



Machine Industry Report

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Belarus, Moldova, Ukraine: Machine Industry Report¹

Abstract

There is the common view that as a result of Soviet heritage, the machine building sector continues to make up a large segment of the economies of Belarus, Ukraine, and Moldova. The main goal of this paper was to review the current state of the machine building sectors in Belarus, Ukraine, and Moldova, and to assess their vulnerabilities. A comparative analysis of developments, trends, and the institutional background of the machine building sector showed that machinery can be considered more vulnerable in Belarus and Ukraine, while it appears less vulnerable in Moldova. Common vulnerability factors for Belarus and Ukraine are low capacity utilization, weak export diversification, the relatively low quality of products, outdated equipment and technology, labor-intensive production and the low quality of management. Specific machinery-related issues in Belarus include excessive employment and high levels of governmental interference in industrial policy. Ukraine-specific issues are poor corporate governance and underinvestment. The key challenge for machinery in Moldova is the improvement of corporate governance along with the stimulation of small and medium-sized enterprises (SMEs) in the sector.

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List of abbreviations

GDP – Gross Domestic Products
NACE codes - Nomenclature of Economic Activities
WTO – World Trade Organization
TFP – Total Factor Productivity
FDI – Foreign Direct Investment
SWOT tables/analysis - Strengths, Weaknesses, Opportunities, Threats tables/analysis
LHS - Left Hand Scale
RHS – Right Hand Scale
SOEs – State-owned enterprises
USSR (SSR) – Union of Soviet Socialist Republics
p.p. - percentage points
CIS – Commonwealth of Independent States
CEE- Central and Eastern Europe
MNF – Most Favorable Nations
FEZs – Free Economic Zones
EBRD – European Bank for Reconstruction and Development
MOI – Ministry of industry
JSCs – Joint Stock Companies
EU – European Union
FINNs – Former Privatization Investment Funds
OECD – Organization for Economic Co-operation and Development
R&D – Research and development
EEU – Eurasian Economic Union
SO – Strengths, Opportunities
WT – Weaknesses, Threats
ST – Strengths, Threats
WO – Weaknesses, Opportunities
DCFTA - Deep and Comprehensive Free Trade Area
SME – Small and Medium Enterprises
V4 – Visegrad Four (Visegrad Countries)

Executive summary

The machine building sectors in Belarus, Ukraine, and Moldova are to a significant extent shaped by the heritage of the Soviet period. In the present report we tried to find out what has changed over the last 15-20 years in the machine building sectors of the three selected countries, and what positive results or missed opportunities have emerged as a result of country-specific decisions. We have concluded based on our review that machinery can be considered to be a more vulnerable sector of the economy in Belarus and Ukraine, while it is less vulnerable in Moldova.

Belarus, Moldova, and Ukraine are still in the process of implementing structural adjustment in the economy to transition from a Soviet-type market model to a free market-based model, although the pace is different in each of these countries. This transition period includes a structural move from more labor-intensive and technologically simpler products to more advanced industries and products, a development that gradually shifts these industries towards becoming engineering-based industries. In 2013, industry accounted for 41.9% of Belarusian GDP, a figure that is reflective of its relatively high share of GDP over the last 25 years. Industry in Ukraine and Moldova substantially shrank from shares of 50.5% and 33.3% of GDP, respectively, in 1991 to 26.2% and 17.1% of GDP, respectively, in 2013. The role of machinery in the economies of these countries has also been changing. As of 2013, machinery has been providing relatively more value added in Belarus (4.6%) compared to Ukraine (2%) and Moldova (0.8%). The machine building sectors in Belarus and Ukraine take up a significant share of the total employment of these countries, while in Moldova this ratio is considerably lower. However, the level of investment in the machine-building sector in Belarus and Ukraine is low, while in Moldova it absorbs a higher share of investments as compared to its share in value added. In terms of its contribution to exports, the machine building sector accounts for a relatively higher share of total exports in Moldova, which indicates that exported machinery products offer a comparatively higher value added than in Belarus and Ukraine.

In Belarus, industry is based on large state-owned post-Soviet enterprises including machine building giants like MAZ (trucks), MTZ (tractors), BELAZ (heavy-weight trucks), and a few others. Despite the fact that there have been some positive moments (for example, large investment projects and massive investments to reduce the energy intensity of machine building production, etc.), Belarus' machine building sector currently finds itself in a rather difficult situation and requires reforms. Large enterprises have worn-out assets, investments are used inefficiently, the quality of products changes slowly, and price competitiveness remains dependent on the exchange rate of the national currency. The country's critical dependence on Russia because of the high share of imported components and fossil fuels, and because of the vast share of machinery exports that are purchased by Russia (almost three-quarters of the products produced by the Belarusian machine building sector are exported to Russia), reflects the depths of the structural problems of the Belarusian economy and the

absence of institutional reforms over the last 25 years. As a result, after Russia's accession to the WTO, and the subsequent massive devaluation of the Russian ruble in 2014, Belarusian machinery output dropped by 20% in the same year.

