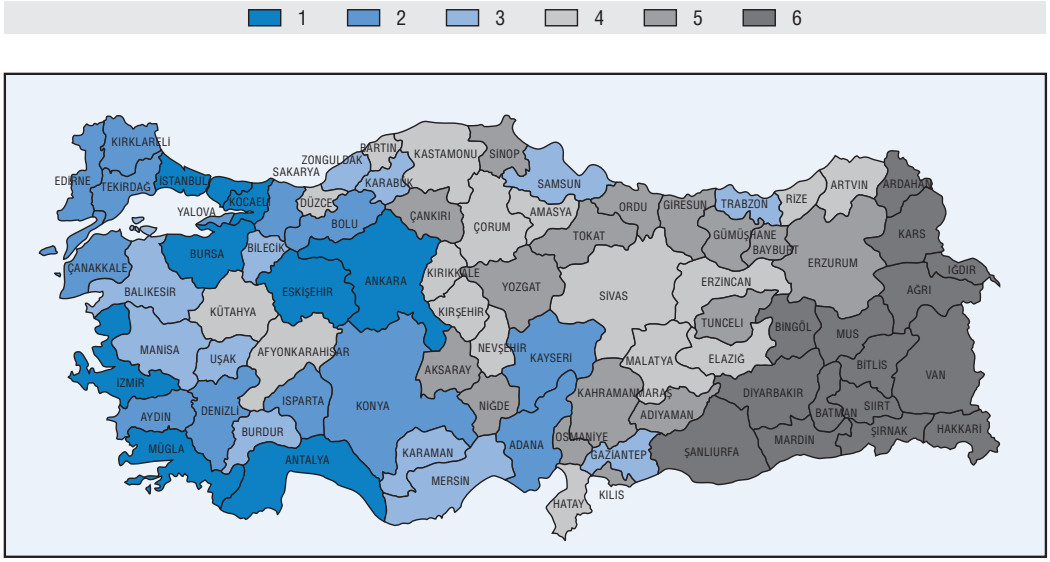
Source: MoSIT (2011), Makine Sektörü Strateji Belgesi ve Eylem Planı 2011-14 (Machinery Strategy Report and Action Plan 2011-14), http://www.sanayi.gov.tr/Files/Documents/makine_sektoru_strateji_b-23052011142400.pdf.

Government incentives are available for machinery sector investments

The machinery sector is one of the many sectors, whose investment is highly supported by the Government under the new incentive system, which was officially introduced in April 2012. The incentive system has the two-fold objective of i) encouraging investments that have the potential to reduce reliance on imported intermediate goods that are vital to the country's strategic sectors and ii) boosting investment in the less developed regions to reduce regional disparities.

The regional investment incentives scheme - one of the four elements of the overall investment incentives scheme - sorts Turkey's provinces into six areas according to their socio-economic development. This regional scheme offers the less developed areas (especially the 4th, 5th and 6th) favourable treatment in the shape of more generous subsidies and tax exemptions (Figure 10).

Figure 10. **The classification of Turkey's provinces under the regional investment incentive scheme, 2012**



Source: Ministry of Economy, "Bölgesel Teşvik Sistemi" (Regional Incentive System), webpage, http://www.ekonomi.gov.tr/portal/content/conn/UCM/path/Contribution%20Folders/web/Yat%C4%B1r%C4%B1m/Yat%C4%B1r%C4%B1m%20Te%C5%9Fvik%20Sistemi/Tesvik_Haritasi.html?lve&. (accessed on 1 April 2016).

Under this incentive system, there are four different schemes, from which machinery industry investments could benefit. First, under the Regional Investment Incentives Scheme there are specific incentives varying in accordance with the development level of provinces and machinery sector investments could take advantage from this scheme as long as the investment value is higher than at least TRY 500 000. Depending on the regions' classification under the Investment Incentive Scheme, the minimum investment amount could go up to TRY 4 million. Second, a more generous set of incentives applies to investments in machinery of above TRY 50 million under the Large-Scale Investment Incentives Scheme. As for the General Investment Incentives Scheme and the Strategic Investment Incentives Scheme, they are not restricted to any one sector.

In addition to the incentive system, there are various other support programmes, such as R&D grants and export-oriented grant programmes, which are being implemented by government institutions and include machinery industry investments in their scope. However, a study carried out by the Economic Policy Research Foundation of Turkey (TEPAV) found that machinery firms do not truly take advantage of the multitude of grant programmes - either because of the lack of information on the programmes' existence or because of cumbersome application procedures.

Policies encourage the usage of domestic inputs for the machinery sector

The MoE's Input Supply Strategy for 2013-2015 recommended a stocktaking study to uncover the specific input needs of the machinery industry. Considering the sector's heavy dependence on iron and steel products, the MoE favours supporting projects that contribute to strengthening linkages between the machinery and iron-steel industries in Turkey, thereby reducing the use of imported input in the manufacturing process.

The share of industrial electric and electronic supplies can be as high as 35% 40% in the total cost of certain machinery products. The MoE acknowledges that a significant proportion of electronics input is currently not being produced in Turkey, which creates a current account deficit in the machinery industry. An initial feasibility study is suggested by the Ministry to better grasp the industry's specific needs, evaluate Turkey's capacity to produce the industrial electronic products it requires, and support accordingly investment in the high-value added industrial electronic sub-sector.

Turkish machinery products are favoured in public procurement

Since January 2015, a 15% price reduction advantage has been automatically applied to bids from domestic producers in the public procurement of all medium- and high-technology products.[5] This advantage provided to the domestic products is perceived as a tangible step by the government to support high value added production and reduce the current account deficit (Kamu İhale Kurumu, 2015).

The complete list of medium and high-technology products eligible for special treatment under public procurement is annually prepared by MoSIT in line with the Eurostat classification of manufacturing technology intensity. The machinery industry as a whole was included in the first list prepared by MoSIT in 2015.

OECD and EU countries resort to different alternatives to boost domestic firms' participation in public tender. They often encourage small and medium-sized enterprises (SMEs) to take part in public procurement bids to promote innovation, domestic production and they usually do so by splitting contracts into lots and limiting restrictive qualification requirements (OECD,2014c).

2.3. Spatial analyses of the Turkish machinery sector

Current spatial picture

In 2014, a total of 9 881 enterprises operated in the machinery industry according to MoSIT's Entrepreneur Information Database. Close to 35% of those enterprises were based in Istanbul (TR10), while Ankara (TR51), with 11%, had the second highest share of machinery enterprises in Turkey. In terms of number of enterprises, three regional clusters stand out as the main agglomeration areas for machinery production, and these three clusters combined have close to 80% of all the enterprises in Turkey (Table 7).

Table 7. **Agglomeration of machinery enterprises, 2014**

Rank	Name of the cluster	Provinces	Clusters' share of enterprises	Clusters' shares of employees
1	Eastern Marmara Cluster	Istanbul, Bursa, Kocaeli, Sakarya	46.9%	44.1%
2	Central Anatolian Cluster	Ankara, Konya, Eskişehir	19.7%	17.7%
3	Aegean Cluster	Izmir, Manisa, Aydın, Denizli	13.1%	17.2%
			Total: 79.7%	**Total: 79.1%**

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Examination of the distribution of employees in the machinery industry paints a similar picture. The largest number of employees is registered in Istanbul (TR10), followed by Izmir (TR31) and Bursa (TR41). Although a Turkish machinery manufacturing enterprise employs 13 people on average, there are significant regional variations. In the provinces with at least 100 machinery enterprises, Tekirdağ (TR21) and Aydın (TR32) have the largest enterprises, employing on average 39 and 33 people, whereas Istanbul (TR10) with 9 employees falls way below the national average (Table 8).

Table 8. **The leading provinces in machinery manufacturing, 2014**

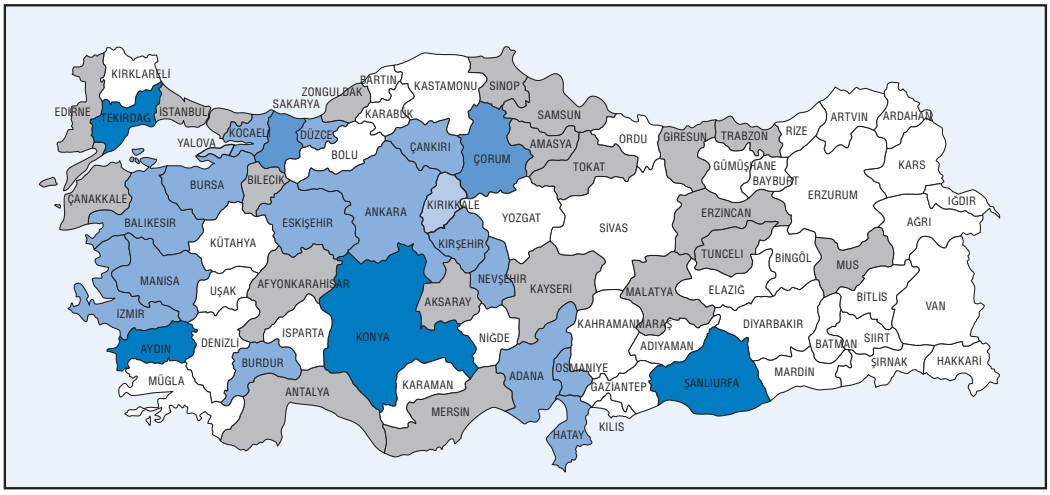
Provinces	Share of total enterprises	Share of total employees	Average enterprise size	Share of total net sales
Istanbul (TR 10)	34.6	23.7	9	31.0
Ankara (TR 51)	10.6	8.6	10	16.1
Izmir (TR 31)	9.8	11.6	15	8.3
Konya (TR 52)	7.9	7.9	13	5.1
Bursa (TR 41)	7.3	11.4	20	12.7

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

In order to better quantify how the machinery industry is concentrated in provincial and regional economies in comparison with Turkey's entire manufacturing industry, the location quotient (LQ) is calculated for each province based on employment.[6] An LQ value of "1" means the province and entire country are equally specialised in the machinery industry, while a value of more than "1" signifies that concentration is greater provincially than nationally. While the LQ does not directly measure comparative advantage, this indicator highlights the provinces in whose economy the machinery industry is more prominent, as well as potentially more export-oriented.

According to the LQ values calculated for all Turkish provinces in 2014, the machinery industry was most heavily concentrated in Aydın (TR32), Tekirdağ (TR21), Konya (TR52) and Şanlıurfa (TRC2) (Figure 11). Although Istanbul was, by far, the most crucial location for the machinery sector, the LQ for the sector is only 0.59 indicating that Istanbul's economy is not specialized in the machinery industry in terms of employment.

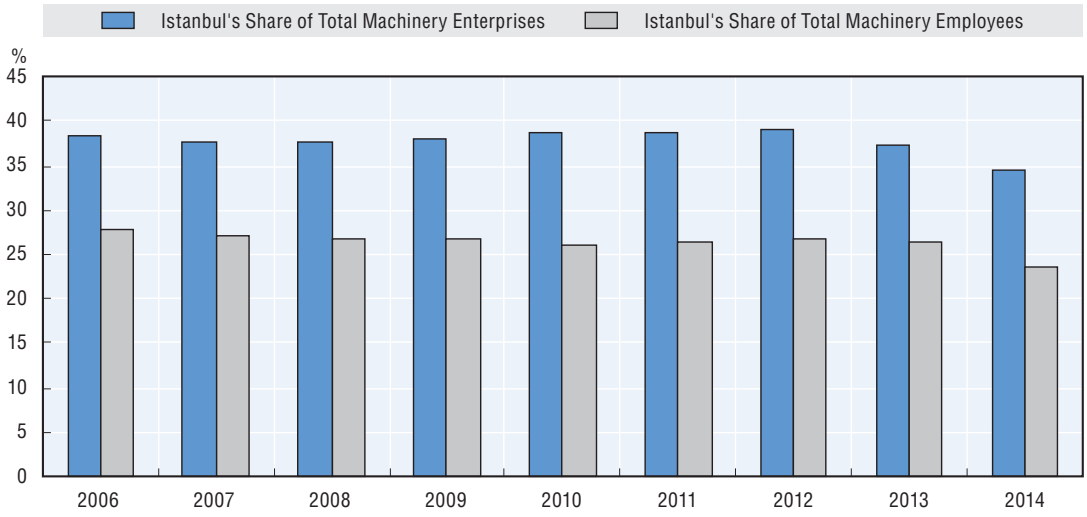
Figure 11. **Location quotients for the machinery industry in Turkey's provinces, 2014**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Although the number of machinery enterprises in Istanbul keeps steadily increasing, the province's share of enterprises and employees nationwide has declined sharply since 2012. Over a period of 9 years, the proportion of workers employed in machinery dropped by close to 5 percentage points - albeit the drop has become more noticeable since 2012 (Figure 12). A similar, yet less pronounced, fall can also be observed in Istanbul's share of enterprises in the country.

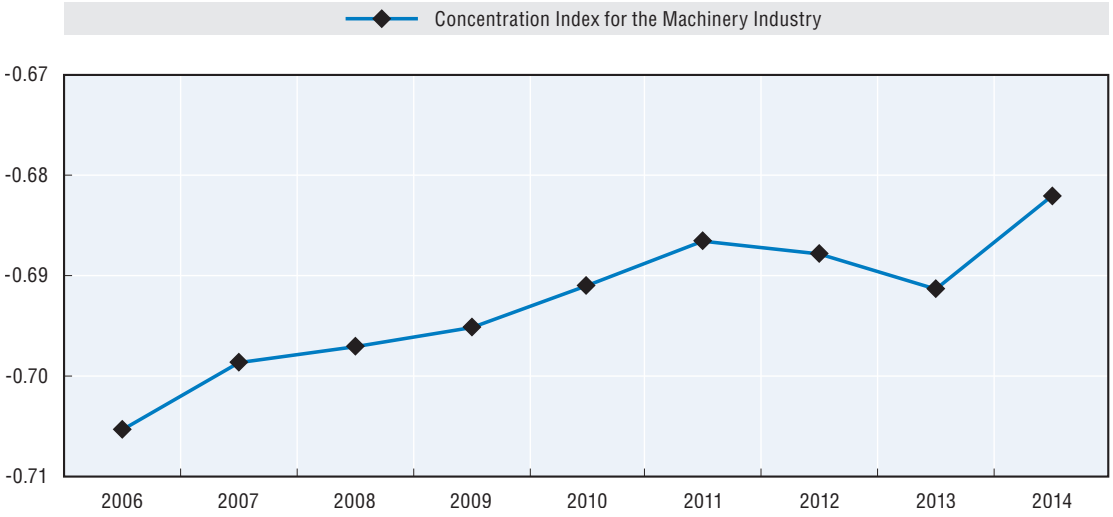
Figure 12. **Istanbul's share of machinery enterprises and employees, 2006-2014**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Based on the employee numbers of provinces, the concentration index[7] for the machinery industry in Turkey is calculated and shown in the Figure 13 below. If all the provinces had exactly the same number of employees, the concentration index would be equal to zero. However, since the index yields negative values, it indicates that there is a disproportionate concentration of employees in a few provinces. The concentration index has a small, but consistent, increase over a short span of time, so moving closer to zero. Therefore, there is an indication that machinery manufacturing activities became more scattered across the country between 2006 and 2014.

Figure 13. **The concentration index for the machinery industry, 2006-2014**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Despite the trend of machinery manufacturing activities getting spatially more diffuse, the machinery industry remains, comparatively speaking, one of the more geographically concentrated manufacturing sectors in Turkey (Table 9). The manufacture of non-metallic mineral products and food products seem to be among the spatially most widely scattered manufacturing sectors in Turkey.

Table 9. **The concentration index for selected manufacturing sectors, 2014**

NACE Rev.2 Sectors	CI Value
Other non-metallic mineral products	-0.559
Food products	-0.569
Chemicals	-0.661
Machinery	-0.685
Basic metals	-0.714
Textiles	-0.729

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Istanbul is the largest machinery exporting province in Turkey

In 2014, 10 provinces accounted for 90% of Turkey's total machinery exports, with 36% originating from Istanbul and Ankara having the biggest shares of 36% and 16% respectively. Although Istanbul's machinery companies continuously increase their machinery exports, the province's nationwide share is gradually shrinking. Other provinces, by contrast, have strengthened theirs'. Gaziantep (TRC1), for example, emerged in the early 2000s as an exporter of machinery products, in particular specializing in the production of machinery for textiles and apparel.

Box 3. **Data privacy in official statistics**

Concerning the export figures of the Turkish machinery and chemical industries, complete and accurate breakdown of export figures by province or sub-sector could not be accurately gathered. In accordance with the regulation approved in 2006, TurkStat is allowed to share individual firm-level data as long as they are grouped together and presented in a table format. This proviso is especially problematic when analysis is carried out at the 4-digit product level. Most provinces have a very small number of firms operating in specific products.

Furthermore, in certain cases, TurkStat might not publish or share the aggregated data if one of the following "data confidentiality" restrictions apply:

- The number of statistical units is less than 3.
- The number of statistical units is above 3, but one unit's value constitutes more than 80%, or the two unit's combined value constitute more than 90% of the total value.

The confidential data could, however, be shared and published as long as they are aggregated with other data in such a way that confidential data was not indirectly revealed.

Source: The Turkish Official Gazette, Türkiye İstatistik Kanunu (Turkey Statistics Law), www.resmigazete.gov.tr/eskiler/2005/11/20051118-1.htm.

Smaller provinces tend to specialise in one of the machinery sub-sectors

In terms of volume of exports, Istanbul seems to be leading in the majority of machinery sub-sectors. Specialisation in one or few machinery products is not apparent for populous and relatively well-developed provinces like Istanbul, Izmir and Gaziantep. However, a slightly different picture emerges in other provinces, such as Aydın, Hatay and Bursa. There, machinery activity concentrates on one sub-sector, in which they sometimes lead exports nationwide (Table 10).

Table 10. **Specialisation of provinces in machinery sub-sectors, 2014**

Province (NUTS II level)	Share of total exports	Leading machinery sub-sector	Share of the leading machinery sub-sector exports in the total exports of the province
Istanbul (TR10)	36.3%	Manufacture of general purpose machinery	24.9%
Ankara (TR51)	16.0%	Manufacture of agricultural and forestry machinery	30.9%
Bursa (TR41)	10.2%	Manufacture of metal forming and machinery tools	40.0%
Izmir (TR31)	9.2%	Manufacture of general purpose machinery	24.2%
Kocaeli (TR42)	5.6%	Manufacture of general purpose machinery	35.8%
Konya (TR 52)	4.8%	Machinery for food, beverage and tobacco processing	27.8%
Aydın (TR 32)	2.3%	Manufacture of general purpose machinery	71.7%
Gaziantep (TRC1)	1.6%	Manufacture of mining, quarry and work machinery	28.9%
Eskişehir (TR 41)	1.5%	Manufacture of other pumps and compressors	35.2%
Hatay (TR 63)	1.2%	Manufacture of general purpose machinery	62.3%
Total	**88.7%**		

Source: TurkStat Database; OECD analysis

Industrial zones specialised in machinery are few and in East Marmara only

As of 2015, there was a total of 281 specialised or mixed "organised industrial zones" (OIZ) in Turkey.[8] Of those, only three are dedicated solely to machinery production and they all are located in the Eastern Marmara Region, i.e. in the same NUTS II region, TR42 (Table 11). However, because of the machinery industry's strong links to other industries, machinery enterprises are also largely present in the mixed OIZs.

The machinery sector is perceived in the TR42 region as highly strategic since it provides significant inputs to other manufacturing sectors, such as the automotive and iron & steel industries, which have a powerful presence in the region. The Eastern Marmara Development Agency has also played an active role in the establishment of the specialised OIZ in Sakarya.

Table 11. **Organised industrial zones (OIZs) that specialise in machinery**

#	Name of specialised OIZ	Province and NUTS II region	Year of OIZ's establishment	Number of enterprises
1	Makine İhtisas Organize Sanayi Bölgesi	Kocaeli – TR42	2001	76
2	Kocaeli Gebze VI (IMES) Makine ihtisas OSB	Kocaeli – TR42	2006	168
3	Sakarya Kaynarca Doğu Marmara Makina İmalatçıları İhtisas OSB	Sakarya – TR42	2014	85

Source: Ministry of Science, Industry and Technology, OIZ Information website, https://osbbs.sanayi.gov.tr/.

MoSIT's ***Machinery Sector Strategy Report*** plans to put in place at least two more OIZs specialising in machinery - one in Bandırma, Balıkesir (TR22) and another one in Silivri, Istanbul (TR10).

Strategic drivers of machinery industry location

Economic driver – proximity to markets

The machinery industry is diverse and comprises numerous segments with different levels of specialisation that require different strategic orientations. The overall trend, however, is that the customers increasingly demand customized machinery products, which brings about the need of customer involvement as early as the product development stage. Accordingly, the firms tend to specialise in a limited set of machinery products and work with a small number of customers.

In addition, today's machinery firms not only supply machinery and equipment to their customers, they also provide after-sales services - e.g. training courses for operators, maintenance and repair - which have become critical over time. In the United States, for example, a crucial player in the machinery industry, roughly 40% of the employment in the industry in 2010 was in service-related activities like marketing, sales, and customer support (McKinsey Global Institute, 2012).

Accordingly, there is a tendency for machinery producers to locate close to their main markets and customers. This is partly to avoid logistics expenses. But this tendency has got a lot to do with the need to conduct needs-assessment and joint engineering studies with customers prior to production and to offer after-sales services to customers in an efficient and rapid manner. This phenomenon is especially pronounced in the machinery tools sub-sector, which produce, among others, special components for the automotive sector in line with the unique needs of vehicle producers. Therefore, a significant proportion of machine tool producers in Turkey is located in the Marmara Region where the automotive industry is particularly well developed. In a similar fashion, European machine tools producers are also relocating some of their activities to East Asia in order to be close to the growing automotive sector there.

Economic driver – agglomeration effects and their limits

The benefits of agglomeration can reinforce geographic concentrations in the machinery industry, leaving the less well developed regions further behind. New machinery enterprises may wish to be located near machinery clusters in the Eastern Marmara or Central Anatolian regions so as to benefit from the presence of a wide variety of specialised suppliers and business services that meet the needs and demands of the industry. In other words, increasing returns to scale, together with forward and backward linkages, allow machinery enterprises to purchase intermediate inputs at lower costs (OECD, 2016d).

The benefits of agglomeration are not limited to the availability of suppliers, though. Agglomeration might also help machinery enterprises tap into the accumulated knowledge as well as available labour pool with relevant experience and skills' set. Moreover, these enterprises may be able to share some indivisible facilities, most notably accredited testing facilities that are indispensable for machinery product certification.

Nonetheless, once the costs of industry agglomeration in a location outweigh its economic benefits, negative externalities hamper the competitiveness of the existing firms and drives the growth of the industry away from agglomeration areas. The costs of agglomeration usually arise due to the exhaustion of existing resources since the demand for them might outstrip the supply of these resources in a specific region.

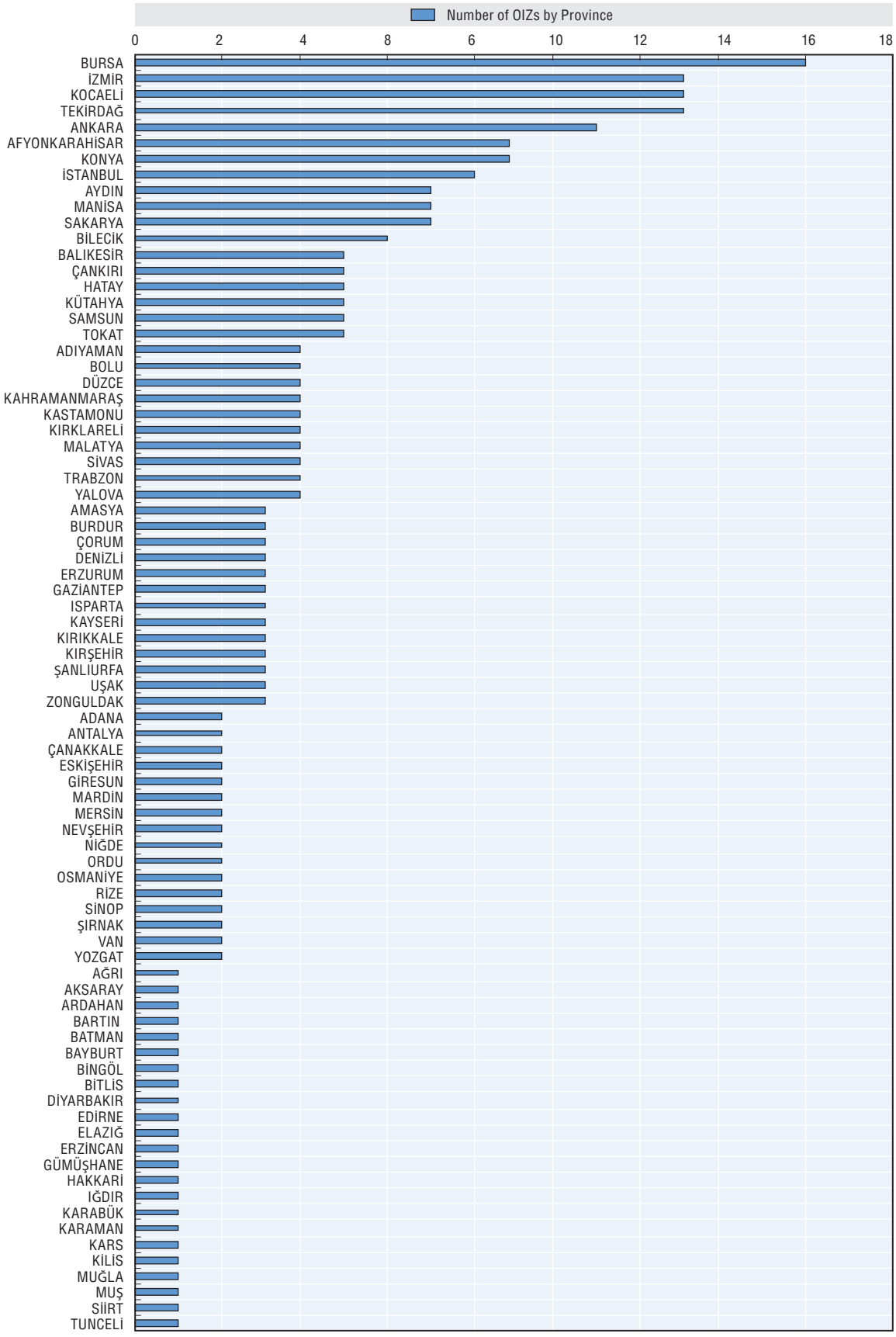
Currently, negative externalities particularly affect heavy industries in big metropolitan areas and they could infringe upon provinces' attractiveness and competitiveness. In the Istanbul area, available land for new investment is quite scarce and expensive, hence pushing up initial fixed costs for enterprises. In addition, enterprises high transport congestion costs in the city centre and along the two bridges crossing the Bosphorus Strait. Last but not least, uncontrolled residential and industrial settlements, as well as industrial waste, have prompted serious environmental concerns triggering the official response of relocating some heavy industries away from Istanbul (OECD, 2008).

Policy driver – cluster policies

There is a wide variety of programmes that could be traditionally offered by governments in order to influence industry's choices of location. The public policy tools are mainly used to reduce regional disparities and mitigate the pollution caused by the concentrations of industries in big cities. One of the tools, which the Turkish government uses principally to encourage industrial development in less developed regions, is cluster policy.

The first OIZ in Turkey was founded in 1961 in Bursa with financial support provided by the World Bank. During the 1970s and 1980s, the number of OIZs in Turkey gradually increased and, in recognition of their growing importance, the then Ministry of Industry and Trade put in place a special fund in 1982. The fund covered up to 99% of infrastructure-related costs of establishing new OIZs. Subsequent to this policy measure regarding clusters, the first piece of legislation regulating OIZs was approved in 2000, and revised further in 2008 (OSBUK, 2015).

Figure 14. **The number of organised industrial zones (OIZs) by province**



Source: Ministry of Science, Industry and Technology, OIZ Information website, https://osbbs.sanayi.gov.tr/.

OIZs enable the well-known investor-friendly environment for firms by providing required transport links, water and power supplies, and waste treatment facilities. Additional incentives are also provided for manufacturers to encourage them to locate in OIZs. In addition to the exclusive support mechanisms provided by Small and Medium Enterprises Development Organisation (KOSGEB), DAs, the MoE and MoSIT, manufacturers located in OIZs enjoy a privileged status under the new incentive system which entitles them to a higher level of financial support compared to the rest of enterprises.