In Ukraine, the most developed subsectors of machinery are railway machine building, heavy machine building, and machine building for agriculture. In order to reduce the distance between the producing company and the supplier of raw materials, these industries are mostly dependent on domestic raw materials located in Eastern Ukraine. The level of productivity in machine building is only two-thirds of the national average, indicating a capital and technology deficit. This suggests that there are problems with international competitiveness. Despite the fact that the exports of the Ukrainian machine building sector are more diversified than those of their Belarusian counterparts, the level of Ukrainian export diversification is nevertheless relatively low, and Russia remains an essential target for exports (more than half of the goods produced by the Ukrainian machine building sector were exported to Russia in 2013). Considering the current political conflict between Ukraine and Russia, a possible loss of access to the Russian market would hit a majority of subsectors very hard. The figures for 2014 show that the machinery sector overall has shrunk by over 20%, while most subsectors that export to Russia, like railway machine building, have dropped by over 60%.

In Moldova, machinery has undergone significant transformations as a result of privatization and changes in output structure. By 2001, 93% of the machine building sector's output was produced by non-state enterprises, and 90% of workers in the machine building sector were employed in the private sector. Currently, Moldova can be described as a supplier of raw materials and components, and Western companies have shown a growing interest in the production of components in Moldova. The machine building sector has become more significant in Moldova's industrial production since 2001, and there is an increased focus on the machine building sector as an engine of industrial growth. Today, Moldovan investments in fixed machinery assets are mostly directed towards the manufacturing of fabricated metal products and equipment, as well as the production of electrical machinery and apparatuses. At the same time, Moldova has made significant strides in terms of diversifying its exports. Back in 1998 Moldova had a low level of export diversification (77.2% of its exports went to the CIS market). By 2013, the dependence on the CIS markets had been reduced to 27.5%, and dependence on the Russian market in particular was relatively low (21.3% of the exports of the Moldovan machine building sector were sold to Russia in 2013). At the same time, however, the Russian factor emerged as an issue of ownership in Moldova, as Russian businesses tend to control strategic enterprises in the metallurgy and machine building sectors on both sides of the Dniester River, though especially on the left bank.

Governmental policies on machinery differ in the three countries. In Belarus, they take various forms of economic stimuli, subsidies (hidden and open), soft budget constraints, and preferential lending rates that benefit companies in the machine building sector directly and indirectly. This often results in the inefficient allocation of resources and reduces the incentives for companies to introduce new technologies and innovations. In Ukraine and

Moldova, the level of governmental interference is significantly lower than in Belarus, and is currently moving towards providing tax incentives in different forms, including the use of free economic zones. There are also issues related to corporate governance. In Belarus, the majority of enterprises are state-owned, which leads to a situation wherein all critical aspects of the operations of enterprises, including their choice of factors of production, and the targeted levels of output and distribution, are directly or indirectly affected by governmental policies. The situation is different in Ukraine and Moldova: the leading enterprises in the machine building sector have been privatized and are often controlled by local business groups. The state of corporate relations in Ukraine and Moldova is characterized by a low level of corporate culture, a discrepancy between the existing corporate governance practices, and globally accepted principles of corporate relations, as well as poor strategic management.

As evidenced by the experience of the Visegrad countries (Czech Republic, Hungary, Poland, and Slovakia), industrial structural changes obviously need highly coordinated efforts by central and local authorities. In the Visegrad Region such efforts were accompanied by economic policy transformations; improvements in business climate and the quality of governance, i.e. price liberalization; opening the markets; increased transparency in privatization (regardless of whether it was rapid or gradual); creating an SME-friendly business environment; development of the banking sectors; as well as institutional development, including efforts at greater protection of property rights and the elimination of corruption. At the company level, machinery development in the V4 countries was driven by a focus on specific market segments and by FDIs provided by strategic investors. Flexible and innovative SMEs in the V4 succeeded thanks to either unique and specialized products or their flexible response to the needs of foreign investors.

Even if we assume that the experiences of V4 countries on the one hand, and of Belarus, Moldova, and Ukraine on the other hand, largely do not lend themselves to a direct comparison, there are some common features in their respective developments. Firstly, improvements in corporate governance (also including the elimination of state intervention in the case of Belarus) are among the key priorities. The practical application of the OECD's corporate governance principles may serve as a tool for achieving better accountability and improved relationship with investors, spurring investments into technologically advanced assets. Secondly, investment incentives should be targeting both local businesses and foreign investors with a better tax system, a better educated workforce and a good transport infrastructure rather than tax holidays, duty free zones, or other political promises. Finally, smooth cooperation with investors at every level (government, municipality, company) and the requisite institutional capacities are also among the decisive factors in the case of both, the V4 as well as the CIS countries. Nevertheless, given the differing levels of sectoral development among the Eastern partners, differentiation between the recipient countries is an important skill in terms of experience transfer. These countries and enterprises display a wide range of structural characteristics, and hence sometimes individual approaches may provide a better basis for experience transfer than national ones.

Introduction and definition of machine industry

The machine building sectors² in Belarus, Ukraine, and Moldova are to a significant extent shaped by the legacy of the Soviet period. In Soviet times, the economy was managed based on the command principle, and significant amounts of money and energy were allocated to the construction of large industrial plants. The machine building sector was one of the engines of economic growth in these countries [22]. The Soviet Union collapsed over 20 years ago and from then on the abovementioned countries had to manage their industrial plants by themselves. Producing quality machinery products turned into a challenge, while selling those products became even more challenging. In this report we made an attempt to estimate the success of such efforts and to assess the current state of the machine building sectors in these countries.

Despite their common history, the comparative analysis of these three countries is rather problematic due to the differences in the definitions of the concept of machine industry in the relevant literature and because of numerous differences between national statistics during the period of transition since 1991. One of the goals of this paper was to assemble comparative data from official statistical sources such as the National Bureau of Statistics of the Republic of Moldova, the National Statistical Committee of the Republic of Belarus, and the State Statistics Service of Ukraine. The Statistical Yearbooks of the three countries were also used for this work. While writing the report, the authors faced the problem of classifying changes in the industries of each country from the 1990s up to the present moment. Moreover, even the prevailing classification of the industries varies among the countries involved, and they each have some specific characteristics. For example, Ukraine and Moldova use a more detailed classification of their machine building sectors, while the Ukrainian "Input-Output" table is nigh impossible to use because of its poorly detailed classification. Considering the above, the authors fully realize that it is difficult to provide a full statistical comparison of the three countries.

Table 1. NACE codes used for definition of machinery

Code No.	NACE code description
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment

Source: Statistical Classification of Economic Activities in the European Community (<http://ec.europa.eu/eurostat/ramon/nomenclatures/>)

The strategic approach of the paper is to use the NACE codes of the machine building sector, including the subsectors presented in Table 1. However, due to the fact that Belarus, Ukraine,

² The report uses different, synonymous and interchangeable names for the machine building sector: "machine industry", "machine building" as well as "machinery."

and Moldova have only recently began to transition to NACE-like codes, extensive work had to be done to complete the database for the period of the last 9-10 years at least.

We used NACE codes 26-30 to define what subcategories of industry are included in the machine building industries in Belarus, Moldova, and Ukraine. Despite some national practices, we excluded subsectors 24 (Manufacture of basic metals) and 25 (Manufacture of fabricated metal products, except machinery and equipment) from the basic definition due to the facts that a) though Ukraine’s metallurgy sector is one of the core economic sectors in terms of production and exports, it is nevertheless not part of the topic of the current report, and b) in Belarus and Moldova subsectors 24 and 25 were quite often presented as a single industry, which effectively would have prevented us from excluding subsector 24 (manufacture of basic metals) from the analysis.

We used the Harmonized System Codes (Table 2) classification – which is available in the UN Comtrade Database – for analyzing export developments and patterns in the machine building sector.

Table 2. Harmonized System Codes

(HS Code)	Harmonized System Codes
84	Nuclear reactors, boilers, machinery and mechanical appliances, computers
85	Electrical machinery and equipment and parts, telecommunications equipment, sound recorders, television recorders
86	Railway or tramway locomotives, rolling stock, track fixtures and fittings, signals
87	Vehicles other than railway or tramway or tramway rolling stock
88	Aircraft and spacecraft and parts thereof
89	Ships, boats and floating structures

Source: UN Comtrade Database (<http://comtrade.un.org/>)

Box 1: EU / V4 classification of the machine industry sector

The Statistical Classification of Economic Activities (NACE) is the industry standard classification system used in the European Union. The current version is the second revision and was adopted by Regulation (EC) No 1893/2006. It is the European implementation of the United Nations' classification "ISIC" Rev. 4. However, in today's world it is difficult to fit it exactly into the statistical records. A car for example basically belongs into NACE 29 – Manufacture of motor vehicles. But a car is not just the result of mechanical engineering. The average car is made up of about 1,800 – 2,200 separate parts. This includes some large components, such as the engine, which is inserted as a unit during the production process, but also contains thousands of individual pieces. Toyota, for example, has stated that a single car the company produces consists of about 30,000 parts, counting every part down to the smallest screws. And the parts are made of very different materials, so some could be counted as products of the textile industry (seats) or of the plastics industry. Furthermore, new and emerging industries are combining some traditional sectors of the economy. The new materials sector (such as composites) is one such example.

Even in the EU and V4, each country defines the machine building sector (or, as it is most commonly referred to: the engineering industry) differently, using different NACE items. In Slovakia, for example, the engineering industry comprises these 4 NACE sectors:

NACE 25 - manufacture of metal products and fabricated metal products, except for machinery and equipment;

NACE 28 - manufacture of machinery and equipment, n. e. c.;

NACE 29 - manufacture of motor vehicles, trailers, and semitrailers;

NACE 30 - manufacture of other transport equipment;

- but not electrotechnical industry;

NACE 26 Manufacturing of computer, electronic, and optic products;

NACE 27 Manufacturing of electric equipment.

Numerous papers try to identify the prevailing challenges that affect machinery development in these three countries, and many suggest appropriate measures to tackle them. Limited competitiveness, worn-out capital assets, and the low diversification of export markets are the most frequently mentioned characteristics in economic literature to describe the machine building sectors in these countries.

D. Saha (et al., 2014) showed that among all Ukrainian sectors, the machine building sector is most exposed to the Russian market, with 32% of output being exported to Russia [7]. Due to the current political tensions between Ukraine and Russia, the authors refer to the potential losses of the machine building sector if Russian demand were to contract, which would hit the sector hard. Taking into account the likelihood of such a scenario, the authors identified three strategic options that the Ukrainian government might choose from: laissez-faire, conservation, and modernization.