One of the strongly asserted arguments for the public support targeted towards the establishment of OIZs is to foster industrial development in less-developed and depressed regions. In that respect, all Turkey's 81 provinces, with the sole exception of Artvin, have at least one OIZ. However, there are considerable regional variations in their distribution (Figure 14). Twenty-seven provinces - most of them in eastern and south-eastern Turkey- have only 38 OIZs between them - roughly 13% of all OIZs in the country. Therefore, it is arguable whether, in practice, the establishment of OIZs really do favour the less-developed regions of Turkey.

The OECD countries' experience demonstrates that the aim of the creation of such zones in the context of regional development policies should be to catalyse development whilst capitalizing on regions' comparative advantages. Peripheral regions are unlikely to succeed unless economic zones are organised around region specific sources of comparative advantage (OECD, 2014d). Nonetheless, internal politics usually make it difficult to undertake the site selection process for economic zones on the basis of clearly defined objective criteria. In the case of Turkey, the concentration of the OIZs in more prosperous provinces and growth poles shows that decisions on where to site OIZs have been less prone to internal politics and arguably more responsive to the demands and regional preferences of private sector.

A second crucial initiative regarding cluster policies is the Cluster Support Programme, which was launched in 2013 by MoSIT. A budget of USD 9 million was earmarked under this Programme for a period of five years. Irrespective of the sector, this Programme provides financial support to projects and work plans of clusters, which show potential for competitiveness and sustainability. Although clusters belonging to every sector, including tourism, are eligible for financial support, the preference is given to manufacturing industry clusters. The only eligibility prerequisite is that clusters should comprise at least one regional chamber of industry or trade, one university and 20 enterprises operating in the cluster's primary operational area. Since the start of this program, no machinery clusters have benefitted from financial support, although some existing clusters have recently acquired legal status (Box 4).

Box 4. **Case study: İŞİM (Work and Construction Machinery Cluster)**

In Turkey, the first cluster in the machinery sector was the Work and Construction Machinery Cluster (İŞİM), officially established in 2007 under the terms of a protocol signed by Çankaya University and the OSTIM OIZ in Ankara. The primary purpose of the cluster was to increase the competitiveness of firms in the work and construction machinery sub-sector located in the OSTIM.

In 2013, Turkey was the 4th largest market in Europe in terms of sales of work and construction machinery. Exports amounted to roughly USS 1.5 billion - 10% of all exports in the machinery sector. Therefore, the work and construction machinery is regarded as an important machinery sub-sector for Turkey.

Capitalising on the experience of working for the public sector, Ankara has gradually become an area of agglomeration in work and construction machinery production. OSTIM OIZ is the nationwide centre in terms of volume of production and sales of work and construction machinery. As of 2014, there were 120 specialised enterprises, almost half of which were exporters. The firms in the cluster specialise in the following areas: light construction machinery, special-purpose work machinery, conveyors and scaffolding systems, concrete plants, crushing and screening facilities, asphalt factories, and spare parts for works machinery.

Source: ISIM Work and Construction Machinery Cluster, website, www.isim.org.tr.

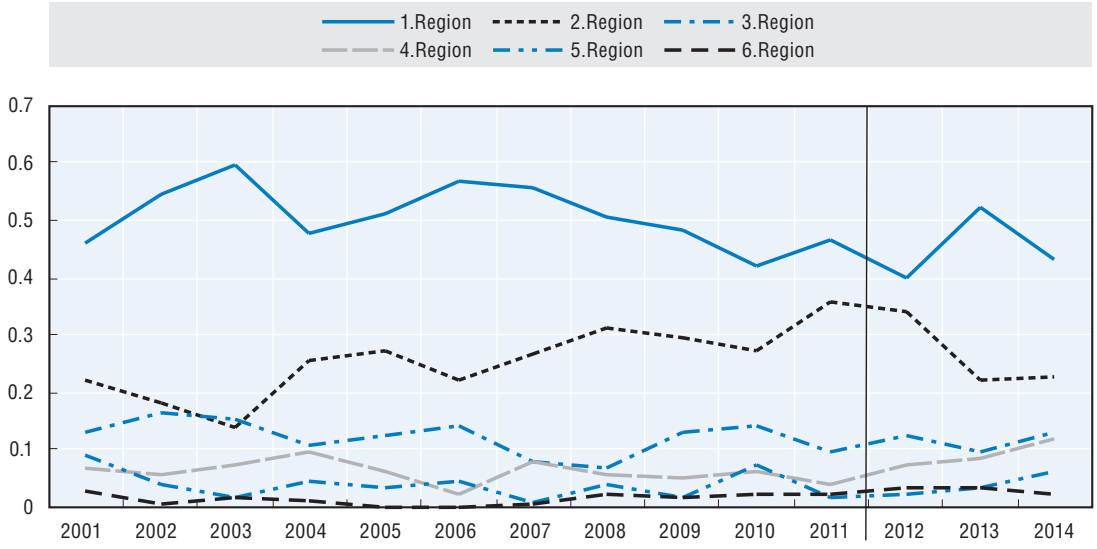
Policy driver – investment incentive system

The various official industry strategies do not spell out recommendations explicitly stating that machinery manufacturing activities, or other heavy industries, should be relocated away from big metropolitan areas, such as Istanbul. However, the new investment incentive scheme, which became effective in 2012, indirectly seeks to develop the machinery industry in less populated and relatively less developed regions by limiting the provision of incentives for the machinery industry in highly populated provinces. For instance, under the regional investment scheme for Istanbul, machinery industry is not one of the incentivized sectors, and the priority is given to investment in social services (e.g. health and, education) and the manufacture of technology-intensive products, such as medical devices and communication equipment.

It is still too early to conclude whether the new incentive system has affected the spatial development of the Turkish machinery sector by boosting investments in the regions where the sector is in its infancy. However, it is already clear that the introduction of the regional investment incentives scheme did not cause major changes in the investment location choices of both local and foreign investors (Figure 15). Since 2012, the majority of machinery investment certificates have been issued in the most developed regions, namely the 1st and 2nd. Although there is a growing, albeit still relatively small, trend of machinery investments in the 3rd, 4th, 5th and 6th regions, their share of investment certificates has remained almost unchanged since 2001, at around 35%.

Indeed, the MoD acknowledged in the Machinery Working Party Report (2014c) that, although the regional incentive scheme favours less developed regions, it would be still hard to convince investors to shift their activities away from the western provinces. Accordingly, the Ministry recommended widening the scope of incentives in the provinces where the market for the machinery products is larger and the logistics infrastructure already well developed.

Figure 15. **Share of investment certificates issued in the machinery sector by region**



Source: Ministry of Economy Database; OECD analysis

Other driver – quality of life

One aspect of spatial development that gets less attention is quality of life in the provinces and regions. If regions are to improve their industrial performance, they should be able to attract and retain skilled labour - especially if these regions do not

host competitive educational institutes or R&D centres. In other words, as long as well-educated, creative young workers cannot be persuaded to move to other cities, the machinery industry, classified as medium-high technology, may fail to develop spatially.

Drawing on the OECD's Better Life Index, TurkStat issued its first Well-Being Index for Provinces in 2016. This single composite index seeks to measure, compare and track over time the well-being of individuals and households on distinct dimensions in Turkey's provinces. It evaluates well-being against 11 criteria, or dimensions - housing, work life, income and wealth, health, education, environment, safety, civic engagement, access to infrastructure services, life satisfaction (TUIK, 2016). The findings of this index reveal stark differences amongst provinces, with Isparta, Sakarya and Bolu ranked highest for overall well-being. The 10 bottom-ranking provinces are all located in the eastern and south-eastern parts of Turkey. The province with the lowest well-being index is Muş (TRB2). The next lowest are Mardin (TRC3) and Ağrı, also in the TRB2 region. Intra-regional disparities among western provinces are also present. A notable example is that the neighbouring provinces, Isparta and Burdur –both from the TR61 region- rank 1st and 50th respectively.

Anticipated spatial developments

In each regional workshop, the main opportunities and obstacles that could affect the spatial development of the machinery sector in the short to medium term were discussed. Accordingly, the following sections look at the regions deemed competitive in certain sub-sectors and product groups. Expected developments and the regions' unique strengths suggest that the regions highlighted in the following sections will either consolidate their positions or emerge as poles of growth in the Turkish machinery industry by 2023[9].

Infrastructure investment and expanding construction sector put spotlight on Ankara (TR51)

Starting with the last decade, Turkey has scaled up infrastructure investments as its emerging economy presented the need for it. According to World Bank data, Turkey ranked second after Brazil in its commitment to total infrastructure investments among 139 emerging countries in 2014. The proliferating investment projects carry the potential for boosting domestic demand for construction machinery and other related machinery products.

Concerning the manufacture of construction machinery, Ankara (TR51) holds an indispensable position in Turkey. It alone hosts more than one-third of country's construction machinery enterprises and fulfils close to 80% of Turkey's total demand in this sub-sector (Turkey Development Bank, 2014). The high concentration of construction machinery production in the region might be partially attributable to the presence of public institutions, such as the Ministry of Transportation, Maritime Affairs and Communications, as well as the Ministry of Environment and Urban Planning, which have the task of undertaking large-scale investment projects in Turkey. In addition, construction machinery enterprises in the TR51 region are increasingly involved in the manufacture of various machinery spare parts catering for the repair and maintenance needs of the General Directorate of Highways and the General Directorate of State Hydraulic Works which are also based in Ankara.

Considering the planned expansion in infrastructure investment and the generally positive outlook for the Turkish construction sector, the TR51 region could well reinforce its role as the main producer of work and construction machinery in Turkey, whilst capitalising on its long-standing experience of serving the public sector.

Investment in railway infrastructure offers ample opportunities for Eskişehir (TR41)

A significant part of the planned infrastructure investment in Turkey over the next decade is projected to occur in the field of transportation, in particular in the construction of new railways and highways. Turkey aims to increase the length of its high-speed railway lines to 10,000 km by 2023 - from only 888 km in 2010 (TCDD, 2008).

Accordingly, one might talk about a high potential which could be harnessed by the Turkish machinery sector to expand and diversify its production in response to the needs of the expanding railway industry.

Although NACE Rev.2 classifies locomotives and wagons under the manufacture of other transport equipment, many of the parts required to produce them - such as related to piston engine -fall within the scope of the machinery industry. Therefore, enhanced investment in railways, coupled with official policies to locally procure whenever possible, is likely to boost the production in some sub-sectors of the machinery industry. As an example, MoSIT announced in 2015 that around 6,500 urban rail vehicles are projected to be procured by various Turkish cities over the next eight years.

Against that background, Eskişehir (TR41) has a comparative advantage since it hosts Turkey's first and only railway systems cluster, established in 2011. The region has long-standing experience in the railway industry, particularly in the production and maintenance of locomotives and wagons. Once becoming operational, the Railways Systems Test Centre can further firm up the province's position in Turkey's railway industry. Even though Eskişehir is the indisputable leader in the Turkish railway industry. Even though Eskişehir is the indisputable leader in the Turkish railway industry, Bursa has also lately emerged as a new player in this field. In this regard, one of Bursa's leading machinery firms made national headlines by producing the new Silkworm tram, said to be made from components supplied only by Turkish manufactures (Rail Turkey, 2015). Therefore, the TR41 region as a whole looks poised to benefit from the opportunities offered by the upsurge in railway investment.

Intensified mechanisation efforts fosters agricultural machinery production in Konya (TR52)

Land consolidation activities in Turkey have recently gained significant momentum, and the Turkish government has pledged to unify the country's remaining fragmented farms by 2020. In that regard, a resolution, which is expected to prevent separation of lands by means of inheritance, was also ratified by parliament in 2014. With the intensified land consolidation efforts in Turkey, small family establishments are believed to be gradually replaced with larger agricultural establishments. As a result, the usage of machinery in agricultural activities will become more widespread.

Konya (TR52) ranks first in Turkey in terms of cultivated area. The need for soil-working tools and machinery has triggered the development of this sub-sector in the region. Although a large number of Turkish regions (e.g. TR32, TR22, TRC2, TR62) engage in the production of agricultural machinery and equipment, Konya was the leading province for it with a market share of almost 65% in 2015 (KONTARKUM, 2014). Boosted by various grant schemes under the rural development programmes that are provided to farmers for the purchase of agricultural machinery, this sub-sector in Konya has reached new heights in production volume.

Although representatives from the agricultural machinery sub-sector at the regional workshop in the TR52 region stressed the need to scale up R&D in order to diversify production and intensify higher value-added activities, Konya is well positioned to respond to growing demand for agricultural machinery in Turkey for the upcoming years.

The South-eastern Anatolia Project helps Şanlıurfa (TRC2) emerge as a centre of irrigation machinery and equipment

The South-eastern Anatolia Project (with its Turkish acronym GAP) is a comprehensive initiative that aims to reduce regional disparities and improve the standard of living of people in the region. GAP is today being implemented as an integrated regional development project which comprises investment in virtually all sectors. It started off, however, as a programme to develop water resources in the region through the building of numerous dams and hydraulic power plants, as well as a large irrigation network (MoD, 2016).

Boosted by the investments under the GAP project, the south-eastern Anatolia has accumulated significant expertise and technology in irrigation systems. In particular, Şanlıurfa (TRC2), situated in the Euphrates-Tigris basin, hosts a number of enterprises that specialise in the manufacture of irrigation machinery and equipment. Although it could not be confirmed by official data, regional stakeholders at the regional workshop emphasised that Şanlıurfa is one of Turkey's biggest producers of submersible motors that are installed underwater with the purpose of providing water to the surface.

A recent study, however, indicated that local companies producing irrigation equipment do not regard their businesses as part of a more complex system, but rather as individual suppliers of parts such as pipes and pumps. This was found out to be in stark contrast to the global trend in which leading companies design their processes around a full irrigation system provision concept - ranging from pipes and fittings to maintenance and productivity services and water control software (UNDP, 2011).

To propel the province's irrigation machinery and equipment production, the Karacadağ Development Agency initiated the project of establishing an applied R&D centre specialized in irrigation technologies. It is anticipated that the centre will facilitate better interaction between machinery enterprises and academia - i.e. Harran University - as part of the effort to produce tangible industrial benefits. Given that the surface of irrigated land in the region will significantly increase in the near future owing to the planned developments under GAP and that there will be growing pressure on farmers to use scarce water more efficiently, irrigation technologies, and hence irrigation machinery and equipment will gain greater importance in the region.

Ongoing digitalisation in machine tool manufacturing mighty give an edge to Bursa (TR41) over other regions

Digitalisation in the machine tools segment of the machinery industry is opening up new possibilities for enhanced productivity and efficiency in the manufacturing industry. These automated and increasingly complex machines are hailed as the future of the machinery industry.

In this niche sub-sector, Bursa (TR41) is at the forefront in Turkey. The province not only hosts a number of large-scale enterprises which primarily specialise in the production of automated machine tools, but it is also home to the highest number of private R&D centres. Specialisation in this sub-sector might be partially attributed to Bursa's relatively advanced automotive industry which has been instrumental in transforming the local machinery sector.

Conscious of the growing number of high-technology products in the export basket of the province, the Bursa Chamber of Commerce and Industry has initiated a move to establish an OIZ exclusively for the manufacture of products that are classified as high-technology. Coupled with an intensification of R&D activities, the new OIZ - scheduled for completion in 2017 - is likely to attract more investors and strengthen the position of Bursa as the leading producer of automated machine tools in Turkey.

Gradual shift towards renewable energy sources intensifies the production of related machinery and equipment in Balıkesir and Çanakkale (TR22)

Turkey recently initiated a forward-looking energy policy which accords greater importance to renewable energy. Under the National Renewable Energy Strategy, Turkey plans that, by 2023, renewable energy will meet 30% of overall electricity needs (MoENS, 2014). In line with the ever- increasing demand for energy, renewable energy investment in the country is projected to expand as part of a policy of increasing the existing electricity generation capacity. Although investment in many renewable energy sources, such as hydropower, triggers the production of various machinery and equipment, the establishment of wind turbines in particular offers a relatively untapped potential for the machinery manufacturers in Turkey.

In that regard, the TR22 region (Balıkesir and Çanakkale) stands out with its commitment to position itself as one of the leading renewable energy centres in Turkey. About 25% of Turkey's total wind energy capacity is installed in this region only, and Balıkesir is the leading province in Turkey in terms of the number of operational wind power plants (TUREB, 2016). An additional 3,000 turbines are currently planned to be established for the next decade (GMKA, 2013). Whilst the number of manufacturers involved in the production of wind turbines, as well as other machinery and equipment related to renewable energy production, is still limited in the region, there is a growing number of both local and national initiatives supporting the development of the sector.

The first such initiative is the 6-month certificate courses on the wind energy sector that are currently being organized for recent university graduates who are out of work. These courses are financially supported by the region's DA and are eventually intended to become part of the continuous education programmes offered by the universities in Balıkesir and Çanakkale. In addition, local private enterprises are collaborating with the Ministry of Education to set up a permanent vocational school with the purpose of bridging the local skills gap in the renewable energy sector, as well as supplying a constant source of skilled labour for this growing sector.

According to a regulation passed in September, 2013, the MoENS was given the responsibility to identify "Renewable Energy Source Areas" in the country with the purpose of putting them only to the use of renewable energy production. In that regard, the MoENS has identified areas in Balıkesir which are solely reserved for the production of renewable energy, most notably wind energy. Therefore, as asserted at the regional workshop, the size and importance of renewable energy in the region's economy is expected to gradually grow over the next decade.

In light of the crucial role of wind energy for the TR22 region, the manufacture of machinery and equipment in the region might develop by specialising in a way to better respond to the local demand from the wind energy sector.

The advanced steel production and metal forging industry in Hatay and Osmaniye (TR63) might offer new opportunities

The machinery industry is a major customer of the steel industry. Therefore in Turkey, as elsewhere, the machinery industry activities tend to agglomerate near steel producers. In Turkey, three provinces account for more than half of the total steel production - Osmaniye (TR 63), Hatay (TR 63) and Izmir (TR31). The rest is spread across the provinces of Marmara and Eastern Karadeniz with Kocaeli (TR42) standing out as the largest producer.

With no steel production in the eastern regions of Turkey, it might be hard to convince the machinery producers to invest there. However, large-scale steel production in the TR63 region (Hatay, Osmaniye and Kahramanmaraş) might offer new opportunities for the spatial development of machinery industry in the eastern parts of Turkey on condition that logistics connections between the TR63 region and the peripheral eastern regions can be improved. Ongoing investment projects, such as the establishment of a new logistics hub in Osmaniye aiming to better integrate TR63 with its hinterland, could eventually contribute to the reduction of freight expenses and help the machinery sector gain competitiveness in Turkey's eastern regions with a limited steel industry.

Therefore, industrial policies aiming to spatially diversify machinery production in Turkey would benefit from a holistic approach in which the inter-industry relations, such as with iron-steel industry, are more closely investigated, as well as how these relations shape the spatial development of the machinery sector in Turkey.

A vigorous entrepreneurial spirit, coupled with the support programmes, might boost the machinery industry in various regions

Entrepreneurial activities vary widely across regions and countries, and economically depressed regions generally have fewer instances of successful entrepreneurs (OECD, 1998). It is argued that entrepreneurial activities are a reflection of the local industrial structure, institutions and entrepreneurial culture (Saxenian 1994). In view of this, OECD countries have developed an array of enterprise support programmes, and promoted entrepreneurship as a way of narrowing regional disparities. Strategies include, but are not restricted to, regional subsidies for assisting start-ups and entrepreneurship awareness programmes to promote entrepreneurship as a viable employment and career opportunity.

According to the Global Entrepreneurship Monitor (2012), Turkey's level of entrepreneurial activity has seen a significant increase in the aftermath of the 2008-9 global financial crisis. In addition, the quality of entrepreneurs has improved, too, since the number of entrepreneurs who turned to entrepreneurship to pursue a business opportunity, rather than out of necessity, had increased to 6.8% in 2012. The demographic make-up of start-up entrepreneurs in Turkey had also demonstrated a change - most of the new entrepreneurs tend to be older, better educated and from a higher income group.

In light of the growing entrepreneurship activities, the Turkish government has put in place, in collaboration with regional authorities and institutions, substantial financial instruments and schemes that directly support innovative SMEs (OECD, 2016b). For instance, SMEs that have moved into technology development zones by the end of 2023 will be exempt from corporate tax and their employees from income tax. In addition, KOSGEB and the Scientific and Technological Research Council of Turkey (TÜBİTAK) have special funding programmes for SMEs' R&D and innovation activities.

Acknowledging the importance of innovative and tech-savvy SMEs to the machinery industry in comparison to other manufacturing sectors, many Turkish regions hold promising potential in spatially expanding their manufacturing base - assuming that the right opportunities are presented. An example of good practice in that regard comes from the work of the MARKA Development Agency. In 2016, under its Development of the Machinery Industry Programme, it earmarked around EUR 1.4 million for machinery SMEs in the TR42 region (Bolu, Düzce, Kocaeli, Sakarya and Yalova). By providing grants, this Programme aims to support innovative SMEs that have developed actionable projects with respect to new machinery products. In 2014 and 2015, the machinery sector was supported by MARKA with similar programmes as well - although the import substitution criterion for eligibility was only introduced in 2016.

Labour market needs assessment reports reveal the lack of skilled labour in many regions

The Turkish Labour Agency (İŞKUR) carries out yearly labour market needs assessments to better understand what kind of occupations are in high demand from the employees, yet the supply is not adequately met from the labour market. According to the 2014 results by İŞKUR, almost 50% of the surveyed manufacturing firms in Turkey reported that they have struggled to recruit qualified workers with the desired skills. In 58 out of 81 provinces, the problem of finding qualified personnel was most acute in the manufacturing sector. Although a breakdown of the data for the machinery sector is not available, a close look at the occupations, which are in shortage, reveals that the lack of intermediate staff, such as machine operators, is a constraint.

The findings of İŞKUR have been confirmed at the regional workshops, when private sector representatives underlined the lack of qualified blue-collar workers as a major constraint on the development of the machinery industry in their regions. Although skills shortages are undoubtedly more pronounced in the eastern regions of Turkey, participants cited the limited number of well-equipped vocational and technical schools offering up-to-date curricula that meet the needs of private sector as a serious problem -

even in bigger cities like Ankara (TR51) and Kocaeli (TR42). Stakeholders at the regional workshops also acknowledged that the demand for vocational education was on the decline and that there was a growing tendency amongst recent graduates to opt for service sector jobs that are generally regarded more prestigious.

In 2012, MoSIT and the Ministry of Education agreed a special protocol on opening vocational schools in OIZs to strengthen technical and vocational education and training (TVET). Further to this protocol, the establishment of new vocational schools on OIZ premises has gained momentum and private sector involvement in the provision of TVET has intensified. As an example, the lack of skilled blue-collar workers is regarded as a binding constraint on the further development of the work and construction machinery sub-sector in many regions. In response, the Construction Machinery Distributors and Manufacturers Union (IMDER) of Turkey identified seven vocational schools in seven different provinces[10] which could provide additional vocational training courses designed and delivered with other stakeholders in tandem (IMDER, 2015). Similar initiatives targeting the skills gap concerning other sub-sectors of the machinery industry could also be useful in removing bottlenecks hampering the machinery industry's development in Turkey.

Chapter 3

The chemical sector in Turkey

3.1. Sector scope

This part of the report on the chemical sector refers only to products listed in Division 20 of NACE Rev.2, "Manufacture of Chemicals and Chemical Products" (Table 12). Overall, the Division 20 comprises products that result from "the transformation of organic and inorganic raw materials by a chemical process" (Eurostat, 2008). First, it encompasses "basic chemicals", such as industrial gases, dyes, pigments, organic and inorganic chemical compounds, which serve as intermediate inputs for other industries and other branches of the chemical industry itself. Second, the Division also includes chemical products that are, by and large, produced as a result of further processing of "basic chemicals". They range from personal consumption products - such as soap, detergent, and perfume - to industrially used input like fertilizers, pesticides, paints and coating, and man-made fibres.

Refined petroleum products (e.g. motor fuel, asphalt), pharmaceuticals, rubber and plastic products come under different headings in NACE Rev.2 and are therefore outside the scope of this analysis.

Unless stated otherwise, all the statistics and data pertaining to the chemical sector are drawn from Division 20 of NACE Rev.2. Using this classification was crucial to consistency, since MoSIT and MoD have also incorporated it in their sector strategies and reports.

Table 12. **Classification of chemical products under Division 20 of NACE Rev.2**

	20 Manufacture of chemicals and chemical products
20.1	**Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms**
20.11	Manufacture of industrial gases
20.12	Manufacture of dyes and pigments
20.13	Manufacture of other inorganic basic chemicals
20.14	Manufacture of other organic basic chemicals
20.15	Manufacture of fertilisers and nitrogen compounds
20.16	Manufacture of plastics in primary forms
20.17	Manufacture of synthetic rubber in primary forms
20.2	**Manufacture of pesticides and other agrochemical products**
20.20	Manufacture of pesticides and other agrochemical products
20.3	**Manufacture of paints, varnishes and similar coatings, printing ink and mastics**
20.30	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
20.4	**Manufacture of soap and detergents, cleaning and polishing preparation, perfumes and toilet preparations**
20.41	Manufacture of soap and detergents, cleaning and polishing preparations
28.42	Manufacture of perfumes and toilet preparations
20.5	**Manufacture of other chemical products**
20.51	Manufacture of explosives
20.52	Manufacture of glues
20.53	Manufacture of essential oils
20.59	Manufacture of other chemical products n.e.c.
20.6	**Manufacture of man-made fibres**
20.60	Manufacture of man-made fibres

Source: EuroStat, 2008, the European Classification of Economic Activities, http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN.

3.2. The chemical sector in Turkey

History

The modern chemical industry in Turkey dates back to the late 1930s when, mainly due to the lack of private capital in the country, the state founded the first chemical enterprises. The first such enterprise was a chemical factory in Gemlik, Bursa, commissioned in 1937, that specialised in the production of synthetic fibre. This factory was followed by the establishment of another large state enterprise, namely the MKEK, which produced chemicals, particularly for the Turkish Armed Forces (Doğan, 2000).

During the planned economy period after the 1960s, the demand for chemical products in Turkey substantially increased in line with the industrialisation efforts, since the supply of intermediate chemical products to other sectors became of great importance. However, due to the chronic foreign currency shortages, the required chemical products could be imported only with difficulties. The situation was further exacerbated by the fact that Turkey's flourishing private sector invested little in the chemical industry because of its capital- and technology-intensive nature. Nevertheless, the development of the chemical industry continued largely thanks to regular public sector investment directed primarily at the areas that required plenty of capital. During that time, various state-owned chemical facilities were established, particularly to take advantage of the vast boron reserves in the country, and to cater for the growing fertilizer demand from the agriculture sector.

With the introduction of the export-oriented economic policies during 1980s, the Turkish chemical sector witnessed a surge in its production capacity and exports. Turkish private sector began to take growing interest and numerous, mostly small-scale, chemical firms started operating. In the last two decades, the Turkish chemical industry has developed significantly in quality and productivity has improved its environmental regulations. It is currently in the process of adopting the EU's technical standards (CEFIC, 2014).