A recent paper by V. Movchan (et al., 2014) tries to quantify the total exposure of Ukraine to the Russian market, as well as the exposure at a sectoral and regional level. The authors found that the manufacture of machinery and equipment sector features the highest level of exposure, with 22% of its output being shipped to Russia [20]. Metallurgy and metal processing ranks fourth in terms of exposure to Russia, with a high but manageable exposure level of 14%. The authors also raised the problems of trade restrictions in entering the Russian market, and underlined the importance of the Ukrainian authorities continuing their efforts to normalize trade relations with Russia, as well to re-orient their exports from Russia to other destinations.

Deloitte and InvestUkraine present an overview of the machine building industry, including an analysis of economic attractiveness, comparative characteristics, and undiscovered opportunities [29].

I Fadieieva(2013) presents an analysis of the current state of corporate governance in Ukrainian mechanical engineering, highlighting the main problems and features of actual corporate governance [30].

K. Kurilionak (et al., 2000) estimated potential gains and losses for various Belarusian industries if the country were to join the World Trade Organization (WTO). Their results showed that potential losses for the machine building sector exceed export gains from improved market access [21].

J. C. Cuaresma (et al., 2012) provides an in-depth analysis of firm growth and its drivers in the context of the machine building industry in Belarus. Their results indicate a significant degree of inefficient resource allocation in state-run firms. The findings suggest that total factor productivity (TFP) in non-state-owned Belarusian machine building firms exceeds the corresponding level of productivity in state-owned enterprises. Moreover, during the observation period 2005-2010, the difference in TFP levels between state- and non-state-owned firms has increased [4]. The authors showed that labor hoarding and soft budget constraints (overinvestment or unproductive investments) play a particularly important role in explaining differences in performance between these two groups of firms.

E. Favaro (et al., 2012) focused on state-owned enterprises in Belarus, especially in the machine building sector, and highlighted the importance of the Russian market for this sector [1].

M. Akulava (2011) analyzed the impact of foreign direct investment on economic performance, using the Belarusian industrial aggregated panel data for the 2002-2009 period. The results thus obtained showed that the distribution of foreign capital across the various sectors of the economy determines the impact of FDI on economic performance. In Belarus, FDI has no positive impact on machinery and is negative for black metallurgy [27].

The abovementioned papers studied the vulnerability of the machine building sectors in Ukraine and/or Belarus. Nevertheless, none of the papers performed a comparative analysis of the vulnerability of machinery in the aforementioned countries.

The overall goal of the report is to compare the respective vulnerability of the machine building sector in Belarus, Moldova, and Ukraine. A vulnerability check involves an analysis of the main macro parameters (such as the contribution of the machine building sector to GDP; its share of exports; its export diversification; as well as employment and investments in the sector) as well as an analysis of country specific institutional parameters combined with micro-level case-studies from machinery companies in the three countries.

The specific objectives of the report are thus the following:

- a) to present a comparative analysis of the main machinery trends in Belarus, Moldova, and Ukraine;
- b) to identify major common opportunities and crucial common problems in the development of the machine building sectors in the three countries;

- c) to describe institutional features of the development of machinery based on micro-level data and case-studies;
- d) to assess applicable Visegrad experience with respect to machinery development.

Box 2: Development challenges of the machine building sector in the V4 countries

The key problems in the transition of these sectors stem from the "nature" of the machine building industry. It is characterized by these factors:

- **High manufacturing intensity and high investment need**
 - a sizeable share of value added must be spent on research and development (R&D) to be able to compete in the global markets;
 - predominantly small-batch and single-item production – adapting products to customer needs;
 - high qualification requirements for staff & high labor costs + staff needs continuous training;
 - large and relatively complex communication requirements between manufacturing, engineering, and design departments.
 - the market for products is mostly global, and swift technological innovation leads to the continuous renewal of products and to changes in patterns of use.
- On the other hand, the sector features high productivity and the **machine industry has significant potential for further growth and expansion.**

Current challenges in the V4:

- **Loss of skilled labor**, especially the resulting shortage of engineers and highly-skilled personnel in advanced technologies;
- **Diminished access to credit** from financial institutions, especially venture capital e.g. for R&I;
- Progress is required with respect to the energy supply infrastructure, as well as for the energy efficiency of buildings, transport networks, and industrial production – energy demanding sector / **highly vulnerable to changes in energy policy**;
- **Investments in research and development (R&D)** are crucial and the development of smart technologies is important, but none of the V4 countries invest much into R&D;
- The V4 economies are now at a stage where they gradually **lose the advantage of price competitiveness**, especially in the manufacturing industry. This recent development is the result of an increase in the costs of labor, energy, and services, and is also amplified by the increasing attractiveness of the conditions for locating certain types of activities in developing countries. The intensity of FDI inflow into the V4 has decreased significantly in recent years, even if there have been some major deals (e.g. Jaguar/LandRover recently announced an investment in Slovakia);
- **Unfair global competition** caused by **non-compliant goods** is affecting the competitiveness of this sector. "Theft" of know-how is also a major challenge. Access to state aid and EU funds are also a challenge with respect to fair competition;
- Growing **environmental costs** related to increasing pressure on the environmental aspects of production;
- External costs related **to policy changes** – the instability of the regulatory framework and the administrative burden associated with complying with the regulatory rules, such as standardization, certification, etc.;
- Low level of **entrepreneurship** and inadequate performance of the endogenous entrepreneurial sector in the V4 countries is closely connected to the high **dependence** of the V4 countries' economic development on the activities of foreign-owned companies that use the V4 countries as a manufacturing base;
- Lack of **cooperation and value added chains** among local based companies, especially SMEs.