Industry structure

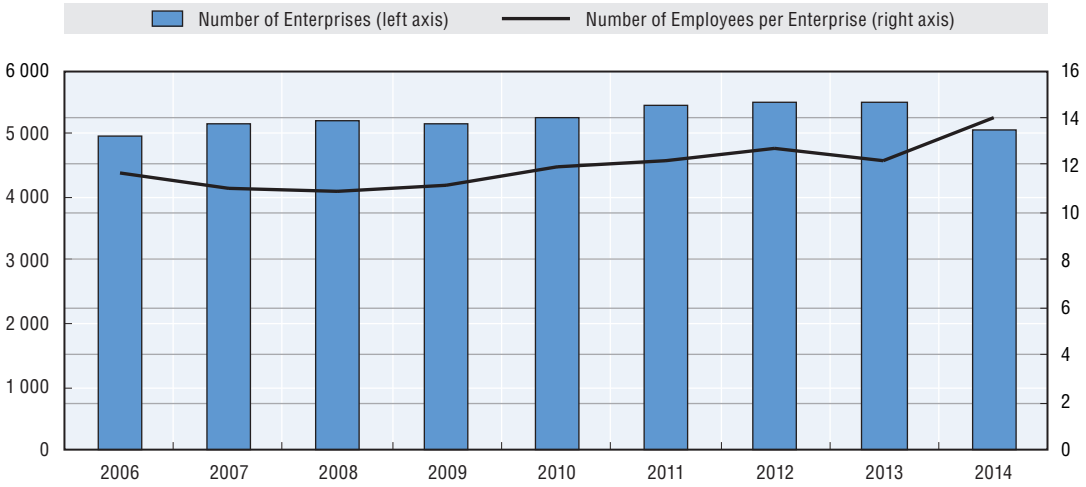
The number of enterprises operating in the chemical sector is stagnant

According to the MoSIT's database of "Enterprise Information System, there were a total of 5 042 registered enterprises[11] operational in the chemical sector in 2014. The number of enterprises grew by 1.4% per year between 2006 and 2013 (Figure 16) until a sudden contraction in 2014 when, compared to the previous year, there was a fall of around 400 enterprises operational in the chemical sector. Three provinces, namely Istanbul (TR10), Ankara (TR51) and Izmir (TR31)[12], accounted for the bulk of the decline.

In 2014, just under 25% of all chemical enterprises were involved in the production of "plastics in primary forms" (NACE Rev.2, 20.16), whereas the least number of enterprises, to be precise only 30 in the whole of Turkey were operating in the "synthetic rubber in primary forms" sub-group.

Although growth in the number of chemical enterprises has been generally stagnant since the 2008 financial crisis, employment in the sector increased steadily from 2009 to 2014, when the average number of employees in the chemical firms rose to 14 (Figure 16).

Figure 16. **Number of chemical enterprises and employees per enterprise in Turkey, 2006-14**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Chemical enterprises are growing in size

The industry, particularly the basic chemicals sub sector, necessitates the establishment of large manufacturing facilities that produce bulk quantities. Thus, chemical companies, on average, tend to be capital intensive. Combined with considerable high-technology requirements, firms operating in the industry hold a competitive advantage in terms of high barriers to entry. Therefore, the sector consists of a small number of firms which, on average, have more employees in comparison to the firms operating in other manufacturing branches.

Although the majority of Turkey's chemical firms are SMEs, the share of micro-enterprises[13] has a decreasing trend. In 2012, 83% of all enterprises in the industry had fewer than 20 employees - down 5 percentage points on 2009 - whereas about 6.5% employed more than 50 workers in the same year (Table 13).

Table 13. **Distribution of chemical enterprises by number of employees, 2009-12**

(% of total)

Number of employees	2009	2010	2011	2012
1-19	88.6	85.8	85.5	83.4
20-49	6.4	9.1	8.9	10.3
50-99	2.3	2.4	2.9	3.2
100-249	1.8	1.8	1.7	2.2
>250	1.0	0.9	1.0	1.0
Total	100	100	100	100

Source: TurkStat Database; OECD analysis

There is a strong presence of large firms specialised in chemical production.

In the list of Turkey's top 500 industrial enterprises, drawn up annually by the Istanbul Chamber of Industry (ISO) from companies' net sales, chemicals and chemical products manufacturers rank among the biggest companies. In the 2014 edition, the largest companies were concentrated chiefly in the petrochemical, automotive, and steel and iron industries. Nonetheless, of 60 companies whose main operational area was defined as manufacture of chemicals and chemical products, 7 ranked in the top 100 (Table 14).

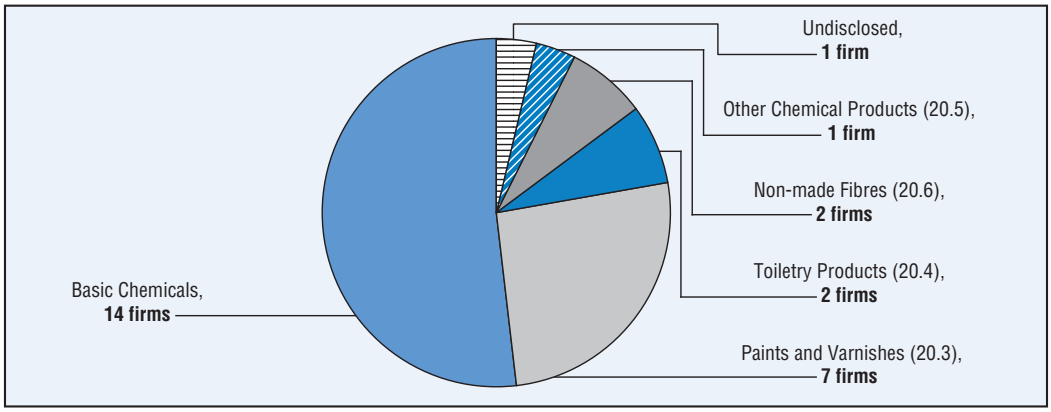
Table 14. **Turkey's largest chemical enterprises, 2014**

2014 ranking	Name of enterprise	Operational area	Sales (TRY billion)
1	Tüpraş	Petrochemicals	37.5
2	Ford Otomotiv	Automotive	10.5
3	Oyak-Renault	Automotive	8.8
4	Arçelik	Domestic Appliances	8.5
5	EÜAŞ	Electricity Generation	6.7
6	İçdaş Çelik	Steel and Iron	6.3
7	İskenderun Demir ve Çelik	Steel and Iron	6.2
8	Ereğli Demir ve Çelik	Steel and Iron	6.1
9	Tofaş	Automotive	6.0
10	Aygaz	Petrochemicals	5.7
(…)			
16	PETKIM	Chemicals	3.6
35	AKSA Akrilik	Chemicals	2.1
41	Eti Maden	Chemicals	2.0
56	Hayat Kimya	Chemicals	1.6
61	Toros Tarım	Chemicals	1.4
66	Sasa Polyester	Chemicals	1.2
67	Soda Sanayii	Chemicals	1.2

Source: Istanbul Chamber of Industry (2014a), "Türkiye'nin 500 Büyük Sanayi Kuruluşu" (Turkey's 500 Biggest Manufacturing Companies), Istanbul, http://www.iso.org.tr/news/ici-announced-the-icis-Turkeys-top-500-industrial-enterprises-2014-survey-results/; OECD analysis.

main operational area is the manufacture of basic chemicals (Figure 17), while none produce pesticides and agrochemical products.

Figure 17. **Distribution of largest chemical enterprises by sub-sector, 2014**



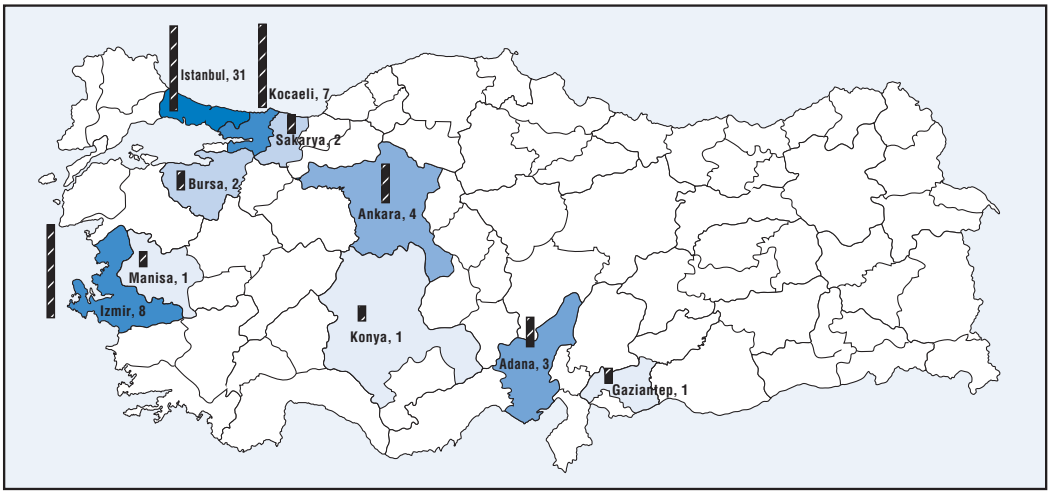
Source: Istanbul Chamber of Industry (2014a), "Türkiye'nin 500 Büyük Sanayi Kuruluşu" (Turkey's 500 Biggest Manufacturing Companies), Istanbul, http://www.iso.org.tr/news/ici-announced-the-icis-Turkeys-top-500-industrial-enterprises-2014-survey-results/; OECD analysis.

According to the sales made in the year 2014 Petkim A.Ş. - the leading Turkish producer of a wide range of petrochemicals, particularly plastics and synthetic rubber -, was the largest enterprise in the chemicals industry, with TRY 3.6 billion worth of sales. Its output meets about 30% of total domestic demand for petrochemicals in Turkey (MoE, 2014). It is followed by AKSA Akrilik, the largest Turkish manufacturer of man-made fibres, and Eti Maden, which produces high added-value boron products.

Despite the presence of several large and influential firms in the Turkish chemical industry, none of them are actually global players according to the yearly top 100 chemical companies list prepared by Independent Chemical Information Service [2015]. Even the sales of Petkim A.Ş, the biggest-selling Turkish chemical firm, were only 40% of the firm ranked 100th in the 2015 edition of ICIS list.

According to ISO's top 1 000 list in 2014, the biggest chemical enterprises are spread across ten provinces (Figure 18). Slightly more than half are registered in Istanbul, though being registered in a province does not necessarily mean that all production takes place there. On another note, with the exception of one enterprise, namely Eti Maden, all of the listed companies are private enterprises, 16 of which are majority-owned by foreign investors.

Figure 18. **Spatial distribution of the largest chemical firms, 2014**

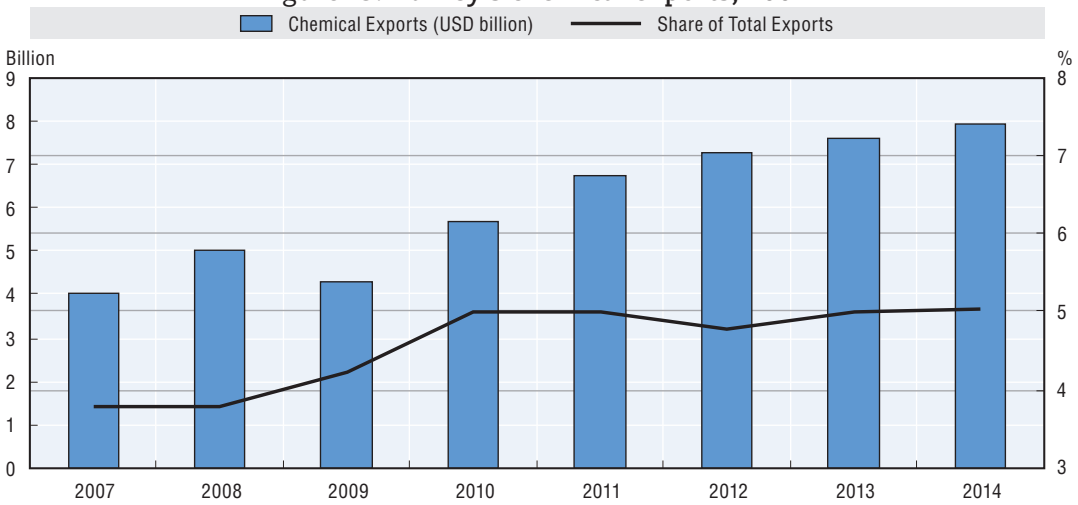


Source: Istanbul Chamber of Industry (2014a), "Türkiye'nin 500 Büyük Sanayi Kuruluşu" (Turkey's 500 Biggest Manufacturing Companies), Istanbul, http://www.iso.org.tr/news/ici-announced-the-icis-Turkeys-top-500-industrial-enterprises-2014-survey-results/; OECD analysis.

Trade and foreign direct investment performance

Turkey's chemical and chemical product exports steadily increased between 2007 and 2014, showing a compound annual growth rate (CAGR) of 10.1%. The sector's exports only faltered in 2009 during the financial crisis, before rebounding strongly. In 2014, the value of chemical exports was stood at around USD 7.9 billion, which is 4.5% higher than the previous year (Figure 19).

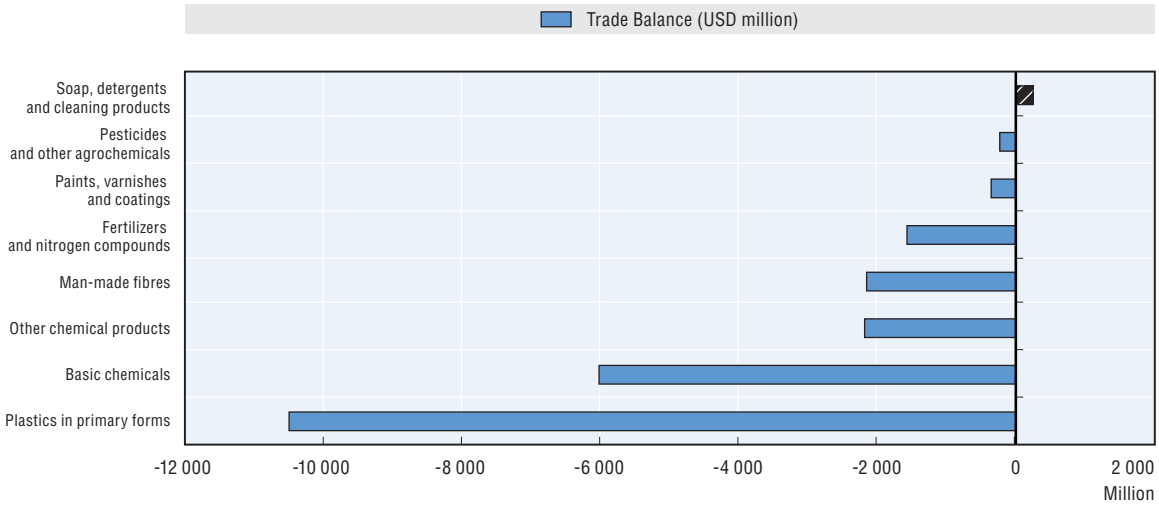
Figure 19. **Turkey's chemical exports, 2007-14**



Source: TurkStat; OECD analysis.

The main exports of the Turkish chemical industry are consumer chemicals - comprising soaps, detergents and cosmetic products, all classified under NACE Rev.2, sub-division 20.4. Between 2009 and 2013, these products had consistently accounted for one-third of all Turkey's chemical exports. Moreover, this subdivision was the only branch under the chemical industry with a positive trade balance. All the other sub-divisions recorded sizeable trade deficits. In 2014, the largest trade deficit was observed in the sub-group of "plastics in primary forms" - with an amount of USD 10.5 billion (Figure 20).

Figure 20. **Trade balance in Turkey's chemical sub-sectors, 2014**

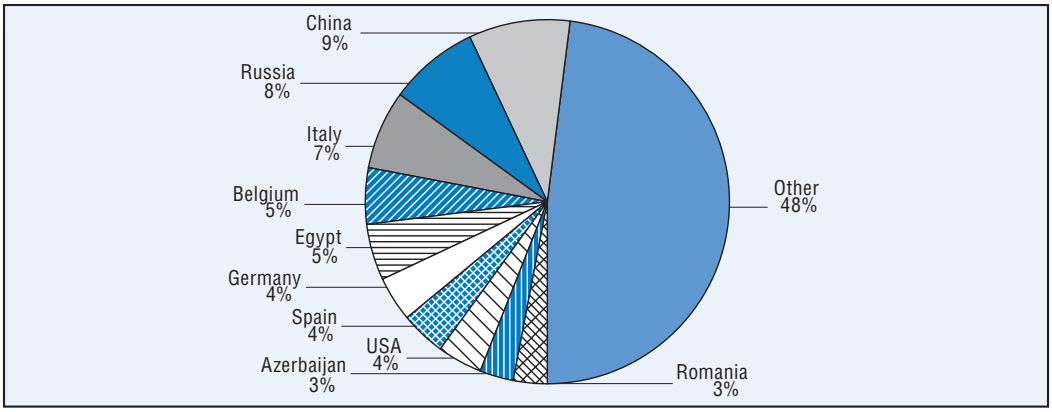


Note: International Standard Industrial Classification of All Economic Activities (ISIC), Rev.4 was used to calculate the trade balance of Turkey in the chemical sub-sectors. More specifically, export-import data were gathered from the following ISIC Rev.4 codes: 2411, 2412, 2413, 2421, 2422, 2424, 2429 and 2430.
Source: TurkStat Database, OECD analysis.

Turkey exports to the emerging markets and its neighbours

In the last decade, the three leading export markets for Turkish chemical products have been China, Russia and Italy. In 2013, they accounted for close to 25% of Turkey's total chemical product exports (Figure 21). Nevertheless, Turkey's export market is rather diverse and not dominated by a limited number of countries. The emerging countries, as well as Turkey's neighbours, are the main export markets for Turkish chemical products. While the EU28's share in 2013 was around 41%, it also supplied over half of all Turkey's chemicals imports, most of which came from Germany and Belgium.

Figure 21. **Turkey's chemical exports by destination, 2014**



Note: Standard International Trade Classification (SITC), Revision 4 was used to analyse Turkey's chemical export destinations. More specifically, export data were compiled from the following SITC Rev.4 Codes: 51, 52, 53, 55, 56, 57, 59.
Source: UN Comtrade Database, http://comtrade.un.org/; OECD analysis.

Turkey has set moderate export targets for its chemical industry

According to the study conducted by TIM, the Turkish chemical sector has an overall export target of USD 24 billion[14] by 2023. In order to achieve this target, exports will have to grow by almost 14.5% per year between 2014 and 2023, whilst the industry maintains its share of the total targeted exports at 4.7%. In other words, in terms of

export composition of the country, the chemical industry is not foreseen to increase its share. The biggest projected increases come in the paints, varnishes and coatings sub-sector, probably due to anticipated production increase in this sub-sector to meet growing demand of the Turkish construction sector.

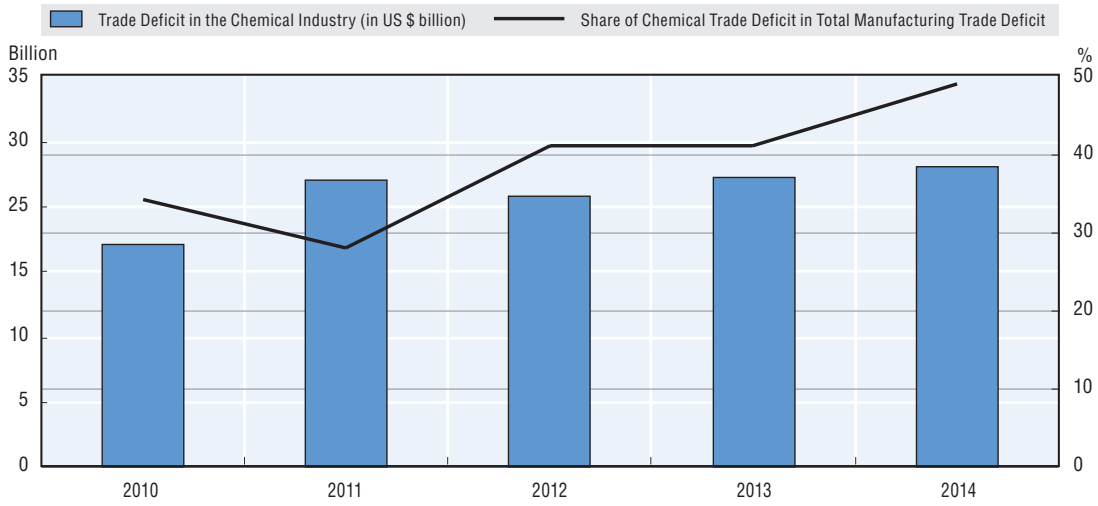
The TIM study also identifies 29 countries as priority target markets for the chemical sector. Amongst them, special attention is given to Brazil, Russia and Mexico as new markets, and it is projected that the biggest increases in exports will be to those markets, as emerging economies' demand for chemical products rises.

Turkey has a persistent trade deficit in the chemical sector

The two most defining features of the Turkish chemical industry are its high dependence on imports and chronically low export ratio. In parallel with the growing chemical exports, imports keep rising up at an almost same rate. In volume, the trade deficit in the chemical sector increased to an all-time high of USD 23.1 billion in 2014 (Figure 22), even though the export to import ratio for the sector remained constant at around 23% in 2010-14. This sizeable trade deficit in the chemical industry accounted for roughly half of the total trade deficit in the manufacturing sector.

The trade deficit is not a problem *per se*, since it is most likely attributable to the lack of feedstock, amongst others crude oil and natural gas, that is indispensable for chemical industry. However, the growing trade deficit might also signal chronically insufficient investment, as well as a general lack of competitiveness of the Turkish chemical industry, which hints at structural problems in the sector that need to be addressed.

Figure 22. **The trade deficit in Turkey's chemical industry, 2010-2014**



Source: TurkStat Database, OECD analysis

The share of imported inputs is getting larger

The chemical industry in Turkey has traditionally been dependent on imported raw materials because of insufficient oil and gas reserves and a chronically low production capacity in petro-chemicals (ISO, 2014b). According to one estimate, 68% of all input in the Turkish chemical industry is imported (Saygili, 2010), and it is reported that the share of imported input had risen up by about 5 percentage points since 2002.

The industry's dependence on imported input affects not only Turkey's current account balance, but it also seriously exposes chemical firms to the price fluctuations of input. What is more, compared to their international competitors, Turkish firms are generally at a disadvantage when supplying inputs. Delays and additional logistics costs are believed to negatively affect their competitiveness (Duru, 2014).

Nonetheless, Turkey is endowed with mineral reserves like boron, chrome, soda ash and trona, which serve as crucial raw materials for the different branches of the chemical industry.

Domestic trade for the Turkish chemical industry is dominated by intra-sectoral trade

In 2013, more than 40% of Turkish chemical firms' domestic sales were to firms producing chemical, plastic and rubber products, while some 65% of their domestic purchases were by firms operating in the broad chemistry industry, which includes the petro-chemical sector (Table 15). The large volumes of intra-sectoral trade throws into sharp relief the chemical industry's relatively long value chain, and underlines the importance of intermediate chemical products used by other branches of the broad chemical industry itself. The strong linkages between chemical firms in Turkey might also strengthen the clustering trends.

Inter-sectoral trade in Turkey displays that the domestic chemical products are purchased chiefly by the textile, construction and ceramics sectors. The largest sales of chemical product were, by far, to firms producing textiles. However, there is also mounting demand from the booming construction industry for concrete, cement and plaster, which makes "other non-metallic mineral products" the second largest non-chemical sector that purchases chemical products.

Table 15. **Inter-sector domestic trade involving the chemical industry, 2013**

	Chemical sector domestic sales	Share	Chemical sector domestic purchases	Share
1	Chemical Products (NACE Rev. 2 Code: 20)	22.8%	Chemical Products (NACE Rev. 2 Code: 20)	44.9%
2	Rubber and Plastic Products (NACE Rev. 2 Code: 22)	19.6%	Rubber and Plastic Products (NACE Rev. 2 Code: 22)	12.6%
3	Textiles (NACE Rev. 2. Code: 13)	19.1%	Fabricated Metal Products (NACE Rev. 2 Code: 25)	7.4%
4	Other Non-metallic Mineral Products (NACE Rev. 2 Code: 23)	6.6%	Coke and Refined Petroleum Products (NACE Rev. 2. Code: 19)	6.8%
5	Wood Products (NACE Rev. 2 Code: 16)	5.2%	Textiles (NACE Rev. 2. Code: 13)	5.1%
	Total share	**73.2%**	**Total share**	**76.8%**

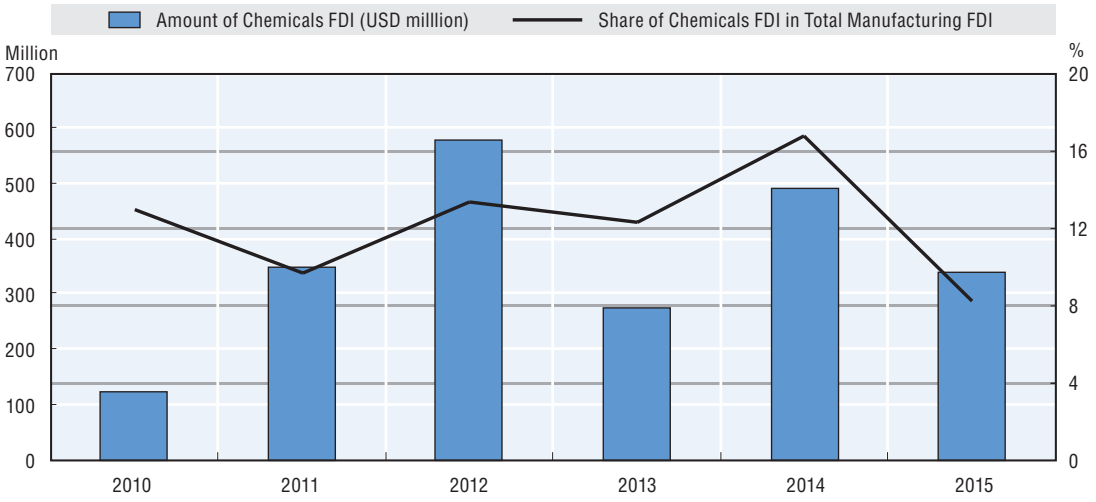
Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

The Turkish chemical industry attracts a steady inflow of FDI

According to statistics published by the Central Bank of Turkey, FDI flows into the chemical sector significantly fluctuated during the period of 2010-15. However, its share of FDI in the manufacturing sector as a whole seems to lie consistently within the range of 8% and 16% (Figure 23). Over the same period, in terms of FDI inflow amount, the chemical sector was outperformed only by two sectors, namely the manufacture of food and beverage products and computer, electronic and optical equipment.

In 2012, the chemical sector FDI stood at USD 579 million, recording the highest amount since 2010. However, it was unable to keep up such a solid performance and, in 2015, FDI dropped 30% over the previous year. Despite fluctuations, though, the Turkish chemical industry attracts sustained FDI inflows, which has a significant impact on Turkey's balance of payment, especially in the short run.

Figure 23. **FDI inflows in the chemical sector, 2010-2015**



Source: Ministry of Economy (2016), "Uluslararası Doğrudan Yatırım Verileri Bülteni – Haziran 2016" (Foreign Direct Investment Data Bulletin – June 2016), Ankara, www.ekonomi.gov.tr/portal/content/conn/UCM/uuid/dDocName:EK-226930; OECD analysis.

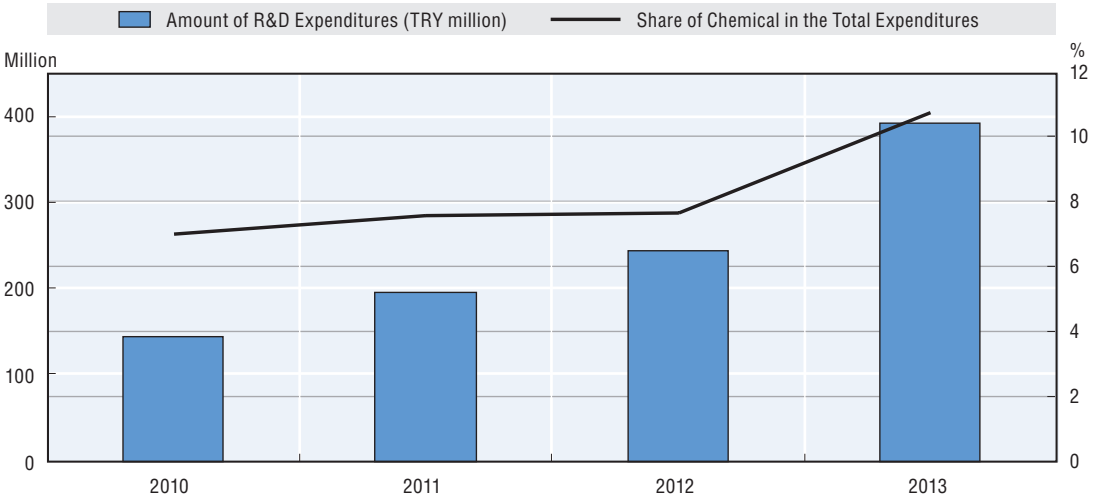
As of December 2015, there were 6 192 firms with foreign capital operating in Turkey. In the manufacturing sector as a whole, the highest number of firms with foreign capital, 680 to be precise, was in the chemical industry. These figures reconfirm the capital- and technology-intensive nature of the industry, rendering a steady FDI inflow highly crucial for the Turkish chemical sector.