Following the abovementioned objectives, the structure of the study is as follows. Chapter 1, which is entitled "Comparative analysis of the machine industry trends in the three countries", presents the review of the general performance of the machine building sectors in Belarus, Ukraine, and Moldova, including the past and current conditions under which these operate. Chapter 1 is divided into four subchapters and discusses the most important developments regarding machinery, such as changes in industrial specialization patterns, export and import patterns, investments, and human capital in machine industry. There is also a special focus in Chapter 1 on the Russian Federation as the main destination market¹⁵

and the source of raw materials in these the three countries. Chapter 2 is entitled "Institutional analysis based on micro-level data and case studies", and it moves from the macro to the micro level to illustrate the institutional strengths and weaknesses of machinery development based on micro-level data and case-studies from the three countries. Chapter 2 is broken down into three parts: an analysis of institutional regulations and economic policy, a review of ownership issues and corporate governance practices, and a review of past and present reforms and innovations. Chapter 2 is concluded by SWOT tables for each of the countries discussed in order to structure the information obtained. The SWOT analysis includes draft strategies for the development of the machine industry in Belarus, Ukraine, and Moldova. Finally, a summary and a vulnerability check conclude the previous parts of the report and answer the question regarding the vulnerability of the machinery sector in the countries thus reviewed.

Comparative analysis of main machinery trends in the three countries

Manufacturing is the core of the real economy. The planes we fly, the cars we drive, the cell phones and computers we use are all products of the manufacturing sector, specifically machine building. Machinery is usually a capital-intensive sector of the economy that provides comparatively high value added and know-how that make our lives easier and more comfortable. The machine building sectors of Belarus, Ukraine and Moldova are to a large extent a legacy of Soviet times. In the current chapter we seek to answer the question if the machine building sectors in Belarus, Moldova, and Ukraine are indeed among the key sectors of the respective national economies today, and we also wish to ascertain how far their positions have changed over last 15-20 years. We are interested in both external (contribution to GDP, contribution to exports, export diversification, share of employment in this sector as a percentage of total employment) and internal industry processes and patterns (productivity, wages, efficiency, investments, assets, financial results).

Belarus, Moldova, and Ukraine are still in the process of performing the structural adjustments which are necessary to transform their economies from Soviet-type systems to market-based economies, although the pace is different in each of these countries. This transition period includes a structural shift from more labor-intensive and technologically simpler products to more advanced industries and products, as well as engineering-based industries. In 1991 these countries were heavily industrialized as industry produced 50% of GDP in Belarus, 50.5% in Ukraine, and 33.3% in Moldova. By 2013, the role of industry in the overall economy had fallen modestly in Belarus (to 41.9% of GDP), while it shrank substantially in the case of Ukraine (to 26.2% of GDP in 2013) and Moldova (to 17.1% of GDP in 2013). The role of machinery in the economy of these countries has also been changing. As compared to 2005, Belarusian machinery has declined in terms of output, employment, and exports, while its contribution to the country's GDP has also fallen but remains the highest among the three countries (Table 3). In Ukraine, the industry's declining performance between 2005 and 2013 has resulted in a decrease in its contribution to GDP, along with falling output and employment; nevertheless, the industry's share of exports has risen over the same period. The role of machinery in Moldova's overall industry has increased since the early 2000s, which has manifested itself in expanding output and soaring exports, and a higher share of GDP in 2013 when compared to 2005. As of 2013, machinery has been providing relatively more value added in Belarus (4.6%) than in Ukraine (2%) or Moldova (0.8%).

The different strategies of industrial transformation in Belarus, Moldova, and Ukraine are also illustrated by the fact that machinery products offer comparatively higher export value added in Moldova than in Belarus and Ukraine. The machine building sector accounts for a relatively higher share of all exports in Moldova (14.9%) than the contribution of machinery to the

country's GDP or its share of industry. The role of Moldovan machinery exports is very similar to the corresponding figures of Ukraine and Belarus, even as the sector's output and share of employment is considerably lower in Moldova than in the other two countries.

Table 3. Main indicators of the machine building industry in Belarus, Ukraine, and Moldova

	Belarus		Ukraine		Moldova	
	2005	2013	2005	2013	2005	2013
Industry value added, % of GDP	44.0	41.9	32.3	26.2	16.3	17.1
Machine building value added, % of GDP	6.7**	4.6**	3.3*	2.0*	0.6*	0.8*
Machine building output relative to GDP, %	18.9	16.2	13.5	9.2	1.9	2.2
Machine building output, % of industry	19.0	18.1	12.7	9.7	3.4	5.6
Employment in machine building sector, % of industry employment	29.2	25.8	22.6	17.2	9.7	8.4
Export of machine building sector to total export of all HS commodities, %	19.3	18.2	13.1	16.3	5.6	14.9

* Calculated based on World Bank data on manufacturing value added, % of GDP and share of machinery in manufacturing output

** Calculated from data provided in Input-Output tables: value added in machinery is the sum of gross output minus the value of intermediate inputs used in production for industries 26-30, classified as machinery

Sources:

World Bank – World Development Indicators

National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>).

National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

The following text analyzes these countries in detail and intends to show what the differences are in their output, exports, employment, and investments, and why these differences exist. Each country will be divided into subsectors. Table 4 shows which machinery products are crucial in each country in terms of production and exports.³

³ With respect to production, commodities are not ranked, while for export the list is ranked by diminishing export value in each product group.

Table 4. Key commodities of the machine building sector in Belarus, Moldova and Ukraine

Belarus	Ukraine	Moldova
Production		
<ul style="list-style-type: none"> ✓ Tractors ✓ Buses ✓ Metal cutting machines ✓ Lorries (inc. dump trucks) ✓ Trolleybuses ✓ Feed harvest combines ✓ Bicycles ✓ Household refrigerators and freezers ✓ TVs ✓ Household washing machines 	<ul style="list-style-type: none"> ✓ Trailers and semi-trailers for the transport of other goods ✓ Machine-tools ✓ Refrigerating or freezing equipment ✓ Cranes ✓ Tractors ✓ Cars ✓ Lorries 	<ul style="list-style-type: none"> ✓ Electrical Equipment; ✓ Pumps (hydraulic, electrical pumps); ✓ Food & beverage equipment; ✓ Tractors;⁴ ✓ Cutting tools; ✓ Trailer and semi-trailers (also for agricultural use); ✓ Bicycles;⁵
Export		
<ol style="list-style-type: none"> 1. Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof (agricultural machinery, tractors and truck tractors, trucks, spare parts and accessories for automobiles and tractors) 2. Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof 3. Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles 	<ol style="list-style-type: none"> 1. Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof 2. Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles 3. Railway or tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signaling equipment of all kinds 	<ol style="list-style-type: none"> 1. Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles 2. Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof 3. Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof

Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>).

National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

⁴ CKDs (Knocked-Down kits) of Belarus tractors from the Bobruisk tractor plant.

⁵ CKDs (Knocked-Down kits) of bicycles for the EU market.

Box 3: The machine industry sector in the EU

The engineering industry is the largest industrial branch in the EU, with a turnover of over €1,825 billion in 2014. The industry accounts for over a quarter of manufacturing output and a third of the EU's manufactured exports.

Automotive industry: The automotive industry employs approximately 12 million people. Manufacturing accounts for three million of these 12 million jobs, sales and maintenance account for another 4.3 million, and transport for 4.8 million. The automotive sector accounts for 4% of European GDP.

Mechanical Engineering: 3 million people are employed in this sector in the EU and it has a 9.5% share of all the production in EU manufacturing industries. EU is the world's largest producer and exporter of machinery with an estimated 36% share of the world market.

Aeronautics: Ca. 500,000 jobs and a turnover of close to EUR 140 billion. The EU is a world leader in the production of civil aircraft, including helicopters, aircraft engines, parts and components, but the industry is highly concentrated in terms of geography (United Kingdom, France, Germany, Italy, Spain, Poland, and Sweden) and the small number of enterprises it comprises.

Electrical and Electronic Engineering industries: EEI produces a wide range of products, ranging from consumer products to turbines, trains, power grids, and power stations. EEI's gross output is ca. EUR 703.3 billion, representing 9.6% of all EU manufacturing gross output. At the same time, the EU is the largest electrical engineering market, followed by the USA and Japan.

Ships and Maritime Equipment Industry: Employs more than 500,000 people and has an average annual turnover of around EUR 72 billion. It is made up of around 300 shipyards, 80% of which can be considered to be 'small to medium' (building ships of 60-150mt). Marine Equipment Manufacturing is made up of around 7,500 companies.

Defense industries: Directly employs about 400,000 people and has a turnover of EUR 96 billion annually. It comprises over 1,350 companies, mostly SMEs.

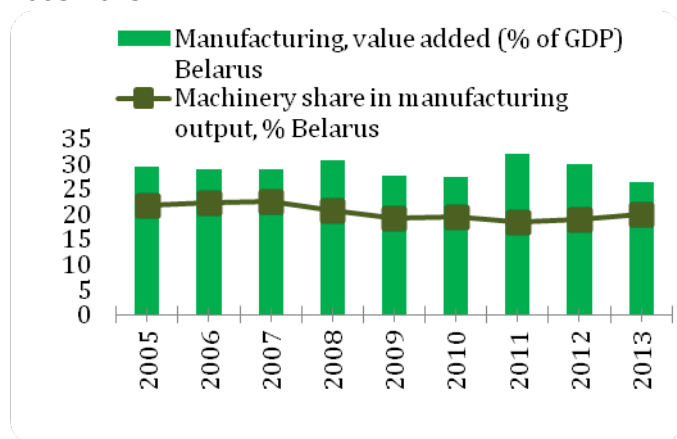
Source: European Commission (2016). Available at http://ec.europa.eu/growth/sectors/index_en.htm (Accessed on 01/25/2016)

Changes in machinery specialization patterns by output

Changes in the contribution of machinery to GDP and the role of these specialized industries in the total industry of the three countries discussed here indicate that machinery has seen its role in industry and manufacturing decline in Belarus and Ukraine, while it has been gaining in importance in Moldova. This happened in parallel with the process of gradual change in industrial specialization in Belarus and Ukraine: despite massive output, machinery has been losing productivity, which has also resulted in a drop of its share of value added and exports.⁶ According to figures 1-3, the outputs of the machine building sectors of Belarus, Ukraine, and Moldova have been following different trajectories: output has been declining in Ukraine and Belarus, while it has been on the rise in Moldova. Trends in the share of machinery as a percentage of manufacturing output indicate that structural changes in the machine building industry went deeper in Moldova, while these changes were rather modest in Belarus and Ukraine.