R&D and innovation

Business enterprises increasingly focus on undertaking R&D activities

Private sector R&D expenditure in the Turkish chemical industry has grown at an impressive rate since 2010 (Figure 24) and 95% of R&D expenditure is financed by the private sector itself. However, albeit small in size, the public sector and universities also make financial contributions that complement private sector expenditure. In 2013, the chemical industry accounted for around 11% of the private sector's total R&D outlay,[15] the second highest amount of expenditure after the manufacture of motor vehicles and trailers.

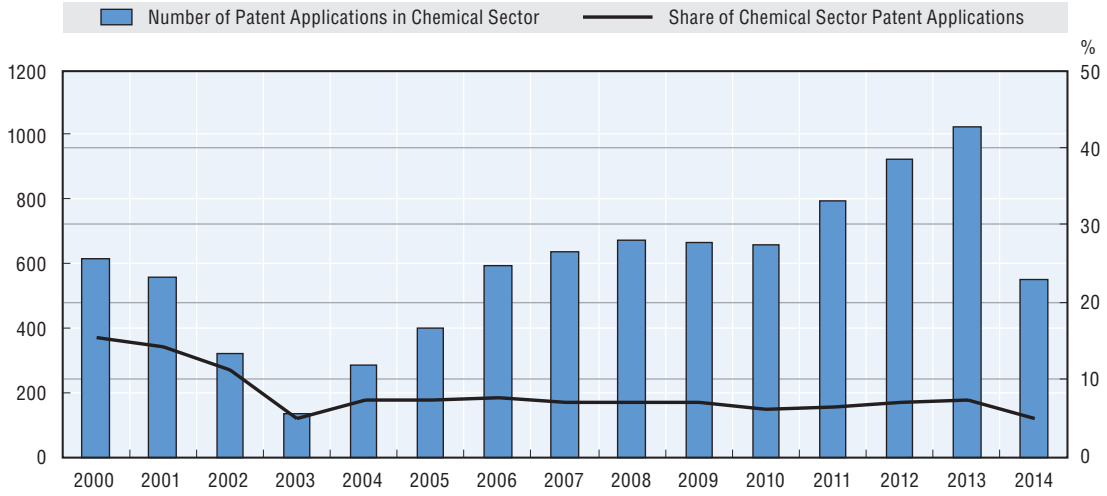
Figure 24. **Private sector R&D expenditure in the chemical sector, 2010-2014**



Source: TurkStat Database; OECD analysis.

In accordance with growing R&D expenditure, the number of patent applications in the chemical sector has also grown substantially. In 2013, over 1 000 patent applications pertaining to the chemical industry were filed - the highest number of patent applications ever made in a single year in the sector. The share of patent applications in the overall manufacturing sector is relatively stable at 9% (Figure 25).

Figure 25. **Patent applications in the chemical sector, 2000-14**



Source: Turkish Patent Institute, www.tpe.gov.tr/TurkPatentEnstitusu/statistics/; OECD analysis.

In 2009, the private sector's increasing focus on R&D received a boost from the R&D Centre Support Programme rolled by MoSIT with the purpose of encouraging R&D activities in manufacturing. Since the outset of the programme, 186 companies were issued R&D Centre certificates. As of January 2015, 165 centres were still operational, roughly one-quarter of which serving the automotive industry. The siting of the R&D centres mirrors the geographical concentration of chemical firms, with 11 R&D Centres on chemical industry are located in Izmir and the provinces of Marmara (Table 16).

Table 16. **Chemical firms' R&D centres, 2015**

#	Name of R&D Centre	Location	Date of establishment
1	Kayalar Kimya A.Ş.	Istanbul	2012
2	Organik Kimya A.Ş.	Istanbul	2009
3	Akdeniz Kimya Sanayi ve Ticaret A.Ş.	Izmir	2011
4	DYO Boya San.Tic.A.Ş	Izmir	2009
5	Kansai Boya San. ve Tic. A.Ş.	Izmir	2013
6	Betek Boya ve Kimya A.Ş.	Kocaeli	2013
7	Hayat Kimya Sanayi A.Ş.	Kocaeli	2013
8	Polisan Boya Sanayi Ticaret A.Ş.	Kocaeli	2014
9	Pulver Kimya San. ve Tic. A.Ş.	Kocaeli	2014
10	Setaş Kimya San. ve Tic. A.Ş.	Tekirdağ	2012
11	Akkim Kimya San. ve Tic. A.Ş	Yalova	2013

Source: Ministry of Science, Industry and Technology, R&D Centres website, https://biltek.sanayi.gov.tr/sayfalar/argeDetay.aspx (accessed on 1 February 2016).

Sector strategies and policies

National policies encourage investment in chemical industry to reduce imports

Under the 10th Development Plan of Turkey, the chemical industry was identified as a priority manufacturing sector and some broad objectives for the chemical industry were set out in this Plan. One major problem, highlighted in the Plan, is that available

land is often fragmented into small parcels and investors struggle to find areas that are sufficiently large to locate their large-scale investment preferably near the sea. Accordingly, the plan advocates increased support for the establishment of chemical parks by allocating logistically appropriate sites for new investments in petrochemicals, plastics, composites and advanced materials. In addition, under the new programme for reducing import dependency[16] currently envisaged, the 10th Development Plan aims to decrease the import/aggregate supply ratio in the chemical industry over the period 201418.

The overarching strategy for the chemical industry was prepared by MoSIT for the first time in 2012 covering a four-year period until 2016 (Box 5). Apart from the strategy documents, MoSIT has also been preparing bi-annual chemical sector reports since 2012. These reports mainly give an overview of the latest developments in the sector and supply the most recent statistics.

Box 5. **Recommendations from the Ministry of Science, Industry and Technology's Chemical Sector Strategy Report**

In the *Chemical Sector Strategy Report 2012-16*, the Ministry of Science, Industry and Technology (MoSIT) identifies six general targets for the sector and sets out 36 action items in order to achieve the targets. The greatest emphasis in the report is on increasing the high value-added chemicals production in Turkey to boost exports and, accordingly, narrow the large trade deficit.

The negative impact on the Turkey's current account balance of the sector's chronically high dependence on imported intermediate goods is underlined. To address the issue, the strategy paper urges greater effort in attracting foreign direct investment, particularly concerning petrochemicals. Iran, Saudi Arabia and Russia are singled out in the strategy as countries to woo in the bid to attract FDI into the chemicals industry.

As for challenges, harmonisation with the EU's REACH regulation on protecting the environment and health has been repeatedly highlighted as a major concern for Turkish producers. MoSIT calls for awareness-raising seminars on harmonisation with EU regulations to overcome the growing problems of Turkish chemical producers seeking to export to the EU. In the meantime, MoSIT argues for carrying out new studies in order to identify new export markets for Turkish producers and so reduce their dependence on exports to the EU market.

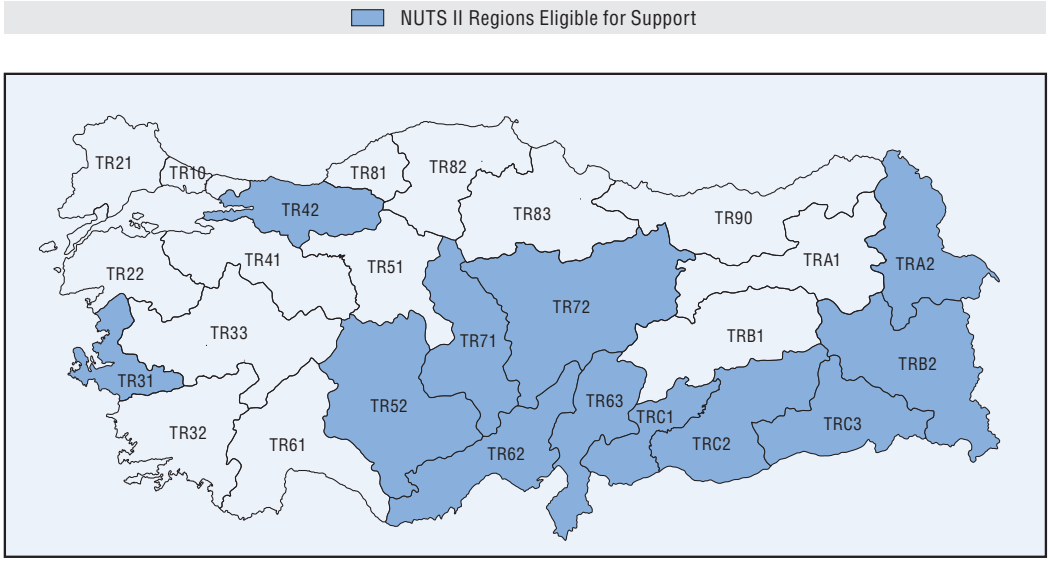
Source: MoSIT (2012). Kimya Sektörü Strateji Belgesi, 2012-2016 (Chemical Sector Strategy Report, 2012-2016), http://sgm.sanayi.gov.tr/Files/Documents/kimya-sektoru-strateji-be-11012013165132.pdf.

Government incentives are provided for investment in the chemical sector

The chemical industry is one of the many sectors where investment enjoys strong financial backing from the government under the new incentive system described in greater detail in the previous part of this report (see "Government incentives are available for investment in the machinery sector"). Under the scope of the incentive system, chemical industry investments could benefit from all four different schemes (Table 17). To qualify for one of the schemes, a company needs first to obtain an investment certificate from the Ministry of the Economy before the investment is initiated. The amount of investment must usually exceed a certain threshold depending on the requirements of the different incentive schemes.

As part of the Regional Investment Incentives Scheme, there are specific incentives varying in accordance with a province's degree of development. Chemical sector investments could take advantage from this scheme in 12 NUTS II regions (Figure 26) until March 2015 when the scope of the incentives was extended to include all the NUTS II regions with the exception of Istanbul. The minimum investment value should be at least TRY 500 000 or TRY 4 million, depending on the region.

Figure 26. **Regional investment incentives for the chemical industry until March 2015**



Source: Ministry of Economy, Regional Investment System, www.ekonomi.gov.tr/portal/content/conn/UCM/path/Contribution%20Folders/web/Yat%C4%B1r%C4%B1m/Yat%C4%B1r%C4%B1m%20Te%C5%9Fvik%20Sistemi/Tesvik_Haritasi.html?lve (accessed on 1 June 2016), OECD illustration

The Turkish government lends even greater support to investments in sectors heavily dependent on imported intermediate goods and products. Under the Strategic Investment Incentives Scheme, chemical industry investments are eligible for a generous set of incentives as long as they exceed TRY 50 million and meet other criteria[17] required. In addition to the incentive system, there are various other support programmes, such as grants and export-oriented grant programmes, which are implemented by government institutions. They very often include chemical industry investments in their scope. The various types of financial incentives provided under the new incentive system are elaborated in the Table 17 below.

Table 17. **Types of support provided under the incentive system for the chemical sector**

	The New Incentive System			
	General Incentive Scheme	**Regional Investment Incentives Scheme**	**Large-scale Investment Incentives Scheme**	**Strategic Investment incentives scheme**
VAT exemption	X	X	X	X
Customs tax exemption	X	X	X	X
Income tax stoppage support	X (Only in the 6th region)	X (Only in the 6th region)	X (Only in the 6th region)	X (Only in the 6th region)
Income tax reductions		X	X	X
Employee insurance premium support		X	X	X
Employee insurance premium support		X (Only in region 6)	X (Only in region 6)	X (Only in region 6)
Credit interest rate support		X (Limited to certain regions)	X	X
Investment land allocation*		X	X	X
VAT reimbursement				X

Note: (*) Land may be allocated free of charge for investments in accordance with the rules and principles set by the Ministry of Finance - depending on the availability of such land.
Source: Ministry of Economy, Regional Investment System, http://www.ekonomi.gov.tr/portal/content/conn/UCM/path/Contribution%20Folders/web/Yat%C4%B1r%C4%B1m/Yat%C4%B1r%C4%B1m%20Te%C5%9Fvik%20Sistemi/Tesvik_Haritasi.html?lve, (accessed on 1 June 2016).

Policies encourage the usage of domestic inputs for the chemical sector

The Input Supply Strategy for 2013-2015 prepared by the MoE acknowledges that Turkey does not possess the production capacity for the majority of the inputs required by the chemical industry at large. Accordingly, it recommends undertaking feasibility studies for various sub-branches, such as the manufacture of fertilizers in the chemical industry, and accordingly promoting investment in very specific product groups with the objective of reducing the use of imported inputs in the manufacturing process.

In addition to general suggestions on identifying input needs of the chemical industry, the Strategy also sets out a more specific roadmap for certain areas of the chemical sector. For the manufacture of paints and varnishes, it points out that domestic production's competitiveness is hampered because of the logistics and inventory costs attributable to dependence on one key imported input - titanium dioxide. Accordingly, the strategy urges the Ministry of Energy and Natural Resources (MoENS) to intensify its efforts in prospecting for rutile and ilmenite reserves.

Similarly, the MoE underlines in the strategy document the growing importance of palm and other vegetable oils in cosmetics and cleaning products. To avert price speculation and secure an unaffected supply of palm oil from abroad, the strategy advocates supporting Turkish overseas investments in palm oil that would be primarily used in the domestic manufacture of cosmetic products.

3.3. Spatial analyses of the Turkish chemical sector

Current spatial picture

As of 2014, there were a total of 5 042 enterprises operating in the chemical industry according to the Entrepreneur Information Database by MoSIT. Of those, 38% were based in Istanbul, with Izmir, at 8.5%, accounting for the second-highest share of chemical enterprises in Turkey.

However, looking merely at the locations of enterprises might give a distorted picture of the manufacture of chemical products. For instance, whilst Istanbul hosts around 38% of all the chemical enterprises in the country, only 28% of all employees in the sector are based there. There might be several explanations for the discrepancy between Istanbul's shares in chemical employees and enterprises. First, the number of enterprises in Istanbul might be inflated by the sales and marketing offices of production facilities situated in other provinces. Second, Istanbul might be a breeding ground for the SMEs in the sector and, third, chemical enterprises in Istanbul might, on average, be more capital-intensive and/or productive as compared to other chemical enterprises in Turkey.

Analysing the number of enterprises and employees in the chemical industry, three regional clusters stand out as the main production areas in chemicals which roughly account for 85% of all the chemical sector employees in Turkey (Table 18).

Table 18. **Agglomeration of chemical enterprises, 2014**

Rank	Name	Provinces	Share of enterprises	Share of employees
1	Greater Marmara Cluster	Istanbul, Balıkesir, Bursa, Kocaeli, Sakarya, Tekirdağ	51.1	58.5
2	Aegean Cluster	Aydın, Denizli, Izmir, Manisa, Muğla	12.2	15.1
3	Eastern Mediterranean Cluster	Adana, Gaziantep, Hatay, Mersin, Osmaniye	9.1	10.7
Total			**72.5**	**84.3**

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis

The largest number of employees is registered in Istanbul, followed by Kocaeli and Izmir. On average, a Turkish chemical manufacturing enterprise employs 14 staff, although there are significant regional variations in the average enterprise size. Among the provinces with at least 50 enterprises, Kocaeli has the largest enterprises, with employee numbers averaging 44, whereas Istanbul and Ankara, with 10 and 6 employees, respectively, fall below the national average (Table 19).

Table 19. **The leading provinces in chemical manufacturing, 2014**

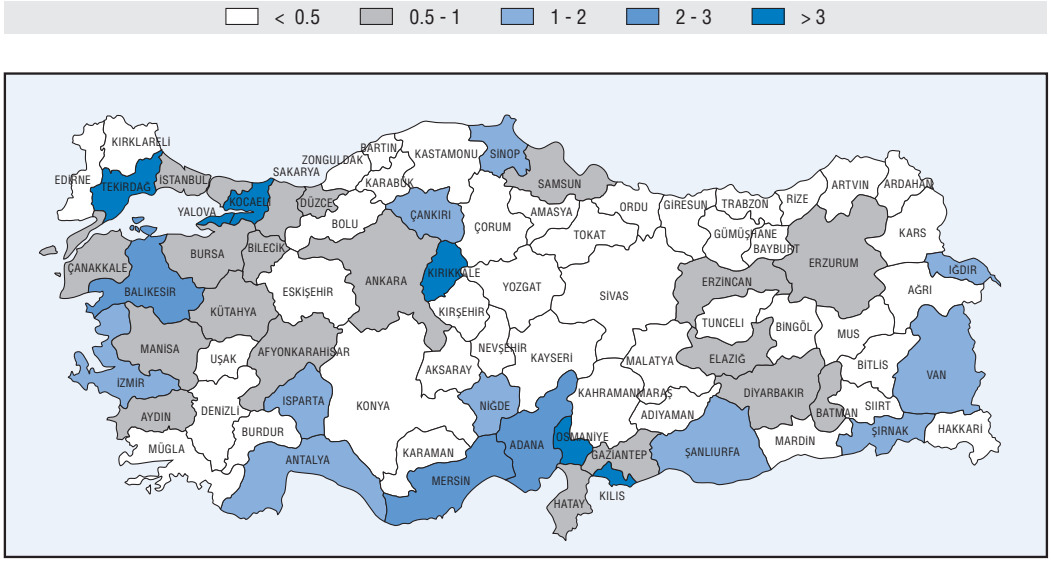
Provinces	Share of total enterprises	Share of total employees	Average enterprise size	Share of total net sales
Istanbul (TR 10)	38.2	27.6	10.1	53.8
Izmir (TR 31)	8.5	12.2	20.0	16.1
Ankara (TR 51)	7.6	3.1	5.7	6.1
Kocaeli (TR 42)	4.9	15.5	44.3	6.5
Bursa (TR 41)	4.3	6.9	22.4	3.2

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

In order to better quantify how the chemical industry is concentrated in provincial and regional economies as in comparison to those of Turkish manufacturing as a whole, the LQ is calculated for each province based on employment[18]. While LQ does not directly measure comparative advantage, this indicator highlights the provinces in whose economy the chemical industry is more prominent, as well as potentially more export-oriented.

According to the LQ values calculated for all the Turkish provinces in 2014, the chemical industry was most concentrated in Yalova (TR42), Kırıkkale (TR71), and Tekirdağ (TR21) (Figure 27). Although Istanbul was the chemical industry's most crucial location for the chemical sector, its LQ was only 0.68 indicating that Istanbul's manufacturing is not necessarily specialized in the chemical industry in terms of employment.

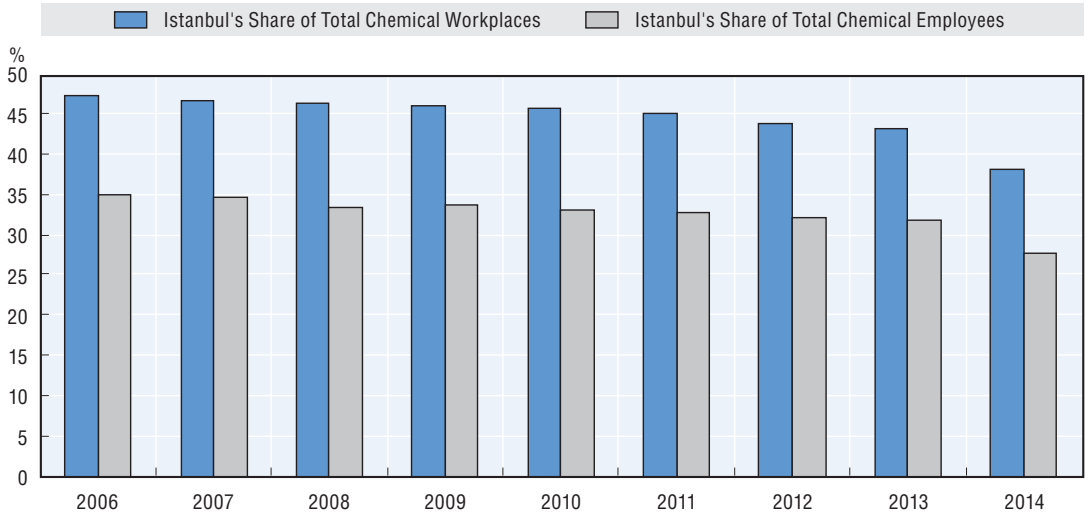
Figure 27. **Location quotients for the chemical industry in Turkey's provinces, 2014**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Istanbul's traditional dominance in Turkey's chemical industry is currently being challenged by other regions. Its share of enterprises and employees has been slowly declining. Over a period of 8 years, Istanbul's share of total chemical enterprises dropped by 8 percentage points (Figure 28). A similar decrease, amounting to 7 percentage points, can also be observed in the share of employees in Istanbul.

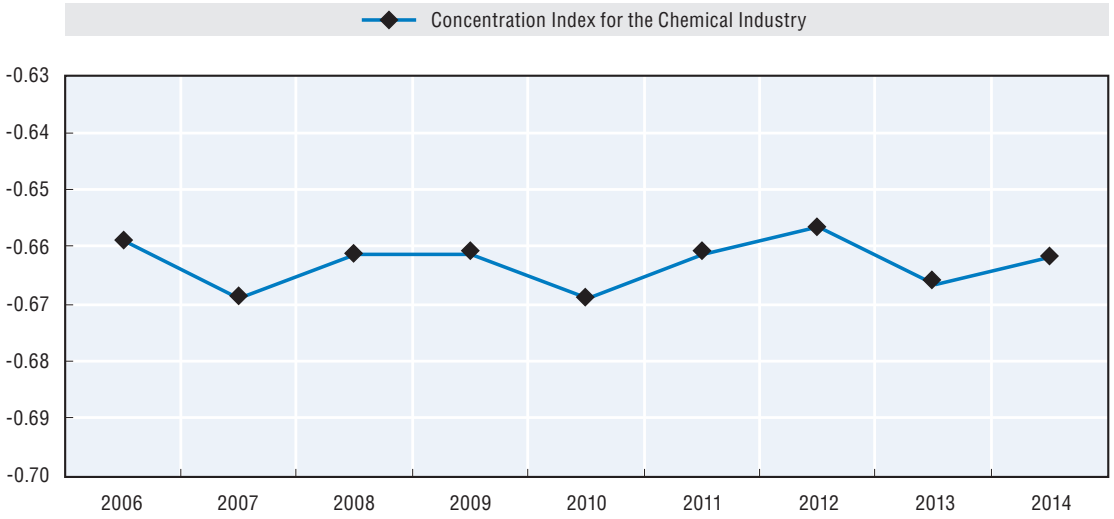
Figure 28. **Istanbul's share of chemical industry enterprises and employees, 2006-14**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Based on the employee numbers of provinces, the concentration index for the chemical industry in Turkey is calculated and shown in the Figure 29 below. If all the provinces had the exactly the same number of employees, the concentration index would be equal to zero. However, since the index takes negative values, it indicates that employees are disproportionately concentrated in a few provinces. The concentration index remained relatively stable between 2006 and 2014, hence signalling that there is no clear trend of chemical sector activities becoming spatially more diffuse or concentrated.

Figure 29. **The concentration index for the chemical industry, 2006-2014**



Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Despite the persistent geographical rigidity, the chemical industry is not one of the most geographically concentrated industries in Turkey. To a great extent, this could be explained by the widespread small-scale production of consumer chemicals, such as soaps and basic cleaning materials.

Istanbul alone exports more than half of Turkey's chemical products

According to TurkStat, almost 85% of Turkey's total chemical exports in 2014 originated from only five provinces - with Istanbul claiming the lion's share at 55%. Although Istanbul continuously increases its chemical exports, its share of the country's exports is gradually shrinking. Istanbul's share in nationwide chemical exports in 2002 stood at 62%, about 7 points higher than in 2014. Over the last decade, by contrast, Kocaeli and Gaziantep boasted the biggest increases in chemical exports. Both provinces' biggest chemical exports are mainly the cleaning and cosmetic products.

Most provinces tend to specialise in a sub-sector of the chemical industry

Since accurate export and sales figures for provinces could not be compiled (Box 6), the number of registered employees working in the manufacture of NACE Rev.2 4-digit product groups could be used as a proxy to better gauge the provinces' specialisation in the chemical industry.

Box 6. **Collection of international trade data in Turkey**

Data on Turkey's international trade are automatically compiled by TurkStat - primarily through the Turkish Customs and Trade Ministry's BILGE database. The main source in this database is the custom declarations collected from customs bureaus in Turkey.

Customs declaration forms do not have a specific question on the location where the exported product is actually manufactured. Therefore, export figures are recorded under the province where enterprises are officially based in. Since most of the bigger exporting enterprises' headquarters are sited in large provinces like Istanbul, Ankara and Izmir, the export figures do not provide a reliable spatial picture of production in Turkey.

Although the regional chambers of commerce usually acquire trade data directly from their member enterprises and hence have a better understanding of their region's export and import volumes, the DAs still expressed the urgent need for having reliable official export data which better reflect their regions' competitiveness. One of the suggestions made in this regard was the inclusion of manufacture location information in custom declaration forms.

Source: TurkStat, foreign trade statistics website, http://www.tuik.gov.tr/PreTablo.do?alt_id=1046.

Specialisation in one or two chemical product groups is usually the case for most of the provinces with the exception of Istanbul, Ankara and Bursa. Most of the activities in these provinces are concentrated on a single sub-sector where they also lead exports nationwide (Table 20).

Table 20. **Specialisation of provinces in machinery sub-sectors, 2014**

Province (NUTS II level)	Leading chemical sub-sector	Share in total chemical sector employment
Istanbul (TR 10)	Plastics in primary forms	22.5%
Kocaeli (TR 42)	Paints, varnishes and similar coatings	30.0%
Izmir (TR 31)	Plastics in primary forms	41.7%
Tekirdağ (TR 21)	Perfumes and toilet Preparations	36.7%
Ankara (TR 51)	Paints, varnishes and similar coatings	25.4%
Bursa (TR 41)	Plastics in primary forms	25.4%
Adana (TR 62)	Man-made fibres	36.5%
Balıkesir (TR 32)	Other inorganic basic chemicals	54.9%
Mersin (TR 62)	Other inorganic basic chemicals	57.7%
Gaziantep (TR C1)	Soap, detergents, cleaning and polishing preparations	33.5%

Source: Ministry of Science, Industry and Technology, Entrepreneur Information System Database; OECD analysis.

Industrial zones specialised only in chemicals are few and close to refineries.

Based on their environmental impact, a large number of sectors and industrial activities in Turkey are now subject to environmental permit and licence regulations which were first introduced in 1983 and further amended in September 2014. In this respect, it is getting gradually more difficult for investors in the chemical industry to obtain the permits required to establish production facilities outside OIZs.

As of 2015, there were a total of 284 specialised or mixed OIZs in Turkey. Most of these are mixed industrial zones and host firms belonging to many different sectors. However, there are three OIZs dedicated to the chemical industry, and thus accommodate only chemical firms (Table 21). The three OIZs, situated in Izmir, Kocaeli and Yalova, are all within close proximity of the two petroleum refineries in Izmir and Kocaeli.

Table 21. **Organised industrial zones (OIZs) specialised in chemical production**

#	Title	Province -NUTS II	Year of establishment	Number of enterprises
1	Aliağa Kimya İhtisas OSB	Izmir (TR31)	1997	39
2	Kocaeli Gebze Kimya İhtisas OSB	Kocaeli (TR 42)	1999	39
3	Yalova Kompozit ve Kimya İhtisas OSB	Yalova (TR 42)	2015	-

Source: Ministry of Science, Industry and Technology, OSB Information website, https://osbbs.sanayi.gov.tr/ (accessed on 01 March 2016).

In addition to these three specialised OIZs, it has been also observed at the regional workshops that a number of regions are in preliminary discussions on establishing new OIZs for the chemical industry - e.g. TR22 (Balıkesir, Çanakkale), TR41 (Bilecik, Bursa and Eskişehir), TR63 (Hatay, Kahramanmaraş and Osmaniye) - or, as in TR31 (Izmir), on enlarging existing ones. Despite many of the regions' high interest to attract chemical sector investment, it seems unlikely that all their plans will go ahead simultaneously, as the existing strategy documents do not anticipate such strong demand for investment in the Turkish chemical sector.

Strategic drivers of chemical industry location

The chemical industry is characterized as a capital-intensive sector, and companies' investment decisions usually represent a significant and generally long-term financial commitment to a specific location (Ketels, 2007). It is to be expected, therefore, that chemical firms would be relatively less spatially mobile and their choices of location relatively inelastic to the short-term financial incentives and subsidies provided by governments. The following sections summarise the main economic, policy and other drivers of location for the chemical industry.

Economic driver – proximity to markets

For many manufacturing firms, an accessible place to sell their products is vital. Proximity and accessibility to markets help them reduce transport costs and quickly dispose manufactured products to their customers at lower rates. Especially for certain industries that produce perishable, highly fragile or very heavy products having a ready market is indispensable.

There is a tendency for chemical producers to locate close to the main markets and customers. This has different reasons depending on the nature of chemical products. However, since a significant share of chemical products is relatively bulky and there are complexities with transporting hazardous chemicals, their manufacturers demonstrate an eagerness to be near their target markets.

However, as noted earlier, different sub-sectors of the chemical industry target different markets. Whilst manufacturers of cosmetics, cleaning products, paints and coatings prefer being as close as possible to large residential areas, the other chemical

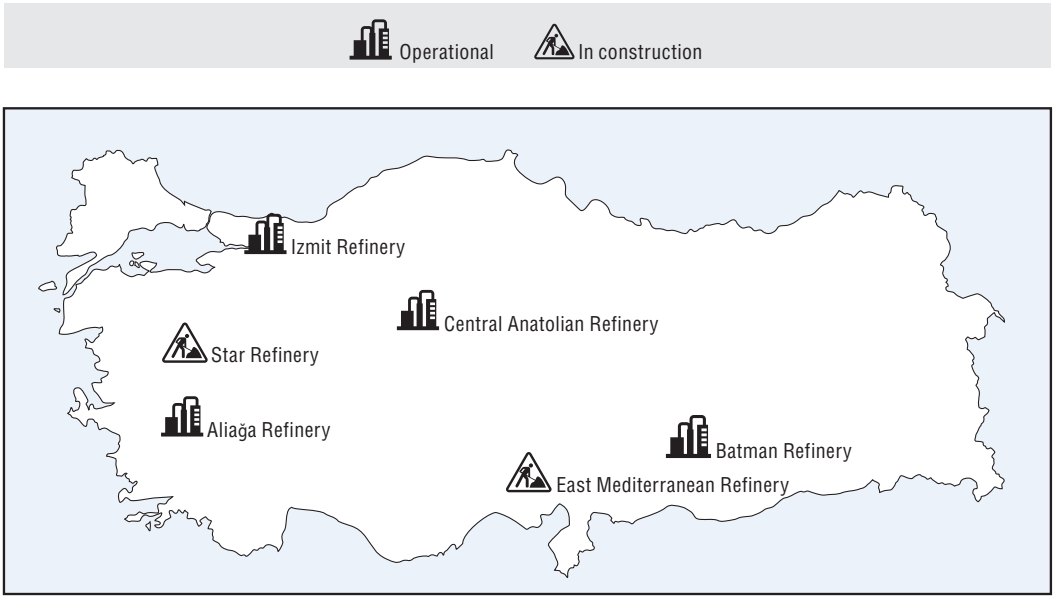
producers would arguably opt for locations where their target manufacturing industries are concentrated. For example, most fertilizer manufacturers in Turkey are located in regions with a highly developed agricultural sector.

Economic driver – proximity to raw materials

Oil refineries provide a wide range of feedstock required by the chemical industry. Most of the inputs used by the industry, and directly supplied by refineries, are bulky and hence usually costly to transport. Therefore, clustering of chemical firms around oil refineries is widely observed. One of the best examples, in that regard, is the Port of Rotterdam, where the chemical cluster has its five refineries at its core.

There are currently four oil refineries operating in Turkey (Figure 30). However competition is anticipated to heat up over the next few years with two new oil refineries being built in Izmir and Adana that are scheduled to being operations in 2017 (Oxford Business Group, 2015). The two refineries will be the first new processing facilities to be launched in Turkey since 1972 - a good reflection of the mounting demand for oil derivatives and growing Turkish chemical industry.

Figure 30. **Oil refineries in Turkey**



Source: Peker H., Gümrah F. (2007), "Türkiye'de Rafineri Sektörü" (Refinery in Turkey), Mühendis ve Makine Volume: 48 No: 575, UCTEA Chamber of Mechanical Engineers, Ankara.

Currently, the total processing capacity of the four oil refineries stands at 28 million tonnes per year (Table 22), which is significantly less than the domestic demand for oil derivatives. Turkey's total processing capacity is likely to get a significant boost when the Star refinery at Izmir starts its operations. This new plant is projected to have an annual capacity of 10 million tonnes per year (ibid).

Table 22. **Processing capacities of oil refineries in Turkey**

Refinery	Processing capacity in 2014
Aliağa	11 million tonnes/year
İzmit	11 million tonnes/year
Central Anatolian (Kırıkkale)	5 million tonnes/year
Batman	1 million tonnes/year
TOTAL	**28 million tonnes/year**

Source: TÜPRAŞ, www.tupras.com.tr/detailpage.tr.php?lPageID=831.

Although Turkey is relatively poor in oil and gas reserves, it is still endowed with some other mineral reserves crucial to the chemical industry. As one of the world's top five chrome ore suppliers, Turkey produces some of the most important chrome chemicals, such as sodium bichromatic and basic chrome sulphate (MoE, 2014). Although chrome ore reserves are to be found in almost all the country's regions in small quantities, close to half of its total chrome ore reserves are concentrated in the province of Elazığ (TRB1) (JMO, 2015).

Furthermore, Turkey also enjoys a comparative advantage in boron chemicals due to the size of its huge reserves. According to the latest estimates, it possesses about 72% of the world's boron reserves which are concentrated chiefly in the four provinces, namely Eskişehir, Balıkesir, Bursa and Kütahya (Eti Maden, 2015). Although most sectors in Turkey have been opened to foreign investment, only state-owned entities are allowed to mine and process boron, uranium and thorium (DTIS, 2014). Boron chemicals are produced exclusively by the state-owned company Eti Maden in its four facilities situated in Eskişehir, Balıkesir and Kütahya.

Of all the manufacturing industries in OECD countries, the chemical industry is the largest consumer of water (OECD, 2001). Water does not only serve as feedstock in the industry, but it is also used extensively for waste control and cooling heat sources such as thermal electric power plants. Because of the chemical industry's heavy dependence on water consumption and the need to discharge waste water, investment locations are usually close to water sources that ensure a steady supply. The agglomeration of chemical firms in Turkey around the Marmara, Aegean and Mediterranean Seas affirms the importance of being close to water sources for chemical enterprises.

Economic driver – agglomeration effects

The benefits of agglomeration may reinforce geographic concentrations in the chemical industry and leave the less-developed regions further behind. New chemical enterprises might prefer to be located in or near the existing clusters, mostly in the Marmara and Aegean provinces. Clustering enables them to tap into the available labour pool with relevant experience and skills sets or to take advantage of the presence of suppliers and business services specialised in the needs and demands of the chemical industry.

In addition to the widely recognized benefits of clustering, chemical firms have an additional incentive to agglomerate. Since the output of one sub-sector of the chemical industry may become the input of another, it makes economic sense for chemical facilities to be geographically close to one another. In certain advanced and highly specialised chemical clusters around the world, networks of pipelines connect chemical facilities and facilitate interaction between the production processes.

Economic driver – transportation infrastructure

Since transportation costs account for a significant share of overall costs along the value chain -particularly in the basic chemicals sub-sector - chemical firms naturally tend to prefer locations that have efficient transportation infrastructure and services, and are regarded as logistical hubs (Ketels, 2007). In that respect, industrial ports offer many advantages to the chemical industry since they widely function as holistic logistics platforms. They provide firms with various transport options via barge, rail and road connections enabling easy access to the hinterland.

In Turkey, there are a limited number of ports with railway connections used for freight transport, and most were built by the state. The ports which were constructed by the private sector seldom offer railway connections or the necessary infrastructure (Rail Turkey, 2014). There are a total of 12 ports with railway connections suitable for freight transport, half of which are in the Marmara Region (Table 23). Kocaeli is the only province in Turkey that boasts three ports with railway connections.

Table 23. **Provinces with ports connected to railways**

	Aegean Sea	Black Sea	Marmara Sea	Mediterranean Sea
1	Aliağa (Izmir)	Samsun	Bandırma (Balıkesir)	İskenderun
2	Izmir	Zonguldak	Istanbul	Mersin
3			Kocaeli (x3)	
4			Tekirdağ	

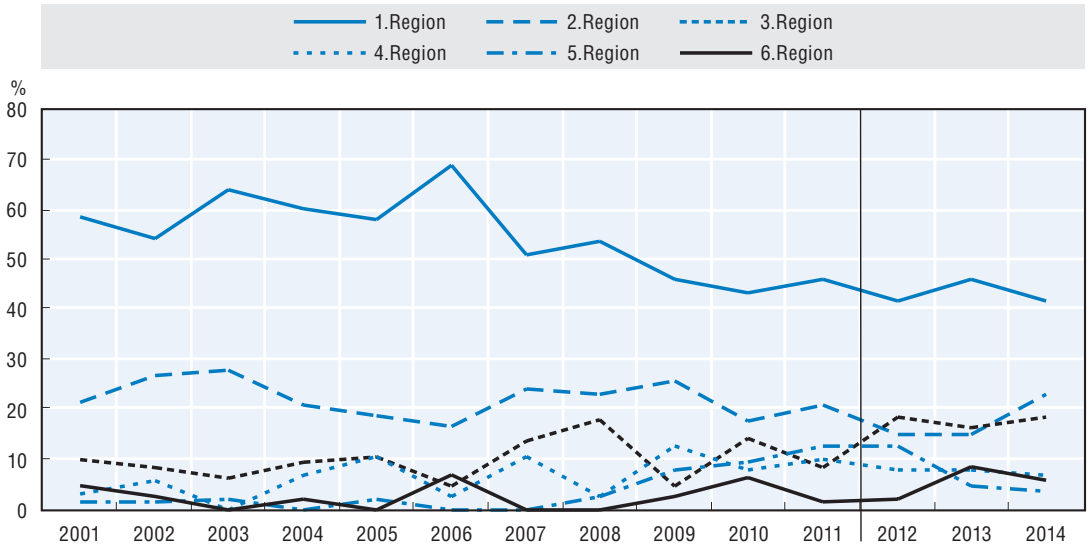
Source: RailTurkey, https://tr.railTurkey.org/2014/02/12/demiryolu-baglantili-limanlar/, accessed on 1 February, 2016.

Policy driver – investment incentive system

Official industry strategies do not explicitly spell out that chemical industry activities should be relocated away from large metropolitan areas. However, the new incentive system, introduced in 2012, indirectly sought to develop chemical industry in only certain regions - mostly away from large metropolitan areas-. Until March 2015, it prioritised investment in the chemical industry in 39 provinces which did not include the large, more prosperous regions like Istanbul, Ankara or Bursa. The main beneficiaries were Izmir, Eastern Marmara and Eastern Mediterranean provinces, as well as all the socio-economically least developed provinces that the investment incentive system classifies under the 6th region. However, since March 2015, all the provinces - with the sole exception of Istanbul- are included in the scope of the incentive system. Thus, it could be argued that Turkish policies, until recently, aimed to shape the future development of the chemical industry around existing clusters.

It is still too early to assess the incentive system's impact on the spatial development of the Turkish chemical sector. However, there are some initial signs that investment in the chemical in less developed regions has been gradually increasing. The share of investment certificates issued in the 3rd, 4th, 5th and 6th regions has doubled since 2001 from 20% to 40% (Figure 31). Nonetheless, the largest number of investments is still directed towards the socio economically most developed provinces grouped as the 1st region.

Figure 31. **Share of investment certificates issued in the chemical sector by region**



Source: Ministry of Economy database; OECD analysis

Other drivers – quality of life

As explained in greater detail in Part 2 on the machinery industry in Turkey, quality of life in provinces/regions is highly crucial for industries requiring skilled and well educated labour. Provinces and regions that do not provide for the social and

environmental needs of their residents are not successful in attracting the workforce required for the development of certain industries. Cognizant of the fact, the MoD highlights the difficulties experienced by chemical firms in finding large investment areas that are close to residential areas with high social and environmental standards.

Anticipated spatial developments

In each regional workshop, the main opportunities and obstacles that could affect the spatial development of the chemical sector in the short to medium term were discussed. Accordingly, the following sections look at the regions deemed competitive in certain sub-sectors and product groups. Expected developments and the regions' unique strengths suggest that the regions highlighted in the following sections will either consolidate their positions or emerge as poles of growth in the Turkish chemical industry by 2023. Last but not least, special attention is also paid to the Black Sea Region which has been at the centre of national policy in the chemical industry since the 2000s.

Chemport Project is expected to boost chemical production in Balıkesir and Çanakkale (TR22)

In recognition of the need for an industrial cluster dedicated solely to the chemical sector, MoSIT initiated a project called "Chemport" in 2013. Drawing on the experience of the Netherlands in the Port of Rotterdam, Turkey moved to establish an industrial zone that addressed the special infrastructural requirements of the chemical industry - particularly an industrial zone with its own port (Fortune Turkey, 2015).

The sector-specific industrial zone is planned to be established on the border of the Çanakkale and Balıkesir provinces in the Southern Marmara Region. The ultimate goal of the project is to reduce Turkey's very large trade deficit in the chemical industry by boosting the production of high value-added intermediate chemical goods.[19]

Chemport was initially planned to be operational by the beginning of 2016 and, by 2023, to be drawing between EUR 5 and 8 billion of private investment from key, influential chemical industry actors (MoSIT, 2015a). Nevertheless, during the consultations held with MoSIT officials in October 2015, it was found that the Chemport project has been put on hold because of the regulations -that imposes limitations on the use of agricultural land for industrial activities- and objections raised by some civil society organisations. Under the terms of Turkish legislation, no plant which emits chemical waste, dust and smoke, can be constructed within three kilometres of an olive grove unless it is an olive oil factory. The industrial zone, which was supposed to cover an area of almost 30,000 square metres, falls within the three kilometre radius of the existing olive groves in the area of Biga-Bandırma.

The Chemport project, if realised, is expected to give the chemical industry a significant boost in the TR22 region and could arguably create a strong, new chemical cluster in the region. Nevertheless, there is concern amongst the local stakeholders that a large chemical industry would be detrimental to local agriculture and tourism. In that regard, it emerged from the regional workshop that the location selection had been undertaken without consulting a wide range of local stakeholders or addressing their misgivings over such a large-scale project.

New oil pipelines and ongoing refinery construction put Adana and Mersin (TR62) on the map

A special report by the Çukurova Development Agency argues that the chemical industry in the TR62 region (Adana and Mersin) is expected to take off given the planned construction of a new oil refinery in Ceyhan (in Adana province) and an oil and gas pipeline between Samsun and Ceyhan.

Ceyhan already lies is the end point of two oil pipelines - one originating from Baku, Azerbaijan, and the other from Kirkuk, Iraq (Figure 32). Up to 2004, the region also had a functioning refinery in Mersin, which was subsequently converted into a storage facility,

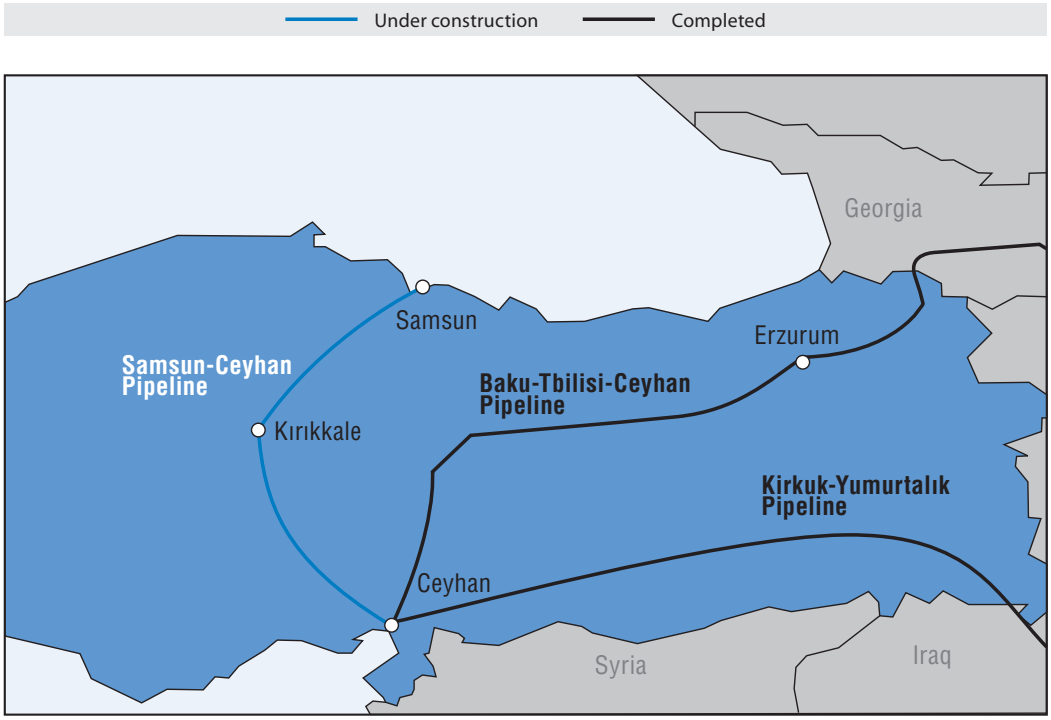
however. The currently planned oil refinery in Ceyhan is expected to have a processing capacity of 10 million tonnes per year, roughly equivalent to the capacities of the Aliağa and Kocaeli refineries.

In view of the ongoing and expected developments pertaining to pipelines and oil refineries, the Council of Ministers approved the establishment of a new industrial zone in Ceyhan in 2007. It is strongly backed by Adana's local authorities since it would boost the production and export of high value-added chemical products. However, since 2007, the industrial zone could not be established mainly because of the problems related to the expropriation of immovable properties in the earmarked plots of land (MoENS, 2013).

Moreover, in 2016, Çukurova University, with the support of local stakeholders, took the first steps towards establishing an R&D centre devoted to the chemical industry. The purpose of this initiative is to identify high value-added chemicals that are currently not produced in the TR62 region and to subsequently develop the required technology to manufacture such chemicals in co-operation with regional private actors. In addition to the development of new chemical products, the specialised R&D centre is also expected to contribute to the development of skilled labour indispensable to the further advancement of the regional chemical industry.

All these developments appear to point to the TR62 region becoming increasingly important in Turkey's chemical industry.

Figure 32. **Existing and planned oil pipelines in Ceyhan in the province of Adana**



Source: OECD illustration

Izmir (TR31) is expected to retain its position as a leading chemical-producing region

Following the privatisation of the Aliağa Refinery in 2008, ambitious investment plans have been unveiled in Izmir (TR31). The largest of them concerns the ongoing construction of a second refinery which is scheduled for completion by 2018 (IZKA, 2014). Second, a cluster concept has been adopted in the region, and a master plan for a chemical industry park has been drawn up based on the successful example of the Jurong Island Chemical Park in Singapore (PETKIM, 20111). In parallel, a number of new commercial ports are also being built by both private and public sectors.

These developments are not surprising considering Izmir's highly developed downstream plastics and paint industry which sustain the demand for petrochemicals and basic chemicals. Therefore, the broad chemical industry, including petrochemicals, as well as plastics and rubber industries, has been growing as a whole in the region providing fertile ground for the emergence of chemical industry clusters in the region. Consequently, and unlike other developed and highly populated provinces such as Istanbul (TR10) and Ankara (TR51), the chemical industry does not seem to be shifting away from Izmir. On the contrary, boosted by new investments, it is projected to grow in size.

Commercialisation of indigenous plants draws increased attention in many Turkish regions

Numerous cosmetic products contain natural ingredients which derive from plants. Among these are essential oils, pigments and other substances of biological origin with useful properties for cosmetic applications (Business Biodiversity, 2013). Cognizant of the rising consumer demand for natural ingredients and the increased application of plants in the cosmetics industry, many Turkish regions have started contemplating how to commercialize their endemic plant species within the scope of the cosmetics industry.

With respect to the application of aromatic plants in the cosmetic industry, three regions in Turkey emerge as front runners. The first one is the TR32 region (Aydın, Denizli and Muğla) which hosts Turkey's first Cosmetic Products Application and Research Centre. The Centre was established in 2013 at the Sıtkı Koçman University in Muğla. It undertakes R&D projects as part of an effort to harness the potential of the region's rich endemic plant life and commercialize it in the cosmetics sub-branch of the chemical sector. At the regional workshop in the TR32 region, local stakeholders briefed on the planned upcoming initiatives to scale up the work undertaken by the R&D centre and establish a technology development zone designed to attract investors who specialise in the cosmetics industry. In addition, they also argued for stronger co-operation between the region's provinces since Denizli is also believed to have strong potential in the manufacture of chemical products derived from medicinal and aromatic plants.

Second, the TR61 region (Antalya, Burdur, Isparta) has long-standing experience in the production and processing of medicinal and aromatic plants - particularly the production of rose oil, which is used extensively in perfumes. Although essential oils production in the region is well advanced, the application of these oils in the cosmetics industry has yet to be developed. In order to promote the regional R&D activities in this field, a rose and rose products research and application research centre, called "Gülar", is currently being restructured in Isparta to better serve the needs of the local private sector. At the same time, the universities in the region are synergizing their efforts with the regional technological development zones to undertake joint studies.

Finally, Hatay (TR63) annually produces around 8 500 tonnes of dried bay leaves - 8.5% of total world production (DOĞAKA, 2013). Acknowledging the large commercial potential of bay leaves, the TR63 region has undertaken a comprehensive stock-taking study of regional bay production and examined how to boost the production of cosmetic products containing laurel oil extracted from bay leaves. In this regard, the DOĞAKA Development Agency has set out an action plan to support regional SMEs as they seek to launch a diversified range of cosmetic products, such as soaps, shampoos and cream that contain laurel oil.

New building codes and energy certificates might advance perlite-based construction chemicals in eastern Anatolia.

Recently, Turkey has begun to align its building energy regulations with the European legislation on buildings. A part of this process is adoption of the Building Energy Performance Regulation stipulates that all new buildings must have an energy identity certificate, whereas existing buildings will be required to have it by May 2017.

Starting from 2017, buildings without a performance certificate will not be permitted to be sold or rented (IPEEC, 2015).

Against that background, the use of heat insulation materials in buildings has been soaring recently in Turkey, triggering the manufacture of related construction chemicals, in particular those based on perlite. In their expanded form, perlite chemicals offer thermal insulation, fire resistance and other desirable properties when used in cement or plaster (Singh, Manjit, and Mridul Garg, 1991).

About 65% of Turkey's total perlite reserves are located in the provinces of eastern Anatolia (MoD, 2001). Notwithstanding this, all the extraction and processing activities related to perlite take place in western provinces, particularly in Izmir (TR31). In order to capitalize on the sizeable perlite reserves in eastern Anatolia, the development agencies in two regions, TRB2 (Bitlis, Hakkari, Muş and Van) and TRA2 (Ağrı, Ardahan, Iğdır and Kars), prioritized extraction and processing in their development plans. Subsequently, these agencies have initiated specific financial support mechanisms to boost the manufacture of perlite-based construction chemicals that would be used as input for the growing construction sector in Turkey and the Middle East.

Despite the two regions' increasing efforts to put perlite reserves to industrial use, it is still relatively early to foresee whether eastern Anatolia will emerge as a new industrial centre concerning perlite-based construction chemicals. Nevertheless, regional stakeholders were quite optimistic about the sub-sector's future in the region. It was widely held that the construction sector in neighbouring Middle Eastern countries could significantly boost the demand for related chemicals provided that political stability in these countries returns.

Kütahya (TR33) is moving towards becoming the centre of boron chemicals in Turkey

Boron reserves exist in eight countries, the biggest being in Turkey, the USA, and Russia. Turkey has the largest boron reserves, enjoying a 72% share of the world's total. Although boron chemicals have a wide range of applications, they are most commonly consumed in the glass, ceramics, agriculture and detergent industries, which together account for 85% of boron's total consumption (Yilmaz, 2007).

The facilities producing boron chemicals are spread across three provinces in Turkey, namely Eskişehir (TR41), Balıkesir (TR22) and Kütahya (TR33). However, in the last decade the majority of new investment was directed at the Emet district in Kütahya province. The existing capacity of the boric acid plant in Kütahya was significantly enhanced in 2011, and a new facility is currently being built. It will produce boron-added cement, arguably more durable than the regular cement used in large-scale infrastructure projects such as highways and dams (Zafer, 2016). In addition, upon completion of the multi-purpose boron project in 2014, Kütahya also became the centre of production of the higher value-added boric acid chemicals used in the manufacture of fragile glazing for electronic products. Supported by the Zafer Development Agency and National Boron Research Institute, R&D projects seem to have gained momentum in the region, leading to the increased application of boron in various industries.

The Zafer DA acknowledges that the prevalent use of boron in construction chemicals as well as cleaning products such as detergents could trigger the development of the chemical industry in Kütahya. Accordingly, discussions are underway in the TR33 region to establish an OIZ dedicated to the chemical industry based on local mineral resources. Such an OIZ could also trigger other potential downstream industries, such as ceramics and glass, which require a constant source of boron in their production processes.

Eastern Mediterranean provinces challenge the dominance of Bursa in man-made fibres

The manufacture of man-made fibres commenced in Turkey in 1964 with the establishment of the country's first synthetic yarn factory in Bursa (TR41). Since then, the production of man-made fibres has grown rapidly and, in the last decade, unusually

high cotton prices further boosted the demand for man-made fibres by forcing some fabric manufacturers to reduce their dependence on cotton by switching, where possible, to man-made fibres (ICAC, 2014).

Turkish synthetic fibre producers have traditionally agglomerated in Bursa to supply input for the large textile industry in the province and its surroundings. However, since early 2000s, with the growth of cotton production in Southeast Anatolia on account of the GAP Project, textile manufacturing activities have partly shifted to eastern Mediterranean provinces (MoD, 2007).

In parallel with these developments, large plants manufacturing man-made fibres were established in Adana (TR62), Kahramanmaraş (TR63) and Gaziantep (TRC1), which has led to the gradual accumulation of know-how and technology in those regions. In recent years, R&D activities in this chemical sub-sector have intensified, and high-tech fibres, e.g. bullet-resistant materials, are also being produced alongside with more traditional ones.

Regional stakeholders are of the view that the Eastern Mediterranean regions (TR62-63-C1) could take the lead in Turkey's manufacture of man-made fibres by emulating the successful experience of Bursa in better responding to the needs of the textile producers, such as by establishing accredited laboratories on industrial and technical textiles.

New R&D centres in some regions might boost the chemical sector

Examination of the share of R&D expenditure in total output shows that the chemical sector is, overall, highly R&D intensive compared to many other branches of manufacturing. R&D is crucial for companies to retain their competitiveness in the chemical industry, since it requires flexibility to adapt to the changing consumer demand and to growing body of regulations designed to protect the environment and human health. In addition, the industry is constantly striving to improve the efficiency of its existing manufacturing processes in order to use fewer raw materials and decrease its capital expenditure (McKinsey&Company, 2011).

With the objective of regulating the support of R&D activities in Turkey, the Technology Development Zones (TDZ) Law came into force in 2001, paving the way for the establishment of special sites for high technology investment. The TDZs are defined under the law as "sites integrating academic, economic and social structures at or near the campus of certain universities, advanced technology institutions, R&D centres". These sites are envisioned as places where enterprises could manufacture high technology products and develop new technologies with the help of facilities provided by the TDZs (YOIKK, 2001).