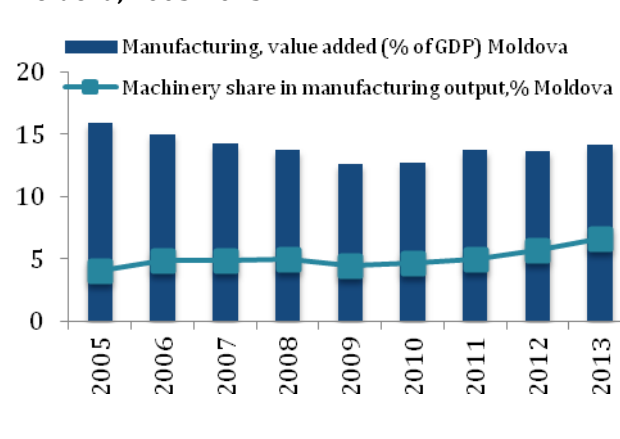
⁶ In the case of Ukraine, the export share in 2005 was at the lowest level at any time during the last 12 years (13.1%), and remained virtually the same in 2014 (13.2%). See the section analyzing export behavior in Chapter I.

Figure 1. Machinery output (% of manufacturing) and manufacturing value added (% of GDP) in Belarus, 2005-2013



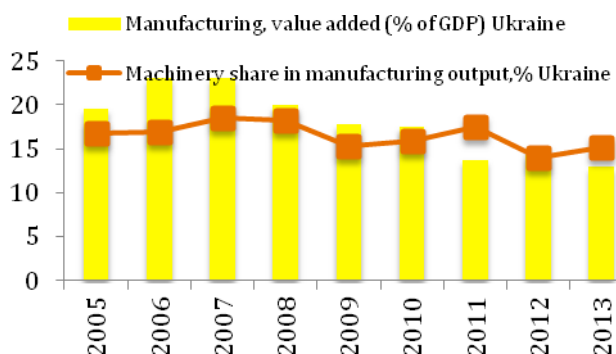
Source: World Bank, National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Figure 2. Machinery output (% of manufacturing) and manufacturing value added (% of GDP) in Moldova, 2005-2013



Source: World Bank, National Bureau of Statistics of the Republic of Moldova

Figure 3. Machinery output (% of manufacturing) and manufacturing value added (% of GDP) in Ukraine, 2005-2013



Source: World Bank, State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

In Belarus, machinery output has been fluctuating around 20% of manufacturing with a slight drop after the 2009 global crisis. However, the GDP contribution of manufacturing in Belarus has been declining since 2011, which suggests that machinery value added has also been declining. There is an evident downward trend in machinery output in Ukraine, which has been accompanied by a rapid decline of value added in the sector and in manufacturing in general. The only positive signal in the case of Ukraine is that machinery output has been more stable than the production of other subsectors of manufacturing. The situation is completely different in Moldova. The machine building sector in Moldova has been gradually recovering its previous output and has reclaimed its importance for the manufacturing industry, with a slight decline during the global crisis years of 2009-2010. The most promising indication of growing value added in machine building in Moldova is that the output share of manufacturing has been growing faster than the contribution of manufacturing to GDP.

Box 4: Machine industry in the V4 – importance & transformations

Machine industry is a very important sector in the V4 countries, with a long tradition and a high share of GDP, output and exports.

Table: Main economic characteristics of the machine industry in the V4 countries

	Czech Republic		Hungary		Poland		Slovakia	
	2005	2013	2005	2013	2005	2013	2005	2013
Industry value added, % of GDP	28.1	27.9	22.1	22.0	22.1	22.1	26.3	22.9
Machine building value added, % of GDP	8.0	9.8	7.7	8.5	3.5	n/a	5.1	6.5
Machine building output relative to GDP, %	32.3	41.0	36.5	37.9	14.6	n/a	30.1	45.2
Machine building value added, % of total industry	28.5	35.1	34.8	38.5	16.0	n/a	19.6	28.6
Employment in machine building sector, % of employment in industry	27.9	32.1	29.6	34.3	19.4	17.8	23.9	29.3
Export of machine building sector of total export of all HS commodities, %	51.2	55.0	62.0	53.0	39.6	38.4	44.9	57.9

Source: Eurostat, 2015.

During socialist times, machine industry was linked to a significant extent to the defense industry, especially in Czechoslovakia. Already in the mid-70's some companies have shifted some of their defense production to other sectors, mostly to the production of agricultural and/or food-processing machines and vehicles such as tractors.

Generally, the first years after the collapse of socialism were the hardest for the machine industry. In Slovakia, machine industry production fell by 30% between 1990-1993. Especially major companies had to reduce the number of their employees, and in many cases the state industry reform programs did not work.