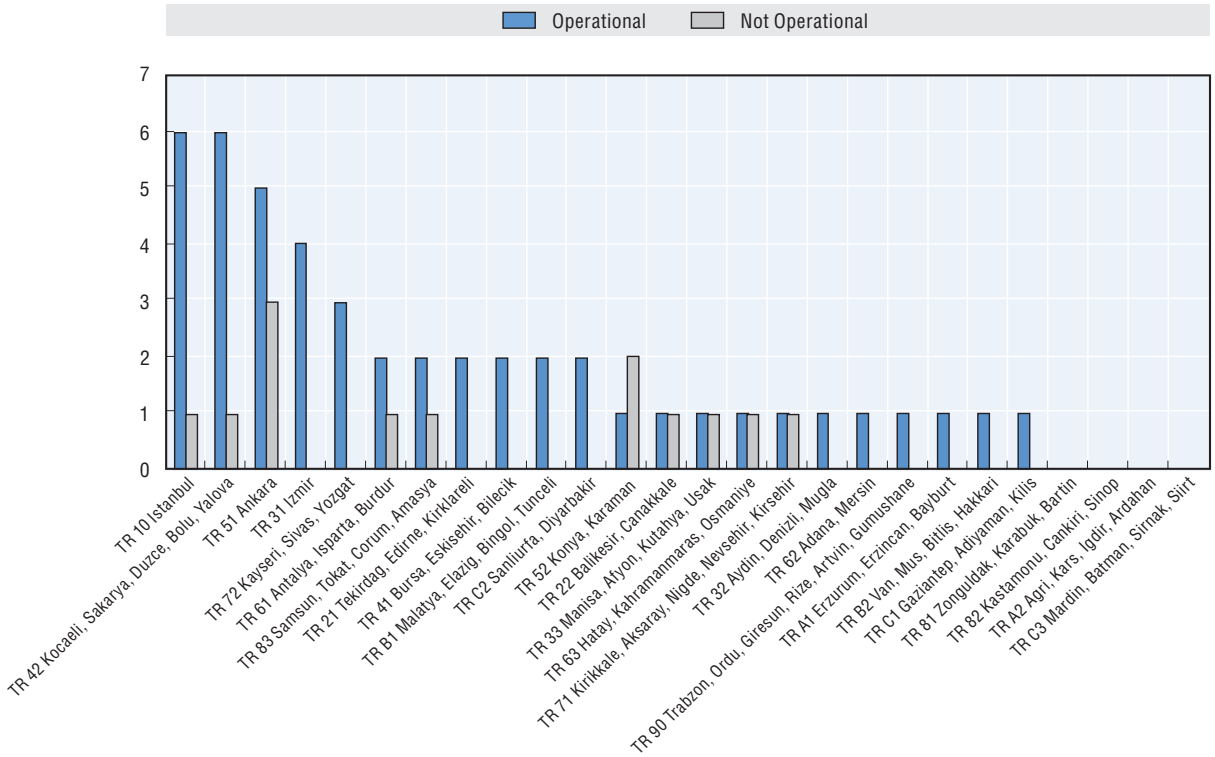
The currently operational TDZs, along with those currently in construction, by NUTS II region are illustrated in Figure 33. With the exception of four regions, all host at least one TDZ. Despite the rapid increase in their number, it has been repeatedly highlighted at the regional workshops that the newly established TDZs have not so far catalysed the industry-academia collaboration to the desired extent. Stakeholders argued that most TDZs focused on information and communication technologies (ICTs) rather than on manufacturing industries, such as chemicals.

Thus, the regional stakeholders were of the view that putting in place new R&D centres under the umbrella of TDZs in regions with a relatively less-developed chemical industry, yet having all the necessary pre-requisites for further development, might be a good step towards increasing the productivity and competitiveness of existing enterprises. In addition, these R&D centres might also trigger the attraction of new chemical investors to the regions.

In this regard, the TR71 region (Aksaray, Kırıkkale, Kırşehir, Nevşehir and Niğde) is one of the regions which could particularly benefit from an R&D centre with a special emphasis on chemical industry. The region has Turkey's largest calcite, perlite and

pumice reserves. All three minerals have extensive use in different sub-sectors of the chemical industry. Despite the fact that the mining of mineral deposits is highly prevalent in the TR71 region, these minerals are, largely, not processed and hence not used as input for the regional chemical industry. Therefore, the establishment of an R&D centre might help the existing enterprises to produce higher value-added chemical products by processing the extracted minerals.

Figure 33. **Number of technology development zones by NUTS II region**



Source: Ministry of Science, Technology and Industry, https://biltek.sanayi.gov.tr/sayfalar/tgb.aspx, (accessed on 1 January 2016), OECD analysis

The expansion of chemical sector activities in the Black Sea Region requires stronger co-ordination with private sector

As part of the integrated Filyos Valley Project, the construction of a large port, a free zone and a specialised OIZ began in 2014 in Zonguldak province. It is argued that this mega-project will be instrumental in fostering the economic development of the TR81 region (Zonguldak, Karabük and Bartın) and creating employment for more than 40 000 people (Çetinkaya, 2014). It should also be noted that, in parallel with the project, the railway connection between Zonguldak and Ankara is currently being rehabilitated with the financial support of the EU.

In line with these infrastructural developments, one recommendation made by the MoD in its Chemistry Working Group Paper (2014c) was to carry out a SWOT analysis concerning the establishment of a mixed industrial zone for the chemical industry in Filyos, Zonguldak. MoSIT's Strategy Report [2012] also calls for a partnership between the public and private sector to invest in the chemistry industry in Filyos, as well as in Samsun. The specific reasons for singling out Filyos and also Samsun are not highlighted in both documents. Although the selection of Samsun as a priority investment location is not self-evident, the ongoing Filyos Valley Project is, arguably, considered as a crucial step to meet the demand of chemical firms, particularly with respect to large-scale plots of land with port and rail connections.

The highly positive outlook for the development of the chemical industry in the Black Sea provinces is, however, not always shared by the Turkish private sector operating in certain chemical sub-sectors. Because of high logistics expenses, as well tight regulations associated with having to cross two Turkish straits in order to reach domestic and international markets, certain private sector representatives at the regional workshops expressed their unwillingness to invest in Filyos, Zonguldak or anywhere in the Black Sea region as a whole. The slightly diverging views on the Black Sea region's attractiveness for chemical industry point to the need for having stronger co-operation with the private sector while national sector strategies are prepared by MoSIT.

Despite the general lack of willingness of private sector in investing in the Black Sea region, the chemical sector's growth is still sustained based on regional resources. In that regard, Kastamonu and Çankırı, both from the TR82 region, are the leading provinces in the region, which increasingly produces chemicals from processing minerals such as copper, bentonite and perlite.

Chapter 4

Looking ahead: How to strengthen the spatial dimension in national sector strategies

This section draws on the studies of the machinery and chemical industries to suggest an approach to strengthening the spatial dimension in Turkey's national sector strategies. It first recapitulates the role of such strategies in Turkey's economic and political landscape and then introduces its methodology. Finally, it sets out the methodology's 10 steps divided into three theme-based groups: "intensify analyses", "improve coherence" and "clarify direction". It also explores the cross-cutting issue of monitoring and evaluation.

4.1. The spatial dimension in national sector strategies

Turkey's Ninth Development Plan (2007-13) acknowledged that the role of the state in the economy had been redefined since the 1970s and, in light of its reduced direct interventions in the economy, Turkey would move away from all-regulating grand plans towards a strategic approach giving priority to organisational and structural regulations that enable the market to work more efficiently and prioritise specific targeted areas. Against that backdrop, the first set of national industrial sector strategies were prepared by MoSIT in 2011 and 2012.[20] These first set of industrial sector strategies do not specifically deal with the spatial distribution of sector activities in Turkey or the breakdown of targets and objectives by provinces and NUTS II regions. This was consequently perceived as rather ambiguous by local stakeholders such as the DAs, which were uncertain about their expected contributions to the overall objectives, as well as what policy actions to undertake in order to foster the industrial sectors' development in their respective regions.

However, starting from 2016, the second generation of sector strategy documents introduced for the first time a dedicated section on the regional aspects. This section, albeit brief, endeavours to highlight the provinces that lead the way in terms of exports, numbers of firms, numbers of OIZs and sector-specific clusters. Although this enhanced attention to the regional development of sectors was welcomed, MoSIT's next generation of sector strategies would still benefit from a stronger regional component.

Further strengthening the spatial dimension of national sector strategies is important for several reasons. First, this would offer regional stakeholders strategic direction by defining their roles and tasks, as well as creating a stronger alignment between the central and regional institutions' policies. Second, regions face different challenges and require unique action plans in line with their priories. Hence, national sector strategies could be an important step in developing policies tailored to regions' strengths and needs. Third, articulating clear and tangible objectives by region in national sector strategies would help meet national objectives. Fourth, national sector policies devoid of a spatial dimension might fall short in implementation. Taking into consideration the spatial dimension would also enable an improved monitoring and evaluation process to better assess the implementation of strategies.

4.2. The ten-step methodology

Given that Turkey has decided to prepare national industrial sector strategies, this section of Part 4 tries to endeavour how to best strengthen the regional dimension in these strategies without going into the merits of the decision. Accordingly, with the objective of providing clearer directions for DAs and other local stakeholders such as local chambers of industry, this section of the report proposes a 10-step methodology that MoSIT could implement when preparing national sector strategies (Table 24). The methodology does not have the ambition to offer a universal approach to the integration of the regional dimension in national sector strategies. Instead, in Turkey's current economic and policy landscape, it seeks to offer MoSIT a new perspective and help it inject further discipline into the inclusion of the regional dimension in national strategies. This methodology draws on the reviews and analyses of the machinery and chemical industries, but is intended to be replicable across all the sector strategies drawn up by MoSIT.

The methodology comprises three main parts:

- Strengthen regional analyses in national sector strategies (Steps 1 to 6);
- Improve the coherence between different regional- and national-level policies (Steps 7 and 8);
- Clarify strategic directions for the development agencies and other regional stakeholders (Steps 9 and 10).

This framework is best to be used as a starting point. Introducing it could enhance communication between MoSIT and the local stakeholders like the DAs. This strengthened co-ordination could subsequently lead to more advanced methodologies and frameworks for the inclusion of the regional dimension in the upcoming planning cycles for national strategy documents.

Table 24. **Ten-step methodology designed for Turkey's Ministry of Science, Industry and Technology**

A. Intensify analyses	**1**	Identification of the sector-specific factors behind firm location choices
	2	Increased use of regional data
	3	Introduction of analyses of product groups and value chains
	4	Consideration of foreign direct investment and foreign enterprises
	5	Examination of clusters
	6	Mapping of R&D activities and regional availability of skills
B. Improve coherence	**7**	Alignment with other national policies
	8	Alignment with regional plans and/or sector reports
C. Clarify direction	**9**	Validation by regional private sector stakeholders
	10	Breaking down overall targets and objectives
		Monitoring and evaluation

Intensify analyses

Step 1. Identification of the sector-specific factors behind firm location choices

The challenge

The selection of industrial location is usually a one-time decision with a highly strategic importance, since the location decision has a direct impact on investors' future operational costs. A poor choice of location can result in substantial costs for a long period of time and relocation of an existing business is neither feasible nor cost-effective in the majority of cases.

Several factors and considerations affect the investors' decisions in choosing a particular location for their investment. There are some factors, such as proximity to markets and customers and the availability of labour, which influence the location decisions irrespective of which industrial sectors the investment belongs to. However, some of these factors might be more crucial, and hence more decisive in shaping the choices, for certain sectors than others.

Spatial analyses in national sector strategies could benefit from identifying the key drivers that influence the location choices of investors' and manufacturers, as well as explaining why the sectors of interest may be more developed in certain regions in Turkey than in the others.

The chemical industry can be taken as an example. Being close to the sea and/or water reserves is a crucial factor for the chemical industry, since water is used extensively for waste control and cooling heat sources. However, in the case of Turkey, there are additional reasons that result in the agglomeration of chemical manufacturers along the coastline of the country. Turkey's chemical industry is highly dependent on imported feedstock, which constitutes the principal input for various chemical processes. Therefore, it makes economic sense for manufacturers to be located near ports that are the entry points for bulky imported raw materials. Without recognising

this factor, subsidies and incentives to landlocked eastern provinces with limited access to ports would have negligible, if any, effect on the development of chemical sub-sectors dependent on imported feedstock.

As for the machinery industry, it seems to have evolved spatially in conjunction with other industrial sectors, such as fabricated metal products and automotive. In Bursa (TR41), the relatively advanced machinery industry might be partly attributable to the inflow of investment into the automotive industry since the late 1960s. Therefore, insulating machinery industry in national sector strategies, without giving consideration to intra-sectoral links, would hamper the effectiveness of policies.

In short, national sector strategies would be significantly enriched if the factors affecting the investors' location decisions were more clearly analysed. Strategy documents would thus not only be able to develop more precise policy recommendations, but they would also help the DAs better grasp the constraints and challenges to sectors' development in their regions.

Suggested options

The factors affecting firms' location choices can be explored by several complementary qualitative and quantitative methods and tools. Qualitative interviews, focus groups and open-ended questionnaires can help uncover the considerations that are most frequently quoted by businesses and investors. They can also lay the foundations for further quantitative analyses. In that respect, these tools should ideally target those companies which have recently relocated and/or set up business at a new site. Because of the sunk costs, enterprises tend to be, on average, immobile, and the factors that affected its choice of location in the past might no longer be relevant or influential.

Quantitative methods include cross-region regressions, which can help explain the variables that are causally associated with the size of manufacturing industries in the average region. A multivariate linear equation regresses the size and/or growth of the manufacturing sector (measured either by employment, total turnover or number of firms[21]) for a sample of all provinces or NUTS II regions on a vector of explanatory factors. Some of the potential independent variables that could be used irrespective of the sector concerned might be the following ones: *number of ports, density of railroads/highways, number of cinemas/movie theatres per population, terror attacks per population, duration of power cuts per year.* The equation estimates the marginal contributions β_i to the size/growth of the sector for each causal factor, assuming that the contribution is the same for all regions.

$$Size\ of\ the\ Sector = \alpha_0 + \beta_1 Factor_1 + \beta_2 Factor_2 + \cdots + \beta_n Factor_n$$

The main shortcoming with cross-region regressions is the endogeneity problem. Since this type of regression analysis needs truly exogenous variables, it might be relatively hard to prove that causality runs only in one direction, and hence the regression might suffer from reverse causality. On the other hand, the omitted variable bias might be less of a concern in this type of regressions, since many of the underlying institutional and policy conditions could be assumed to be the same for all the NUTS II regions in Turkey.[22]

A second quantitative method that could shed light on firms' location choices is input-output analysis. In order to grasp the potential growth of a national and regional industry, it is necessary to go beyond the analysis of a separate industry in isolation. Thus, using input-output analyses would allow MoSIT to take the sectoral interdependence into account and identify how closely a particular industry is related to other industries at both regional and national level.

Step 2. Increased use of regional data

The challenge

Regarding the regional distribution of sector activities, national strategies usually provide no more than a brief overview of how firms are distributed across provinces. Although it is a simple and useful way of grasping where an industrial sector's activities are concentrated, the consideration of additional variables would deepen analysis and help improve evidence-based policy-making.

The main drawback to considering solely the distribution of firms is that a significant number of them carry out their manufacturing operations in provinces other than the one in which they are registered. For instance, none of the ten biggest chemical enterprises registered in Istanbul,[23] manufacture their products solely in Istanbul. They have a number of production facilities spread over other provinces, mainly in the greater Marmara region. Hence, the size of the chemical industry in regions such as TR21 (Edirne, Kırklareli and Tekirdağ) and TR42 (Bolu, Düzce, Kocaeli and Sakarya) would be underestimated if the number of firms was the only indicator used to estimate the chemical industry's size in each region.

Suggested options

Using additional variables would add value and depth to the regional analyses in national sector strategies when gauging the size of the sector's activities in regions. Considering the associated deficiencies of relying on only one indicator, it may be advisable to take advantage of a combination of indicators in order to obtain a more accurate spatial picture of sectors.

At the outset, closer scrutiny of the distribution of workplaces, which include all production facilities, would yield more reliable spatial information on where actual manufacturing takes place. By the same token, the distribution of sector employees by province and region is also a powerful indicator to spatially illuminate the size of sectors. However, using the distribution of employees might be a less accurate gauge in sectors with a large degree of informality, such as textiles, leather and furniture. A third, but equally insightful, indicator could be provincial and/or regional turnover by sector. Regional turnover data is less prone to the discrepancies observed in regional export data, as exports are recorded in the province of the firm's headquarters whereas the actual product might have been manufactured elsewhere in Turkey. Thus, regional and/or provincial turnover data is, usually, more accurate to estimate the size of the industrial sectors by region.

Overall, MoSIT may be well positioned to use a combination of regional indicators in its analyses, since the Ministry hosts the Entrepreneur Information System (EIS) Database, which is a useful source of data for subnational analyses at macro and micro level (Box 7). Moreover, EIS contains data stretching back to 2006, which allows in-depth examination of how industrial sectors have spatially evolved in the last decade and what impact regional policies have had on fostering industrial development.

Box 7. **The Entrepreneur Information System Database**

In 2011, MoSIT was tasked with establishing a comprehensive database with the objective of providing accurate and reliable data for policy makers and researchers to help them develop economic, sectoral and regional policies. In addition to MoSIT's own records from industry registry certificates, the database integrates data from seven different public institutions - the Turkish Statistical Institute, the Customs and Trade Ministry, the Revenue Administration, the Turkish Patent Institute, Social Security, the Scientific and Technological Research Council (TÜBİTAK), the Small and Medium Business Development and Support Administration (KOSGEB). The data that the EIS provides include, amongst others, annual data on firms, employment, turnover, and exports by economic activity and by province. EIS also currently includes data on all 3 million registered enterprises in Turkey. It has been hailed in Turkey as a major step towards filling the gap in regional industrial data and has, for the first time, enabled comprehensive analyses by individual product group and province.

Box 7. **The Entrepreneur Information System Database** (cont.)

Nonetheless, despite the indisputable benefits of the database, the major drawback of the database lies in the inconsistencies concerning the NACE codes allotted to firms. For firms with more than 20 employees, TurkStat officials make field visits before they assign NACE codes. On the other hand, for firms of less than 20 employees, NACE codes are identified and assigned by the firms' accountants. So, if accountants are themselves not very knowledgeable on the classification system, a company might be recorded under a code not related to its operational area.

At the regional workshops, having the wrong NACE codes was often highlighted as a problem - particularly in the machinery industry, where production is closely intertwined with the basic metals industry, which often causes confusion in assigning the right NACE code. Although the problem is less prevalent, if at all, for large-scale firms, many SMEs operating in the machinery industry are thought to have been affected by NACE code mistakes.

Another problem concerning NACE codes is that companies in Turkey tend to commonly change their operational code to be eligible for various financial support and grants from national and local institutions. Although the relative flexibility in choosing the NACE codes makes sense for firms that operate across sectors, it results in unusually large short-term variations in data when broken down by economic activity.

In spite of its weaknesses, the EIS is a major step forward for Turkey in the collection of data on regional industrial activities. The database is currently being upgraded to also provide detailed data at district level, which would further strengthen the spatial dimension of industrial data. However, the assignment of the NACE codes could be made more methodical and operate in accordance with well-defined criteria. The relative randomness and flexibility of NACE code selection affects the reliability of data, as well as the analyses based on them.

Source: MoSIT, Entrepreneur Information System website, gbs.sanayi.gov.tr/AnaSayfa.aspx.

Step 3. Introduction of analyses of product groups and value chains

The challenge

Turkey's national sector strategies generally undertake regional analyses at the sector level - as specified in the NACE classification. Such analyses do not elucidate the spatial dimension of individual products. In other words, the existing regional chapters do not specify which products are manufactured where. Nor do they say which sub-sectors are more prevalent in which region. Their aggregate approach masks the specialisation of provinces in certain product groups and does not provide a detailed picture of spatial production by product group. As an example, the TR63 region (Hatay, Osmaniye and Kahramanmaraş) hosts 1.77% of all machinery enterprises in Turkey, hence does not immediately appear as one of Turkey's main centres of machinery production. However, the region is highly specialised in the manufacture of air, oil and fuel filters for all kinds of automobiles and tractors and Hatay alone accounts for 63% of Turkey's entire filter output.

In the chemical industry, the province of Aydın (TR32) could be cited as another example. A major centre of agricultural production, the province was the second largest producer of cotton in 2015 according to TurkStat. Despite the fact that the chemical industry in the province is minuscule - with barely 350 employees - it is almost entirely focused on the manufacture of cellulose and its chemical derivatives. The cellulose chemicals, with their wide applications in cosmetic and food processing industries, are produced from cotton fibre that is abundant in the province. Similarly, there are many other provinces and regions that are specialised in one or more chemical sub-sectors and not in the whole sector as defined by the NACE Rev.2 classification

Disaggregated data would allow more tailored policies in the regions. Based on the previous example, there is a considerable demand from filter producers in Hatay for the establishment of an accreditation centre under the umbrella of a regional university which would conduct verification tests on local products (DOĞAKA, 2015). If regional analyses do not dissect a sector by product group, it will be impossible to tailor policies to regions.

Suggested options

To better reflect regions' specialisations in national sector strategies, the analyses carried out in the earlier chapters could assist MoSIT in presenting a spatial picture by product group and region. In that regard, the Industry Database of the Union of Chambers and Commodity Exchanges of Turkey (TOBB) would be a good source in complementing the EIS database and help reveal information on individual products. The meticulously prepared and collected capacity reports from all the member firms[24] yield intra- and inter-province analyses pertaining to the production volume of products.

A second important improvement, which draws on detailed product and product group data, could be global value chain (GVC) analyses. Today's economies no longer rely exclusively on domestic resources to produce and export goods and services. Instead, firms, regions and countries increasingly focus on certain activities and are integrated in national or international value chains. While the concept of GVC is not new, their quantitative assessment became possible only recently owing to the development of inter-country input-output tables, a major spinoff of which is the joint OECD-WTO Trade in Value-Added (TiVA) database (OECD, 2016e). This database would allow MoSIT to calculate, among other things, individual sectors' backward and forward intensity indices to reveal comparative advantages (Box 8).

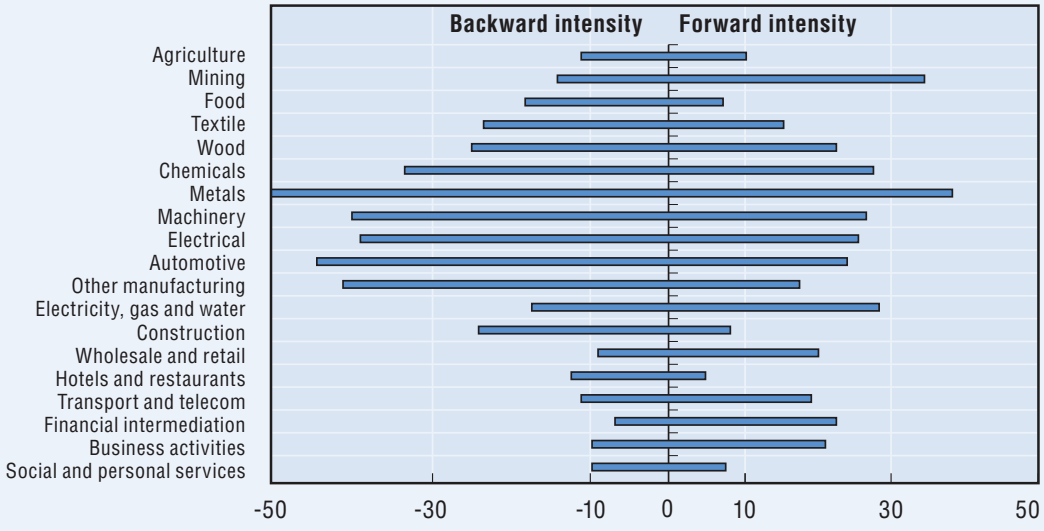
Box 8. **GVC participation by sector**

Individual sectors' backward and forward intensity indices are powerful measures to assess the sectors' participation in GVCs. A sector's backward intensity index measures the share of foreign value added in the sector's gross exports, while the forward intensity index is calculated as the share of the sector's value added in exports that are subsequently embodied in foreign countries' exports.

Measuring a sector's GVC participation is crucial since GVCs are increasingly embedded in industrial and regional policies. GVC participation can extend and diversify potential export markets, foster investment and entail technological skill and managerial spillovers. More specifically, enhanced forward participation in GVCs can help countries improve their trade balance, whilst backward participation can increase competitive pressures and reduce the cost of intermediate input - albeit with zero direct effect on trade balance.

Although Turkey's participation in international trade has deepened since the 2000s, Turkish firms are generally less well integrated in GVCs than the OECD average and occupy predominantly downstream parts in them. Among Turkey's manufacturing sectors, the metals, automotive and machinery industries have the greatest backward intensity, whilst metals and chemical industries have the largest forward intensity (Figure 34).

Figure 34. **Turkey's sectoral global value chain intensity indices**



Source: OECD/WTO (2016), OECD-WTO: Statistics on Trade in Value Added (database), http://dx.doi.org/10.1787/data-00648-en.

A third approach for MoSIT to intensify its product-level analyses could be the product space tool. This tool could be used for the regions of Turkey to closely investigate which specific products are currently not prominent in the export basket of the Turkish regions, and whether intra-sector jumps to these non-prominent products could be made based on the existence of other exported products requiring similar capabilities. Such an analysis would allow MoSIT to better apprehend where the immediate opportunities for different regions of Turkey lie in the product space when it is preparing strategies. To offset the limitations of regional export data in Turkey, the product space representation might be also undertaken using production data.

In this regard, a previous project that Turkey's Economic Policy Research Foundation (TEPAV) conducted with the MoE could offer MoSIT some insight (TEPAV, 2014). The project applied the product space tool to Turkey's provinces to determine which new industries might emerge in the provinces. The main shortcoming of this approach was that the product space was created using country level export data, so the embedded capabilities were relevant to countries, but not necessarily to provinces. Despite this shortcoming, the study is still valuable and could be capitalised on by MoSIT with certain caution.

Step 4. Consideration of foreign direct investment and foreign enterprises

The challenge

A large number of studies show that, if policies are right, FDI can trigger technology spillovers, assist human capital formation, contribute to international trade integration, help create a more competitive business environment and enhance enterprise development. Moreover, beyond the strict economic benefits, FDI might also improve environmental and social conditions in the host country by, for example, transferring "cleaner" technologies and leading to more socially responsible corporate policies (OECD, 2002).

FDI's role in enhancing Turkey's regional development efforts has been perceived as relatively weak, since even the country's more advanced regions had failed to attract much foreign capital until recently. Between 1980 and 2001 foreign companies invested USD 13.7 billion in Turkey, an annual average of USD 624 million and a fraction of the level of FDI flowing into countries of comparable size and development, such as Argentina and Mexico. However, attracting FDI could be an important element in a regional development strategy and could significantly complement domestic investment (Öğütçü, 2002). Indeed, national sector strategies could benefit from having an increased focus on FDI and foreign enterprises in order to allow for more tailored regional development initiatives in that area.

At the time of writing, no published national sector strategy had provided a detailed rundown of sectoral FDI inflow or stock by province and/or region. In addition, out of the all the sector strategies only one of them, namely the chemical sector strategy offers a distribution of foreign enterprises by province.

Suggested options

The MoE publishes data on FDI inflows and FDI stock in its monthly bulletins which do not, however, break down FDI data by region.[25] Apart from official FDI figures, MoSIT might also consider using the number of foreign investment certificates (FIC) as a proxy for FDI inflows.

With the introduction of investment incentive system, both foreign and domestic investors must obtain a certificate in order to benefit from incentives. These investment certificates are issued before the investment is initiated, and contain detailed information on the size, type and actual location of the investment. Notwithstanding the availability of the data on investment certificates by region and sector, the MoE does not seem to follow up on the realisation rate of the issued investment certificates. Although this is

problematic *per se*, the number and amount of the issued investment certificates would still be highly useful - assuming that the realisation rates of investment were broadly similar across the regions.

Nevertheless, the number of investment certificates, despite its shortcomings[26], could be a good proxy for highlighting regional trends in FDI inflow. This is especially crucial since local stakeholders do not typically have a clear picture of actual foreign investment by sector in their regions as observed during regional workshops. For instance, between 2001 and 2016, the highest number of FICs in the machinery industry was issued in Manisa (TR33) and Tekirdağ (TR21). This may be an indication that heavy industries, such as machinery, demonstrate a trend of moving away from major metropolitan centres like Istanbul and Izmir to periphery provinces. In addition, it might be also useful to look at the distribution of investment. In the machinery industry, despite the generous investment incentive system, only 25 provinces out of 81 had been granted at least one FIC since 2001 - which points to a certain concentration of foreign direct investment in the same provinces.

Overall, including the distribution of FDI inflows and of foreign enterprises by province and/or region in national sector strategies, together with statistics on foreign investment certificates, would highlight the regions that have been more successful in attracting FDI - which gives indirect clues about regions' competitiveness. Last but not least, by mapping sectoral FDI inflows by region, national sector strategies would better guide foreign investment promotion activities that are led mainly by the Turkey's Prime Ministry Investment Support and Promotion Agency (ISPAT) and the DAs' local investment support offices.

Step 5. Examination of clusters

The challenge

As part of a cluster, firms can achieve economies of scale, higher productivity and specialisation, and they might lower their transaction costs due to geographical proximity and increased interaction, often based on trust. Such industry concentrations can lead to the appearance of localisation economies, reducing costs through the availability of specialised labour and business services, public sector investments designed to meet industry needs, as well as financial markets geared towards satisfying cluster firms' demands (OECD, 2005).

Cluster analyses can help diagnose regional economic strengths and challenges and identify pragmatic ways to shape regions' economic future (Cortright, 2006). Since clusters are highly influential in orienting regional policies towards groups of firms, enhanced focus on regional clusters might be highly useful in national sector strategies. Thus, identifying established clusters, as well as agglomerations with strong cluster potential would be befitting as a first step towards tailored strategies that meet the special needs of clusters.

In MoSIT's national sector strategies, the section on regional aspects lists the requirements for qualifying for financial support under its Cluster Support Programme. Nevertheless, no further information is provided in the documents on existing clusters, as well as on whether any of the existing clusters have previously benefited from the Programme.

As there are examples of successful industrial clusters in Turkey, it is even more crucial to include these in national sector strategies. The cluster in Konya comprising agricultural machinery producers, which officially established their umbrella organisation Kontarkum in 2012, is one of the most advanced manufacturing clusters in Turkey. Close to half of Turkey's total agricultural machinery exports originate from Konya, and with its 50 member enterprises, Kontarkum leads Konya's agricultural machinery exports. The Mevlana Development Agency in TR52 (Konya and Karaman)

has promoted Kontarkum as a good practice to other emerging machinery clusters in Turkey, such as the agricultural machinery producers in Hayrabolu, Tekirdağ (TR21). For the time being, national sector strategies are silent on good cluster practices, such as Kontarkum, and do not draw on such experiences.

Suggested options

Cluster identification and cluster analyses are key first steps in putting in place a successful cluster policy. A policy for clusters is more effective when supporting existing and emerging clusters rather than trying to create them *ab initio* (Warwick, 2013). Therefore, policies that aim at developing entirely new groups of firms in selected sectors can entail high costs, and might give rise to destructive competition should other regions follow the same policies in pursuit of the same industries.

In its efforts to identify clusters, MoSIT could benefit from taking one or a combination of the following basic methodological approaches: (i) calculation of location quotients, (ii) input-output analyses, (iii) quantitative and qualitative techniques to visualise particular networks/clusters (OECD, 2005). Generally, analyses based on location quotients are a straightforward way of identifying clusters, especially when data and timelines are limited.

Many, if not all, DAs have undertaken comprehensive cluster analyses when preparing their regional plans. Therefore, there is already extensive regional knowledge available on mature and emerging clusters which MoSIT could reference without the need to replicate all these analyses. However, special attention needs to be paid to clusters possibly straddling provincial and regional boundaries. The cluster of industrial ventilation, air conditioning and refrigeration cluster that stretches from Izmir (TR31) to Manisa (TR33) is a good example of the need to take the wider geographical perspective in cluster identification.

For the clusters stretching regional boundaries, the need arises for several DAs (and other relevant regional stakeholders) to synergise their efforts in order to increase the impact of their support to such clusters. One notable example in that respect is the joint work carried out by the DAs of TR42 (Bolu, Düzce, Kocaeli, Sakarya and Yalova) and TR51 (Ankara). These agencies have started discussions on announcing combined financial and technical support programmes for sectors with clusters that straddle the two regions.

Once existing and emerging clusters have been identified, policy makers are in a better position to put in place the right institutional conditions. Some policy options to that end could be to promote the creation of suppliers' associations and learning circles, facilitate communication between the companies in a cluster, ensure effective extension services, and facilitate subcontracting arrangements within a cluster (Warwick, 2013). The recent empirical work on clusters also advises policy makers to be cautious when interfering with local production structures, since they could spread themselves too thin by trying to do too much - given their limited capabilities. Instead, the regions would be better-off if the local authorities intensified their efforts in the efficient provision of public goods that serve the needs of a broad range of local producers (Duranton, 2011).

Step 6. Mapping of R&D activities and regional availability of skills

Challenge 1 – R&D activities

In the strategy documents by MoSIT, there exists a broad section on R&D and innovation, in particular for those sectors classified as, at least, medium R&D intensive according to the OECD taxonomy of economic activities (Verger and Galindo-Rueda, 2016). That section briefly outlines the R&D expenditure incurred and the number of patent applications made in comparison with other industrial sectors in Turkey. In addition, it also summarises the number of active R&D centres owned by private firms in the sector.

The chapters yield national-level information on R&D which is, however, not supplemented by regional information, i.e. analyses on how different regions in Turkey contribute to overall R&D activities. Incorporating such information would be useful, since Turkey's R&D activities are spatially concentrated and insufficient R&D could constitute one of the market failures in the regions.

The strong geographic concentration of R&D activities is not unique to Turkey though, and other OECD countries such as Sweden and the United States are also characterized by the relative concentration of R&D activities in certain regions (OECD, 2010). R&D activities have different spatial dynamics and do not necessarily have to be evenly spread. Nonetheless, unusually heavy concentration of R&D activities can limit the diffusion of knowledge between regions and sectors unless some transmission mechanisms are put in place which would help other regions absorb and adapt new technologies invented elsewhere. Therefore, mapping R&D activities by region would be a pre-requisite for establishing these transmission mechanisms, as well as determining the necessity of scaling up R&D activities at a low cost and without threatening competition in certain regions.

Local stakeholders at the workshop in the TRB1 region (Bingöl, Elazığ, Malatya and Tunceli) repeatedly underlined the importance of scaling up R&D activities - especially to foster the competitiveness of the region in the production of customised machinery for food processing, such as bakery machinery and ovens. If there was no way to sufficiently strengthen co-operation between the newly established technology development centres and the industrial zones in the region, said the stakeholders, an R&D centre specialised in the manufacture and design of food processing machinery could be a policy option for shifting the sector towards higher value-added products and help make the regional machinery producers more competitive.

Suggested options 1 – R&D activities

In January 2016, a new national R&D reform package was announced with the objective of increasing the share of R&D activities in the Turkish economy from 1% to 3% of GDP (TÜBİTAK, 2016). Some of the proposed measures under this reform package, if fully implemented, could foster R&D activities in Turkey. For example, the minimum number of employees required for a company to apply for any R&D incentive is to be reduced from 30 to 15 - a move intended to trigger R&D activities in smaller firms. Moreover, the wages of staff working in R&D centres established in TDZs will be paid by the government for a two-year period and such employees will need, at least, a bachelor's degree in fundamental sciences, such as chemistry and physics. This change might induce positive spill-overs by increasing interest for degrees in fundamental sciences.

In light of this growing attention paid to R&D activities, national sector strategies would benefit from gathering data from the Turkish Patent Institute's database and analysing them. It would enable them to map which regions stand out in a particular sector as far as innovation activities are concerned. Such analyses would shed light on the volume and effectiveness of innovation activities in both provinces and regions. The indicators - e.g. the number of approved patent and utility model applications and the level of R&D spending - are available in the database both by industrial sector and by province and region.

Challenge 2 – availability of skills

The inability of firms to find the skills they need is emerging as a growing hindrance to development. The issue is getting more prominent among policy makers. The malfunctioning of the labour market, specifically the mismatch between the education system and the productive sectors is evident in most regions and sectors - as illustrated in the results of the enterprise surveys conducted all over the world (OECD, 2016c).

Stakeholders, chiefly from the private sector, contended in the regional workshops that the Turkish education system has not been able to supply the skills needed to facilitate the development of machinery and chemical industries in many regions. The issue was more pronounced when it came to blue-collar workers who tend to be, on average, less mobile than their white-collar peers, hence bringing about the need for regions to rely on their local labour force.

One example was the machinery industry's growing need for skilled labour in the province of Çorum (TR83). The machinery sector has grown quite substantially in the last decade and become one of the dominant sectors of Çorum. As of 2014, the province hosted around 50 enterprises, mostly specialized in the manufacture of food and beverage processing machines, and accounted for 1% of Turkey's total machinery exports. Despite the machinery sector's crucial and increasing share of the province's total employment, there was only one vocational high school in 2015 in the whole province. Its machinery-related departments had an annual quota of 48 students (ÖSYM, 2015).

Suggested options 2 – availability of skills

Regional analyses in national sector strategies could be complemented by highlighting the regional supply and demand for skills that are relevant to the sector of interest. İŞKUR regularly conducts labour market needs analyses at the provincial level to determine short-term labour force demand trends and the required skills and qualifications by province and sector that are not supplied by the labour market. Furthermore, the Business Environment and Enterprise Performance Survey (BEEPS), which is a firm-level survey based on face-to-face interviews implemented by the European Bank for Reconstruction and Development (EBRD) in partnership with the World Bank, reports the share of companies citing availability of adequately educated workforce as an obstacle. In 2014, the BEEPS V survey interviewed more than 1 200 enterprises in different regions of Turkey and close to 40% of all the chemical enterprises indicated the lack of adequately educated workforce as an obstacle, making it the highest share amongst all the manufacturing sectors.[27]

Taking advantage of this wealth of information and reflecting the relevant sectoral findings of İŞKUR's needs-assessment studies and BEEPS surveys, MoSIT might be better positioned to strategically plan active labour market policies and specific initiatives in co-ordination with other public institutions to be able to respond to the demands of manufacturing sectors. Enterprises could also play an active role in these initiatives by assisting MoSIT to improve the skill base of the workforce, for example through apprenticeship schemes whose importance was repeatedly highlighted in regional workshops.

Part B. Improve coherence

Step 7. Alignment with other national policies

The challenge

The focus of strategies on the whole sector rather than single product groups is arguably, as suggested in Step 3, a reflection of government policies, most notably the incentive system. Most public support to industrial sectors in Turkey is provided as part of the incentive system and targets NACE Rev.2 sectors, rather than specific product groups and/or activities.

The simplicity of the broadly based sector approach is offset by its limitations. Globalisation and progress in information and communication technology allow firms to fragment their production in the global value chain. As a result, the relevant unit in economic analyses may not be the sector, but the business function or activity along the supply chain. Region and countries increasingly tend to specialise in specific business functions or activities rather than specific industries, such as assembly operations for

China or business services for India (OECD, 2014b). Accordingly, sector strategies could focus more on the specifics of sub-sectors - as could incentives. Instead of offering a whole sector blanket incentives, the targets of public support are suggested to be viewed as activities rather than sectors, since this would help facilitate structuring the support as a corrective to specific market failures instead of generic support for this or that sector (Rodrik, 2014).

The limitations of the broad-based sector approach are especially apparent at the regional level and were singled out in the regional workshops. Regional stakeholders expressed their concerns with the current incentive system's blanket approach. In the chemical sector, for instance, many of Turkey's western regions had not been eligible until March 2015 to benefit from the incentives specific to investment in the chemical sector - possibly because of current efforts to relocate chemical manufacturing away from major population centres, as well as tourism hotspots. Although that policy is understandable, many of the excluded regions like TR32 (Aydın, Denizli and Muğla) and TR61 (Antalya, Burdur and Isparta) put great effort into harnessing the potential of indigenous plants and commercialising them in the cosmetics sub-branch of the chemical sector. This activity, albeit safe and compatible with tourism, had been not supported by the incentive system until recently.

The Izmir Development Agency (IZKA) is an example of good practice in the provision of support programmes, since it generally designs financial assistance programmes that target product groups and activities believed to offer the highest growth potential in the region. For instance, under the scope of machinery sector, IZKA provides its support only to the successful clusters of industrial ventilation, air-conditioning and refrigeration manufacturers.

Apart from the need to better take product groups into consideration, there are also discrepancies between national sector strategies and the investment incentive system when it comes to prioritising locations for investment. By way of example, the national chemical sector strategy singles out Samsun (TR83) and Zonguldak (TR81) as locations where efforts to foster private sector investment should be directed. However, both of these regions had been left out of the regional investment scheme for chemical sector investment until recently.

Suggested options

If there is to be a regional incentive system, then it needs to be aligned with national strategies. Thus, taking the system's existence and structure as given, this part suggests two possible ways to increase its coherence and relevance.

The system's coherence could be improved by intensifying dialogue between the various institutions in charge of strategies and incentives at different tiers of government. One of the ideas proposed by the DAs in regional workshops was to set up an inter-ministerial committee made up of representatives from relevant departments in the MoE, MoSIT and the MoD. The committee could also include representatives from relevant regional stakeholders, such as the DAs. Since there are ongoing deliberations on revising the regional incentive system, the establishment of such a committee could be timely to align the priorities of MoSIT and other Ministries concerned.

The inter-ministerial committee could also initiate discussion on whether regional incentives could be offered for certain product groups and/or activities rather than sectors. If certain product groups are believed to have the potential of providing spillovers and demonstration effects for the certain regions, treating them separately might be more desirable for the regions concerned. For instance, basic chemicals, whose manufacturing process raises concerns for the environment, could be subject to a different set of incentives than consumer chemicals such as cosmetics. In the case of Istanbul, the manufacture of soap and detergents (among other sub-sectors) could trigger positive technological externalities for other sectors, e.g. biotechnology. It could

thus be highly influential in driving science and research-driven industrial development (OECD, 2008). In other words, a certain set of incentives for the manufacture of soap and detergents might be better justified for Istanbul rather than providing the same set of incentives for the entire chemical sector.

To sum up, regardless of the changes and revisions to be ushered in under the planned new regional incentive system, the involvement of MoSIT and, preferably, that of regional stakeholders would be beneficial to the harmonisation of strategies and the co-ordination of the efforts of national public institutions.

Step 8. Alignment with regional plans and/or sector reports

The challenge

Aligning and harmonising national and regional/local priorities and policies is currently at the forefront of the MoD's agenda, since the number of strategic documents and plans, both by national and regional institutions, has significantly proliferated over the last decade. With respect to manufacturing sector strategies, the DAs, as well as provincial chambers of commerce, engage in the preparation of sectoral reports for their regions. These reports often shed light on the binding constraints on the regional development of industrial sectors, and provide a roadmap to overcome them - mostly based on information received from the field through surveys or face-to-face interviews.

A good example in this respect is the chemical sector report published by the Çukurova Development Agency for the TR62 region (Adana and Mersin). The report acknowledges that the chemical sector is expected to gain momentum with investment in the planned refinery and new oil pipelines investments in the region. Accordingly, it calls for region-specific action, such as drawing up an investment promotion strategy directed at producers of intermediate chemicals and boosting the competitiveness of the chemical sector by restructuring regional universities and vocational schools to meet the needs of the chemical industry.

Suggested options

The harmonisation between national and regional/local policies and priorities could be achieved through an iterative process in which a comprehensive review of the existing regional sectoral reports could be undertaken by MoSIT during the preparation of national sector strategies. Some of the analyses and region-specific challenges and opportunities could be incorporated into its national strategy documents if it deemed them relevant. MoSIT's provincial branches available in all Turkey's 81 provinces could play an instrumental role in bringing regional reports to the attention of the Ministry while it is drawing up national sector. That process could be a simple way of tackling the challenge of non-conformity between the different strategies.

An arguably more effective method for MoSIT to achieve harmonisation could be to mobilise relevant regional stakeholders for more structured input during the preparation of national sector strategies. By requesting inputs from regional stakeholders through a standard template and/or clear guidelines, MoSIT could receive valuable information which would not only feed national sector strategies, but also contribute to achieving coherence between national and regional policies and priorities. This comparably sophisticated procedure would be more sustainable in the long term - especially if an active network of relevant national and regional institutions could be established. On the downside, this method would, most likely, require more resources in terms of time and staff, and hence would lengthen the preparation process of national sector strategies.

Part C. Clarify the direction

Step 9. Validation by regional private sector stakeholders

The challenge

Stakeholder consultations are a key tool for transparent and informed policymaking. Their use in the development of new regulations and policies boosts the feeling of "ownership" by all the parties concerned. Thus these consultations increase the legitimacy and credibility of policies. They can also ease implementation by bringing about a more effective compliance from all the actors involved (EC, 2014). In the case of national industrial sector strategies, the contribution of the private sector, which is chiefly affected by these strategies, is indispensable. The main idea behind effective stakeholder engagement is, indeed, that of "attracting, empowering, and managing the expectations of the public" or private sector stakeholders, as in this particular case (OECD, 2015b).

MoSIT has been highly effective in involving a wide range of stakeholders in the initial phase of the preparation of sector strategies. In order to identify the primary problems encountered by sector stakeholders, MoSIT organises "situational analysis" meetings. With the help of these meetings, MoSIT tries to ensure that various stakeholders' main concerns could be taken into consideration in strategy preparation and the necessary changes could be timely reflected in national sector strategies.

Despite the importance that MoSIT accords to consulting with stakeholders and gathering external views during strategy preparation, private sector participation is usually confined to the biggest enterprises operating in the sector concerned and its national federations. Most of the time, therefore, regional actors are not involved in the process, and there is a possibility that the views expressed during situational analysis meetings tend to be biased in favour of the private sector based in Istanbul (TR10) and Ankara (TR51) at the expense of smaller but numerous firms from other regions.

Suggested options

There may be room for further improving the consultation process when designing national sector strategies. First, national sector strategies would significantly benefit from extensive consultations involving a wider array of private sector stakeholders so as to clarify, as well as agree on, a common direction. Not only should the interests of the largest and incumbent enterprises be represented in consultation meetings, but newcomers - SMEs from different regions - should also be encouraged to be part of the consultation process so that policy decisions could be taken based on a broad range of views. Moreover, by ensuring the involvement of a diverse group of private-sector stakeholders, lobbying from narrowly focused interest groups could be effectively counter-balanced (OECD, 2015b).

Second, involving private sector stakeholders at the end of the strategy design process, in addition to *ex ante,* may yield additional information. The proposed actions in the sector strategies could be validated, and subsequently also owned by the private sector. If there is no such validation process, policy actions risk to be not binding on the private sector, hence negatively affect the effectiveness of national policies.

Finally, the greater transparency that would result from consultations would strengthen the credibility of the sector strategy preparation process. It should be pointed out that MoSIT is not required to include all inputs and proposals received from private sector stakeholders in its national sector strategies. However, whenever such omissions take place, the reasons for not taking them on board could be transparently explained and shared with the stakeholders concerned. Together with the other measures mentioned above, transparency would allow the whole consultation process to maintain

its accountability, thus overcoming the potential scepticism that might be attached to the consultation practices from the private sector (OECD, 2015b).

Step 10. Breaking down overall targets and objectives

The challenge

One of the main concerns expressed by the DAs at the regional workshops was that MoSIT does not break down by region the targets that it sets in its national sector strategies. As a result, the regions were generally unsure of how they could potentially contribute to those targets and of the role that they were expected to play in the overall scheme.

In this respect, the export targets for 2023 set by TIM for each industrial sector are reflected in national sector strategies, but again they are not broken down by region. Although these targets are generally quite ambitious, the regions still expressed their wish for regional targets to anchor their planning process and stated that they were willing to take the measures required to meet those targets.

At the time of writing, the TR10 region (Istanbul) was the only region which has endeavoured to have a regional breakdown of the Turkey's overall export targets. Even in this case, the export target for the region is not subsequently broken down into sectors. According to the *Industry Strategy Report* [2015] prepared by the Chamber of Industry of Istanbul, it was assumed that Istanbul's share of national exports would continue to fall and its export target for 2023 was set at USD 160 billion - roughly 32.5% of the overall target of USD 500 billion set by TIM.

Suggested options

To guide and assist the DAs, the OECD has devised a simple method of projecting what regions' export shares might look like by 2023. Instead of setting export targets for Turkey's NUTS II regions, the method intends to be indicative and aims to give the regions an overall idea of what, given their strengths and weaknesses, they might attempt to achieve by 2023. The method is also expected to form the basis for initiating discussions among the different national and regional actors on how realistic the targets are, as well as on what specifically needs to be done in order to achieve these targets by 2023. Annex D looks at the method in greater detail.

It should be emphasised that export targets are only a proxy to measure the regions' competitiveness in tradable sectors, which is of main interest for the Turkish regions. Since better proxies, such as sectoral value-added by region, cannot be used because of the non-availability of data, export data are the second-best option for shedding light on the regions' competitiveness. However, over-emphasis on exports and setting targets could be counterproductive for some regions. Most of the time, enterprises initially succeed on the domestic market before exporting to other countries. Trying to establish a presence in other countries whilst leapfrogging the domestic market could result in failed initiatives (Box 9). Therefore, it would be more advisable to analyse regions' export potential and comparative advantage without trying to achieve a target at all costs.

Apart from the export targets, there are other, mostly qualitative, targets and objectives that are included in national sector strategies without a regional dimension. An instance could be provided from the national machinery sector strategy where one objective is to increase the domestic production of metal forming machinery and hydraulic control systems. These prioritised machineries require, on average, a higher level of technology in comparison with other machinery products. So, unless the prerequisite conditions are met, such as having a well-developed R&D centre and highly skilled workforce, the majority of the regions in Turkey's regions could not be considered feasible places for the manufacture of metal forming machinery and hydraulic control systems.

Box 9. **Export base models**

Although export base or economic base models are often criticised, they remain an important tool for regional economics. The fundamental assumption of export base models is that there are two types of economic activity in a community. Some part of the local economy is oriented to creating goods or services that are sold to other regions, while other parts of the local economy are oriented to providing goods and services to be consumed within the region. While both types of activity are important, the distinction is central to the logic of the model. Few economies are able to produce locally all the goods and services that residents want or firms need as inputs. They have to be purchased from external sources.

The basic sector of the local economy is the part that sells its output externally and generates the revenue needed to do that. The idea is particularly powerful in less dense places because they tend to be small, specialised in the production of a limited number of goods and services, and hence in a position where more of what resident firms and families consume has to be imported. Unless the community receives on-going income transfers (from remittance flows, for example, or pension benefits if there is a large elderly population), it has to generate enough export revenue to pay for its imports. In large urban areas, by contrast, a far higher share of final demand can be met from local sources so the internal dynamics of the economy are both more complex and more dominant.

The second part of the export base theory deals with the role of non-basic, or local, components. Production sold to meet local demand is important because it may be an intermediate input in the production of an export good or because it is consumed by workers in an export activity. Thus, a firm producing lumber that is sold to another firm which produces chairs for sale overseas is a key part of the production process. But the export base theory differentiates the two functions. If there were no demand for chairs, there would be no local demand for lumber. Conversely it may be possible for the chair manufacturer to import wood. Most importantly, if chair sales increase or decrease, there is a direct effect on the sales of the lumber firm.

The shares of the basic and non-basic activities can be determined in a number of ways. By segmenting economic activity on the basis of sales or employment into the two categories, it is possible to determine the shares of the non-basic and basic activities. The ratio of the non-basic to the basic activity provides a simple multiplier. If exports increase by a certain amount, then total economic activity will increase by the multiplier times the increase in exports. The simple development strategy for a low-density region or community consists, in the first place, of increasing exports and, in the second place, of ensuring that there is adequate capacity in the non-basic sector to support the expansion of the economic base. The logic behind the model suggests that some sectors and/or firms are more important than others because they are, in a sense, locomotives that power the local economy. Other firms, while important (and sometimes vital), do not cause the train to move. Their efficiency is nonetheless critical, since it can impinge directly on the competitiveness of export-oriented firms, which may rely on them for inputs and non-tradable services.

Source : OECD (2011b), OECD Territorial Reviews: NORA Region 2011: The Faroe Islands, Greenland, Iceland and Coastal Norway, http://dx.doi.org/10.1787/9789264097629-en; OECD (2015c), OECD Territorial Reviews: The Krasnoyarsk Agglomeration, Russian Federation, http://dx.doi.org/10.1787/9789264229372-en.

Monitoring and evaluation of strategies could also benefit from a stronger regional dimension

All national policies have a spatial impact, irrespective of whether they are targeted to particular regions or not. However, there has been limited analysis of the spatial impacts of policies that were not designed to have a geographical impact (Ballas, 2005). Evaluating policies from a spatial point of view is not an easy undertaking, and there is no conclusive evidence on the best methodology for assessing the impact of policies. The different factors that affect policy implementation (international commercial and business cycles, for example) make it difficult to conduct straightforward, traditional

cost-benefit analysis (OECD, 2013b). Despite these challenges, MoSIT might consider using geographical micro-simulation models to evaluate the impact of national policies on regions and accordingly make the necessary policy revisions.

Despite the inherent complexities of assessing the impact of national sector policies, monitoring and evaluation (M&E) mechanisms are nonetheless crucial to improving policy effectiveness. Regular monitoring of policies and action plans that included in national sector strategies could contribute to solving unanticipated problems that arise when policies are still being implemented. Thus, effective monitoring would give policy makers a chance to promptly react to any negative signal.

Moreover, if effectively carried out, M&E process would also present good opportunities for spotting possible mismatches between complementary policies, such as innovation, skills, finance, and infrastructure. As such, MoSIT might want to step up its efforts to improve its M&E mechanisms as it seeks to place greater emphasis on the spatial aspects of regional policy. Doing so, however, would require considerable development of its capacity to monitor regional trends (OECD, 2015a).

Concluding remarks

MoSIT could take the 10-step methodology as a starting point as it seeks ways to include the spatial dimension in its national sector strategies. Once implemented, it could improve co-ordination between MoSIT and regional stakeholders, which could, in turn, lead to the development of more advanced frameworks tailored to the expectations of regional stakeholders. Accordingly, the enhanced frameworks could be implemented in the next planning cycles of national strategy.

In conclusion, it is crucial to underline that there is not a one-size-fits-all approach to strengthening the spatial dimension in sector strategies. Any suggested framework should be able to respond to unique settings of regions. This involves understanding context and working at a sufficient level of disaggregation to identify the region-specific challenges and opportunities, and accordingly developing the appropriate policies.

Notes

1. The institutions were MoD, MoE, MoSIT, TIM and ISPAT.
2. In the rest of the report, whenever statistics on enterprises are provided, workplaces/production facilities belonging to the same firm are counted separately.
3. In 2014, 10 out of 23 machinery enterprises ranked top500 of the ISO list.
4. The Project titled "Enhancing the Administrative Capacity of MoSIT Regarding Industry Strategies" had lasted for 18 months, and it was officially completed on 22 July 2014.
5. In other words, even if the domestic producers' bids were to be 15% higher than the bids involving imported products, the domestic producer would still be awarded the contract in line with the new public procurement regulation.
6. A LQ is calculated by taking a sector's share of a regional total for an economic indicator (value added, output, employment, etc.) divided by the sector's share of the national level for the same indicator. In this report, the LQ for the industrial sectors are calculated using employment data since the regional value-added data broken down by sector are not available.
7. The concentration index was calculated according to $C = \frac{2}{\alpha}\mathrm{cov}(employee\ number,\ ranking)$, (employee number, ranking), where employee number is the number of machinery sector employees registered in each province, ranking is the fractional rank of provinces by the number of machinery sector employees, and α is the mean of employees in all the provinces of Turkey.
8. Organised industrial zones are one of the three types of special investment zone in Turkey. For more, go to www.invest.gov.tr/en-US/investmentguide/investorsguide/Pages/SpecialInvestmentZones.aspx
9. The year 2023 is the 100th anniversary of the Turkish Republic, and therefore this year has been chosen in Turkey as a milestone for the objectives and targets, including the export targets.
10. The selected vocational schools are located in the following provinces: Malatya (TRB1), Kahramanmaraş (TR63), Sivas (TR72), Batman (TRC3), Izmir (TR31), Bursa (TR41) and Trabzon (TR90).
11. As in the machinery sector part, if a registered firm has more than one operational workplace/facility, these workplaces are counted as separate enterprises.
12. In 2014, the number of workplaces decreased in Istanbul, Ankara and Izmir by 450, 60 and 42 respectively.
13. A microenterprise is defined here as an enterprise employing less than 20 people.
14. The export targets for pharmaceutical, rubber and plastic products have been deducted from the overall target for the broad chemical industry of TIM.
15. Because of data confidentiality, the R&D expenditures for NACE Rev. 19 and 20 are combined and presented together.
16. In the 10th Development Plan, 25 priority transformation programmes were set out - each with their own performance indicators and actions plans. More information on the programmes can be found on http://odop.kalkinma.gov.tr/dokumanlar/ODP_TOPLU_KITAP_yeni%20yapilan%2004122015.pdf.
17. More information on the eligibility criteria for strategic investment incentives can be found on http://www.invest.gov.tr/en-US/investmentguide/investorsguide/Pages/Incentives.aspx.
18. A resulting value of one signifies the province and nation are equally specialised in the chemical industry and a value of more than one signifies the province has a higher concentration as compared to the nation's manufacturing.
19. The intermediate chemicals, whose domestic production is prioritised by MoSIT, are styrene-butadiene rubber, polyamide, polyacryclic acid, methyl cellulose, cellulose acetate, ethylene glycol, polymethyl methacrylate, polycarbonate and silicon.
20. The first set of sector strategies by MoSIT comprises the following industries: Automotive, ceramics, chemicals, electric & electronics, iron-steel and non-ferrous metals, machinery.
21. The regional gross value added data has not been available in Turkey since 2011.
22. In reality, the institutional structure and quality (institutional thickness) might vary across regions. However, in a highly centralised country like Turkey, it is safe to assume that regional public institutions, and to some extent the regional private sector stakeholders, share similar characteristics.
23. According to the "Top 500 Industrial Enterprises of Turkey" List, the biggest ten chemical firms in Istanbul are Aksa Akrilik, Hayat Chemicals, Toros Agriculture, Soda Industry, Türk Henkel Kimya, Betek Paint and Chemicals, Ravago Petrochemicals, Bayer Türk, Gübre Factories and BAGFAŞ.
24. The data is collected from all the firms that are registered in at least one of the local chambers of commerce in Turkey.
25. The bulletins provided detailed FDI information only for selected manufacturing industries that attract the highest FDI.

26. When using investment certificates as proxy, MoSIT should be aware of another shortcoming. According to IMF's 6th Handbook, transactions, to be defined as FDI, must be a transfer from parent company or person. Due to the multitude of financing mechanisms, a foreign firm with an investment certificate does not have to necessarily engage in FDI transfer to finance its investment.
27. As the BEEPS survey does not have sectoral classifications as per the NACE code, the results of the study might not be directly comparable to the sector scope defined by MoSIT. Furthermore, the BEEPS surveys results are available only at the NUTS I level.

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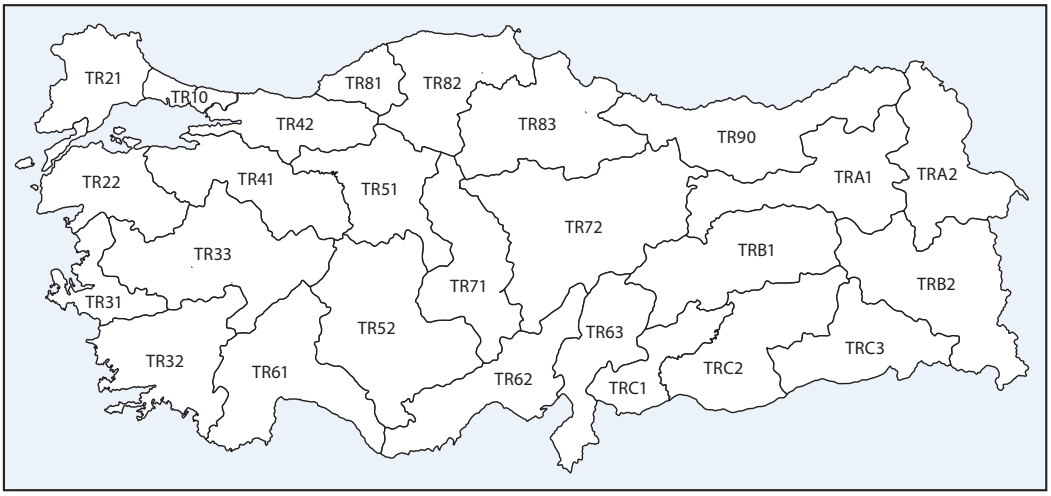
Annex A.
Maps of Turkey's NUTS II and NUTS III subdivisions

NUTS stands for the French *Nomenclature of Units for Territorial Statistics (from the French, Nomenclature des unités territoriales statistiques)*. Developed and regulated by the European Union for statistical purposes, NUTS refers to subnational jurisdictions in Member States and EU candidate countries.

Figure A1. **Turkey's NUTS II regions**



Note: The 12 NUTS I and 26 NUTS II subdivisions of Turkey are officially referred as regions and sub-regions respectively. However, in this report, NUTS II subdivisions are always referred as regions.

Figure A2. **Turkey's NUTS III provinces**

Note: At the time of writing, legislation had been drafted and sent to the Turkish parliament to move the centres of two southeastern provinces, Şırnak and Hakkari, to Yüksekova and Cizre districts respectively and rename the provinces after these districts.

Annex B.
Regional workshops

The regional technical workshops were held at the following venues and on the following dates.

Table B1. **Places and dates of the regional workshops.**

#	Name of region	Date	Number of workshops	Venues of workshops	NUTS II regions covered
1	Black Sea Regions	17-20 November, 2015	2	Samsun, Trabzon	(1)TR81, TR82, TR83, (2) TR90
2	Aegean Regions	14-18 December, 2015	3	Izmir, Denizli, Uşak	TR31, TR32, TR33
3	West-Central Anatolian Regions	28-29 January, 2016	2	Ankara, Konya	TR51, TR52
4	West Marmara Regions	15-19 February, 2016	3	Bursa, Balıkesir, Tekirdağ	TR21, TR22, TR41
5	East-Central Anatolian Regions	7-11 March, 2016	3	Malatya, Kayseri, Nevşehir	TRB1, TR72, TR71
6	East Marmara and Northeast Anatolian Regions	29 March-1 April, 2016	3	Kars, Kocaeli, Istanbul	TRA2, TR42, TR10
7	Mediterranean Regions	27-29 April, 2016	3	Adana, Osmaniye, Antalya	TR62, TR63, TR61
8	Eastern and Southeast Anatolian Regions	28-30 June, 2016	5	Ankara	TRC1, TRC2, TRC3, TRB1, TRB2
			24	**26 NUTS II regions**	

Annex C.
Pilot sector selection

The technical workshop participants and survey respondents who were asked to select two pilot sectors were also asked to take the following criteria into account when making their pilot sector selection.

- **Economic relevance**. The pilot sectors should be either relevant to the Turkish economy as a whole (e.g. high exports, large shares of employment) or potentially significant for most NUTS II and/or NUTS III subdivisions in the medium to long term (e.g. large current growth of sector).
- **Spatial trends**. The two chosen sectors should exhibit different spatial trends - e.g. one sector might have a heavy concentration of firms in a few NUTS II regions, while the other may comprise economic activities which are generally evenly spread.
- **Available documentation**. The selected pilot should be covered by a full-fledged, validated national plan, strategy, or set of targets prepared by MoSIT, MoE, and TIM.
- **Sector stakeholders' buy-in**. Stakeholders in the pilot sector - from both private and public sectors - should demonstrate eagerness to take part in the project.
- **Study fatigue**. The sector should not have undergone many previous studies carried out by public sector or civil society actors.

The aggregate survey results, as well as discussions at the technical workshop revealed that there was no absolute consensus on the pilot manufacturing sectors. However, respondents did show a preference prefer for the chemical, machinery, automotive and electric and electronic sectors. Accordingly, they were shortlisted for further discussion with the MoD.

Annex D.
Breaking down export targets

With the objective of providing guidance and assistance to development agencies, a simple method is presented below to break down the nationwide export targets set by TIM in each manufacturing sector. However, the method seeks not to set export targets for Turkey's NUTS II regions, but to be indicative and give the regions an overall idea of what, given their strengths and weaknesses, they might attempt to achieve by 2023.

The method consists of two parts. The first part is quantitative breakdown. It calculates the region's shares of exports on an indicative basis. Its aim is to offer a starting point to stimulate discussion of what the individual regions might expect their export shares to be by 2023 compared to other regions and based on their recent performances in various dimensions.

The second part is qualitative adjustment. It subjectively adjusts the projections obtained from quantitative breakdown to allow for the regions' particular features. Adjustment is "subjective" in that it entails consultation. It is, however, fact-based, too, as it relies on region-specific developments and short, medium term opportunities expected by 2023, which might significantly boost or hamper the export performance of the manufacturing sector concerned.

D.1. Quantitative breakdown

An indicative export share of the regions in 2023 is calculated as the average of the following three projected export shares under different assumptions:

- **Export trend**. It is assumed that the value of regions' manufacturing sector exports (in USD) will grow between 2015 and 2023 by the same rate as between 2008 and 2015. In other words, regions manufacturing sector exports are linearly extrapolated on the assumption that the trend of the previous eight years trend continues unchanged. The regions' export shares in 2023 may thus be calculated accordingly. While being simplistic, it is, nonetheless, a powerful way of projecting the regions' individual shares of Turkey's total manufacturing sector exports.

$$Export\ Trend_{ij} = \frac{Export\ Amount(2015)_{ij} \times \left(1 + \frac{Export\ Amount(2015)_{ij}}{Export\ Amount(2008)_{ij}}\right)}{\sum_{i=1}^{i=26}\left[Export\ Amount(2015)_{ij} \times \left(1 + \frac{Export\ Amount(2015)_{ij}}{Export\ Amount(2008)_{ij}}\right)\right]}$$

i: NUTS II region
j: manufacturing sector

- **Investment intensity.** The regions' manufacturing sector exports in 2015 are highly correlated with the number of investment certificates issued in 2001-05 in each manufacturing sector.* Investment is (arguably) a good proxy for the regions' competitiveness and comparative advantages and offers an indication of their future production and export levels. It is assumed, therefore, that the investment certificates issued in 2010-15 in each manufacturing sector will be closely correlated with each region's manufacturing sector exports in 2023. Consequently, the regions'

shares of sectors' exports in 2023 are distributed in proportion to their shares of the total number of sector investment certificates issued in the whole of Turkey in 2010-15.

$$Investment\ Intensity_{ij} = \frac{Export\ Amount(2015)_{ij} \times (1 + \frac{Inv.Certificates(2010-15)_{ij}}{Inv.Certificates\ (2001-05)_{ij}})}{\sum_{i=1}^{i=26}[Export\ Amount(2015)_{ij} \times (1 + \frac{Inv.Certificates(2010-15)_{ij}}{Inv.Certificates\ (2001-05)_{ij}})]}$$

i: NUTS II region
j: manufacturing sector

- **R&D intensity**. There is usually a lag between current expenditure in R&D activities and the commercialisation of their results. Assuming that the approved patent and utility model applications by region are a good proxy for the volume of regional R&D activities, the lagged relationship between the R&D expenditure and R&D commercialisation is confirmed by the near perfect correlation of the regional patent and utility model applications in 2006-10 with regional export values in 2015.* Consequently, it is assumed that the successful regional patent and utility model applications made during 2010-15 would also correlate closely with regional exports in 2023. Accordingly, the regional export shares of total manufacturing exports in 2023 are calculated proportionately to the regions' share of successful patent-utility model applications in 2010-15.

$$R\&D\ Intensity_{ij} = \frac{Export\ Amount(2015)_{ij} \times (1 + \frac{R\&D\ Patents\ \&\ Utility\ Models\ (2010-15)_{ij}}{R\&D\ Patents\ \&\ Utility\ Models\ (2001-05)_{ij}})}{\sum_{i=1}^{i=26}[Export\ Amount(2015)_{ij} \times \left(1 + \frac{R\&D\ Patents\ \&\ Utility\ Models(2010-15)_{ij}}{R\&D\ Patents\ \&\ Utility\ Models\ (2001-05)_{ij}}\right)]}$$

- Finally, the average of the three shares is calculated to obtain each region's projected export share in each individual manufacturing sector in 2023. If the regions wished to convert their export shares into an amount, they could multiply the shares with the targets set by the TIM e.g. USD 100 billion for the machinery sector.

$$Export\ Share\ 2023_{ij} = \frac{Export\ Trends_{ij} + Investment\ Intensity_{ij} + R\&D\ Intensity_{ij}}{3}$$

i: NUTS II region
j: manufacturing sector

The regions' projected shares of the machinery and chemical sectors in 2023 calculated with the methods described above are shown in Tables D1 and D2 below.

Table D1. **Regions' shares of machinery exports**

NUTS II Regions	Projected Share in Turkey's Machinery Exports in 2023				Share in Turkey's machinery exports in 2015	Projected change in export share between 2015-23	Projected export value as of 2023 (USD million)
	Based on export trend	Based on distribution of investment certificates	Based on machinery patent applications	Average share in regions			
TR10 İstanbul	27.45%	23.92%	28.28%	26.55%	35.75%	-9.20%	265.48
TR51 Ankara	16.30%	29.06%	18.38%	21.25%	15.46%	5.79%	212.45
TR41 Bursa, Eskişehir, Bilecik	10.11%	7.91%	15.38%	11.13%	11.83%	-0.70%	111.32
TR52 Konya, Karaman	9.09%	10.25%	6.17%	8.50%	5.63%	2.87%	85.04
TR31 İzmir	8.32%	6.09%	8.79%	7.73%	8.77%	-1.04%	77.34
TR42 Kocaeli, Sakarya, Düzce, Bolu, Yalova	4.22%	5.78%	8.29%	6.10%	6.76%	-0.66%	60.97
TR32 Aydın, Denizli, Muğla	7.35%	1.78%	3.80%	4.31%	3.00%	1.31%	43.10
TR83 Samsun, Tokat, Çorum, Amasya	1.60%	2.02%	1.31%	1.64%	1.60%	0.05%	16.44
TR62 Adana, Mersin	1.25%	1.99%	1.26%	1.50%	1.68%	-0.18%	15.03
TR72 Kayseri, Sivas, Yozgat	1.48%	1.44%	1.15%	1.36%	1.05%	0.31%	13.59
TR63 Hatay, Kahramanmaraş, Osmaniye	1.48%	1.35%	0.95%	1.26%	1.46%	-0.20%	12.62
TR33 Manisa, Afyon, Kütahya, Uşak	1.53%	0.91%	1.09%	1.18%	1.19%	-0.01%	11.79
TR61 Antalya, Isparta, Burdur	1.22%	1.16%	0.94%	1.10%	0.72%	0.38%	11.04
TR21 Tekirdağ, Edirne, Kırklareli	1.69%	0.79%	0.81%	1.10%	0.99%	0.10%	10.98
TRC1 Gaziantep, Adıyaman, Kilis	1.29%	0.87%	0.91%	1.02%	1.17%	-0.15%	10.22
TRC3 Mardin, Batman, Şırnak, Siirt	0.63%	1.68%	0.34%	0.88%	0.30%	0.58%	8.85
TRB2 Van, Muş, Bitlis, Hakkari	1.76%	0.39%	0.05%	0.74%	0.48%	0.26%	7.36
TR22 Balıkesir, Çanakkale	0.65%	0.91%	0.32%	0.62%	0.47%	0.16%	6.24
TR71 Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	0.66%	0.53%	0.58%	0.59%	0.60%	-0.01%	5.89
TR90 Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	0.58%	0.40%	0.50%	0.49%	0.37%	0.12%	4.94
TRC2 Şanlıurfa, Diyarbakır	0.44%	0.41%	0.05%	0.30%	0.13%	0.17%	2.99
TR81 Zonguldak, Karabük, Bartın	0.11%	0.17%	0.31%	0.20%	0.21%	-0.01%	1.95
TR82 Kastamonu, Çankırı, Sinop	0.30%	0.08%	0.04%	0.14%	0.05%	0.10%	1.43
TRB1 Malatya, Elazığ, Bingöl, Tunceli	0.18%	0.04%	0.21%	0.14%	0.13%	0.01%	1.42
TRA2 Ağrı, Kars, Iğdır, Ardahan	0.29%	0.07%	0.06%	0.14%	0.18%	-0.04%	1.42
TRA1 Erzurum, Erzincan, Bayburt	0.01%	0.00%	0.02%	0.01%	0.01%	0.00%	0.10
						Total	**1 000**

Source: TurkStat Database; Central Bank of Turkey Database; Turkish Patent Institute, Turkish Patent Institute, www.tpe.gov.tr/TurkPatentEnstitusu/statistics/; OECD analysis.

Table D2. **Regions' shares of chemicals exports**

	Projected Share in Turkey's Chemical Exports in 2023						
NUTS II Regions	Based on export trend	Based on distribution of investment certificates	Based on chemical patent applications	Average share in regions	Share in Turkey's chemical exports in 2015	Projected Change in export share between 2015 - 23	Projected export value as of 2023 (USD million)
TR10 İstanbul	52.57%	43.13%	51.91%	49.20%	56.42%	-7.21%	49.20
TRC1 Gaziantep, Adıyaman, Kilis	4.88%	20.33%	8.08%	11.10%	4.65%	6.44%	11.10
TR51 Ankara	10.71%	14.77%	6.89%	10.79%	10.59%	0.21%	10.79
TR62 Adana, Mersin	4.86%	4.04%	11.41%	6.77%	4.38%	2.39%	6.77
TR31 İzmir	5.73%	4.72%	6.35%	5.60%	9.08%	-3.48%	5.60
TR42 Kocaeli, Sakarya, Düzce, Bolu, Yalova	5.53%	5.57%	3.72%	4.94%	5.54%	-0.60%	4.94
TR41 Bursa, Eskişehir, Bilecik	5.03%	0.76%	3.74%	3.18%	2.87%	0.31%	3.18
TR63 Hatay, Kahramanmaraş, Osmaniye	0.91%	1.85%	0.73%	1.16%	0.56%	0.60%	1.16
TRC3 Mardin, Batman, Şırnak, Siirt	0.73%	2.29%	0.25%	1.09%	0.57%	0.52%	1.09
TR21 Tekirdağ, Edirne, Kırklareli	1.24%	0.87%	1.01%	1.04%	0.93%	0.11%	1.04
TRA2 Ağrı, Kars, Iğdır, Ardahan	1.87%	0.80%	0.18%	0.95%	0.41%	0.54%	0.95
TR61 Antalya, Isparta, Burdur	0.69%	0.75%	0.90%	0.78%	0.86%	-0.08%	0.78
TR71 Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	0.50%	1.58%	0.13%	0.74%	0.31%	0.43%	0.74
TR52 Konya, Karaman	0.35%	0.38%	1.46%	0.73%	0.52%	0.21%	0.73
TR32 Aydın, Denizli, Muğla	0.75%	0.29%	0.52%	0.52%	0.69%	-0.17%	0.52
TR72 Kayseri, Sivas, Yozgat	0.77%	0.14%	0.62%	0.51%	0.28%	0.23%	0.51
TRB2 Van, Muş, Bitlis, Hakkari	0.51%	0.29%	0.71%	0.50%	0.30%	0.20%	0.50
TR90 Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	0.18%	0.16%	0.73%	0.36%	0.34%	0.02%	0.36
TR83 Samsun, Tokat, Çorum, Amasya	0.38%	0.53%	0.16%	0.36%	0.14%	0.22%	0.36
TR81 Zonguldak, Karabük, Bartın	0.82%	0.03%	0.02%	0.29%	0.05%	0.24%	0.29
TR33 Manisa, Afyon, Kütahya, Uşak	0.14%	0.35%	0.25%	0.25%	0.23%	0.02%	0.25
TRA1 Erzurum, Erzincan, Bayburt	0.28%	0.03%	0.02%	0.11%	0.05%	0.07%	0.11
TRC2 Şanlıurfa, Diyarbakır	0.14%	0.11%	0.07%	0.11%	0.09%	0.02%	0.11
TR22 Balıkesir, Çanakkale	0.12%	0.08%	0.11%	0.10%	0.09%	0.02%	0.10
TR82 Kastamonu, Çankırı, Sinop	0.21%	0.02%	0.02%	0.08%	0.03%	0.06%	0.08
TRB1 Malatya, Elazığ, Bingöl, Tunceli	0.08%	0.08%	0.01%	0.06%	0.02%	0.04%	0.06
						Total	**101**

Source: TurkStat Database; Central Bank of Turkey Database; Turkish Patent Institute, Turkish Patent Institute, www.tpe.gov.tr/TurkPatentEnstitusu/statistics/; OECD analysis.

D.2. Qualitative adjustment

In the second step, the regions' unique features need to be taken into account in order to qualitatively adjust the export shares already calculated in the first step. More specifically, qualitative adjustment seeks to shed light on whether:

- the regions expect any particular developments or immediate opportunities which would help them reach, or even exceed, their projected export shares by 2023;
- the regions have any significant limitations which could hinder the further development of the machinery and chemical sectors.

The regional institutions, such as development agencies, are usually well informed about the upcoming developments or constraints that might affect regional export performance. However, in order to gather more targeted insights, additional stakeholder consultations might be undertaken, particularly with the private sector.

Qualitative adjustment considers the below set of factors when it adjusts the results of quantitative breakdown to the regions' special contexts.

- **Geographical developments**. Consideration could be given to expected developments in countries that border Turkey or are close to it, as well as the regions' main export markets. Regions that heavily rely on certain countries for their exports might be vulnerable to political and other changes there. For example, the main export markets of regions TR63 (Hatay, Kahramanmaraş and Osmaniye) and TRC1 (Adıyaman, Gaziantep and Kilis) have traditionally been Syria and Iraq. The conflicts in those countries have depressed the regions' exports and they have struggled to diversify their export markets, which has led to shrinking shares of exports in particular sectors. For some other regions, by contrast, like TRA2 (Ağrı, Ardahan, Iğdır and Kars) and TRB2 (Bitlis, Hakkari, Muş and Van), growing cross-trade with Iran might offer the potential for an enhanced export potential by 2023.
- **Infrastructure developments**. Developments in infrastructure, such as new ports, railways, highways, logistics centres and OIZs, can also be factored into the adjustment of regions' expected export shares. Large-scale investment in infrastructure might help eliminate bottlenecks and reduce transportation-related expenses, which could help improve export performance.
- **Human resources developments**. Considering developments in human resources might entail investigating a region's universities, vocational schools and research and technology development centres to determine how they evolve, both in number and quality, over the short to medium term. If it is believed that the human capital of a region is to change significantly and so affect manufacturing, be it positively or negatively, the changes might well affect the region's export performance, too. For instance, local stakeholders at the regional workshops argued that the technology development centres established in the TR41 region (Bursa, Bilecik and Eskişehir) have helped strengthen industry-academia collaboration and boost the region's the high-technology exports.
- **Other developments**. Some region-specific developments that affect a particular industrial sector might not be captured in the previous geographical, infrastructure or human resources development steps. Yet they might still influence the region's export potential. Some of these developments might be related to specific product groups in a sector, or even a province's social and environmental situation. A specific example from the chemical sector is the relatively new applications of certain raw materials with which some regions are endowed. At the regional workshops in the TR71 (Aksaray, Nevşehir, Niğde, Kırıkkale and Kırşehir) and TRB1 regions (Bingöl, Elazığ, Malatya and Tunceli), stakeholders discussed how leonardite was starting to be used as a soil amendment and fertilizer additive to increase yield. This fact, by itself, does not automatically translate into greater exports. Nevertheless, it might point to a comparative advantage of the region with respect to the chemical sector.

In this regard, analysing the key drivers affecting the location choices of chemical and machinery industries can also be instrumental in predicting regions' shares of exports. Factors and variables which are found to be statistically significant in explaining regional differences in the machinery and chemical sectors might also warrant special attention. For example, the number of ports in a province is highly powerful in explaining the regional differences in the chemical industry in Turkey. Therefore, if a region has ongoing plans to establish new ports, it needs to be highlighted in the qualitative adjustment part by underlining the region's potential in the further development of its chemical industry.

D.3. Case study of the machinery sector in the TRA2 region (Kars, Ardahan, Ağrı and Iğdır)

Quantitative breakdown

Region	Exports in 2015 (USD)	Share of exports in 2015	Export trend	Investment intensity	R&D intensity	Export share in 2023	Change in share 2015 to 2023 (in percentage points)
TRA2	13 023 344	0.18%	0.29%	0.07%	0.06%	0.14	-0.04

Qualitative adjustment

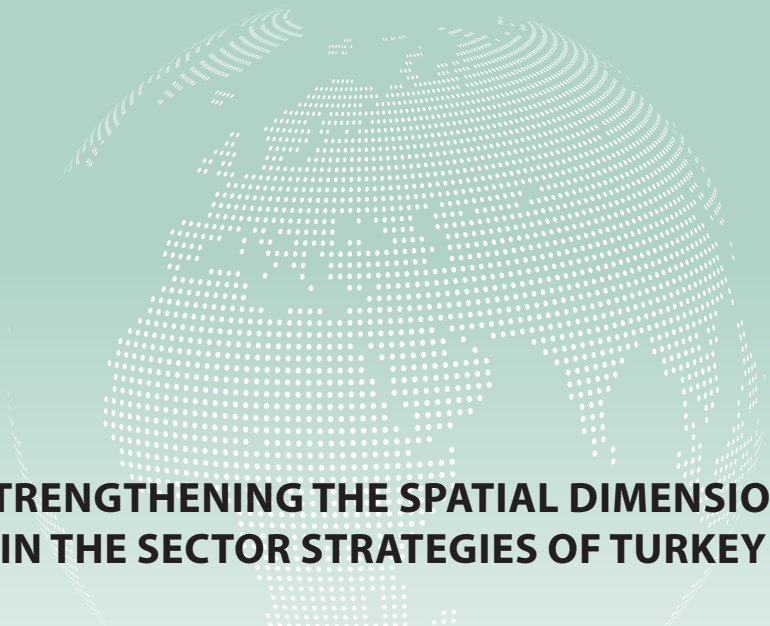
Opportunities for the machinery sector's development in the region

- **Geographical developments**. Despite the fact that the TRA2 region has relatively low production in value terms and little foreign trade activity, it boasts the unique advantage of sharing borders with four countries - Armenia, Azerbaijan, Georgia, and Iran. Taking advantage of the proximity to other markets, the region might gradually increase its trade volume. In that regard, the presence of relatively advanced logistical firms headquartered in TRA2 might assist the region to boost its international trade. However, the lack of a well-developed railway in the region means that foreign trade is dependent solely on road transport.
- **Other developments**. Over the last decades, the region has accumulated expertise in some livestock sub-sectors, such as bee-keeping and cattle farming. Given growing demand in the region for beekeeping and milking machinery - which require comparatively low levels of technology - it might be argued that TRA2 enjoys a comparative advantage in these product groups and that there is potential for further improving production and, by the same token, competitiveness. Moreover, it has been observed that regional actors are providing increasing financial assistance to local machinery firms and contributing to the mechanisation of the agriculture and livestock sectors in the region.

Constraints on the machinery sector's development

- **Infrastructural developments**. The enterprises present in the region are negatively affected by infrastructure problems, such as power outages, underdeveloped sewage and wastewater treatment systems, and limited connection to natural gas pipelines. These problems are exacerbated during the winter period, when the production processes might temporarily come to a halt. Therefore, unless such infrastructural problems are improved in the short term, investment inflows to the region might remain limited.
- **Human resources developments**. Technology zones, which have proliferated in Turkey over the last decade, are non-existent in the TRA2 region. Considering the limited R&D capacity of the regional firms, the absence of technology zones could have adverse effects on export performance.
- **Other developments**. In addition to having a limited number of top universities, the region also struggles to attract qualified personnel from the other regions in Turkey. All the provinces in the region are ranked at the very bottom of TurkStat's well-being index and, during the regional workshop in Kars, stakeholders underlined that the region struggled to retain qualified personnel.

In conclusion, taking into account all the factors listed above, local stakeholders of the TRA2 region might assess whether the region has the potential to exceed the 0.14% share of machinery sector exports projected by quantitative breakdown. Yet despite all the challenges with which the TRA2 region grapples, workshop participants were of the view that the region was presented a big opportunity by the positive trade prospects with Iran, and its machinery exports might, therefore, claim a larger share of exports than the projected 0.14% in 2023.



STRENGTHENING THE SPATIAL DIMENSION IN THE SECTOR STRATEGIES OF TURKEY

Regions play an increasingly important role in OECD economies. They are responsible for delivering policies that directly affect citizens' lives and the business environment. With wide disparities in the economic development of its regions Turkey is among the OECD countries now taking an active interest in regional development policies and regional competitiveness.

The OECD conducted its project, Boosting Regional Competitiveness in Turkey, to help improve regional and sectoral competitiveness policies in Turkey and to make co-ordination between newly created development agencies, the Ministry of Development and other relevant Turkish institutions more effective. The 22-month project was implemented by the OECD in close collaboration with the Ministry of Development of Turkey and co-financed by the European Union and Turkey.

Project findings are examined in four thematic reports. This report explores and proposes ways of incorporating the spatial dimension more fully in national sector strategies.

This project is co-financed by the
European Union and the Republic of Turkey