There is also group of companies (especially in the Czech Republic) that survived transition thanks to their extensive tradition and their importance (which manifested itself in special attention by the government or in finding important global investors during the process of transition). This was the case with the Czech company ŠKODA Transportation, for example, which was originally established in 1859. It survived and is successful owing to the diversification of its product range, which includes a wide variety of industrial products, including railway vehicles and vehicles for urban mass transportation (subway trains, low-floor trams, trolleybuses, etc.).

Another example is the Slovakian company Tatravagónka Poprad, which was established in 1922 and is the only manufacturer of railway freight wagons and bogies in Slovakia, and is also among the biggest producers in Europe with respect to the aforementioned products. The company still enjoys a very strong position in the markets of the former Soviet Republics, but it is also very successful in the EU and has acquired other companies, to wit Fabryka Wagónow Gniewczyna (Poland) in 2009, Bratstvo Subotica (Serbia) in 2011, and 100% of the shares of the German company ELH Eisenbahnlaufwerke Halle GmbH & Co. KG, Landsberg in 2012.

Four general types of successful transition scenarios can be identified at the level of companies:

- 1) A big company that may be either traditional or of recent vintage – survives as a major company mostly thanks to massive government support in its restructuring and the diversification of its production. It produces a wide range of products or has several subsidiaries that specialize in a selected segment of the market. In some cases, they are still to some extent dependent on public investments/orders (defense industry, public transport vehicles, etc.);
- 2) A big company that is fragmented into several smaller companies, only few of which survive through smart specialization or by finding strong investors (mostly FDI) who invest money into the modernization of their production and in opening new markets for them;
- 3) SMEs that have a unique product in the market, strongly specialize on some market niche, and are able to compete globally (one example is SPINEA Prešov in Slovakia, the only European producer of high precision gearboxes, which relies on a unique construction based on its own patented principle; or the Czech company SOR Lichvaby, which completely changed its production from agricultural technologies, such as feeding vehicles, fodder turners, silo unloaders, small mountain tractors, etc., to the production of buses, trolleys, and electric buses);
- 4) Big companies or SMEs that are able to adapt to the needs of huge automotive investors in Central Europe and became their suppliers. In many cases (especially in Slovakia), they are acquired by strong (typically foreign) investors that modernize their production and promote the attainment of international certificates and better management.

Box 5: "Rebirth" of the machine industry thanks to the automotive industry

The Slovak economy is heavily focused on industry, especially on industrial production with medium-high technology. Approximately 4.5% of the labor force in the EU27 work in industrial production involving medium-high technology, whereas in Slovakia this share is 8.1%. With respect to this particular type of industry, Slovakia is the third most specialized economy in the EU. Almost 65% of the related production in Slovakia stems from motor vehicles and their spare parts. Nowhere else in the EU 27 do we observe such a high share of production based on medium-high technologies.

Table: Selected statistics defining some sectors of industry in Slovakia – focusing on machine industry development

NACE	Revenues (million EUR)		Share of total industrial revenue%	Share of exports in%	Share of employment in%	Average wage in EUR	
	2004	2010	2010	2010	2010	2004	2010
5-35 Industry total	48 396	67 484	100.0	100.0	100.0	561	795
24-25	7 276	8 409	12.7	13.0	14.8	612	797
26	1 792	6 816	13.6	26.1	5.8	532	754
27	2 098	2 364	4.4		7.5	492	768
28	1 932	2 630	4.7		8.8	581	845
29 – 30	8 614	13 902	28.1	23.6	17.8	632	889

Source: Statistical Office of the Slovak Republic.

The rebirth of machine building in Slovakia is closely connected to foreign direct investments in the automotive sector. Huge investments by Volkswagen (the first factory in Slovakia, established already in 1991), Peugeot-Citroen (2003), and Kia-Hyundai (2004) turned Slovakia into *the* "car-producing nation." Slovakia produces the highest numbers of cars per 1,000 inhabitants in the world. In 2014 this number was 183 cars per 1,000 inhabitants, the Czech Republic came second with 118 cars, South Korea was third with 82 cars. Hungary was in the 11th place with 23 cars produced per 1,000 inhabitants, while Poland produced 12 cars per 1,000 inhabitants in 2014.

As for the numbers of cars produced, in 2013, 987,718 cars were produced in Slovakia, 1,132,931 in the Czech Republic; 222,400 in Hungary; 583,258 in Poland; 166,428 in Austria, and 50,449 in Ukraine. The total number of cars produced globally was 87,299,993.

The automotive sector in Slovakia directly employs 80,000 employees (compared to 22,000 in 1993) and indirectly creates another 120,000 jobs in over 316 Tier 1 companies in Slovakia (suppliers). Forty percent of the suppliers of these three car producers are located in Slovakia, 60% of car parts are imported. The sector represents 35% of Slovakia's total industrial exports (€17 billion) and creates €2.5 billion of added value annually.

By comparison, the automotive industry in the Czech Republic directly employs 150,000 employees and represents 20% of the country's manufacturing output. The car factories located in the Czech Republic are Škoda Mladá Boleslav (Volkswagen Group), TPCA Kolín (Toyota, Peugeot, Citroen), and Hyundai Nošovice. However, the Czech Republic also has a long tradition of producing trucks (TATRA Kopřivnice, AVIA Praha – Čakovice) and public transport vehicles (KAROSA-IRISBUS, SOR, IVECO, Škoda Plzeň, ČKD Praha).

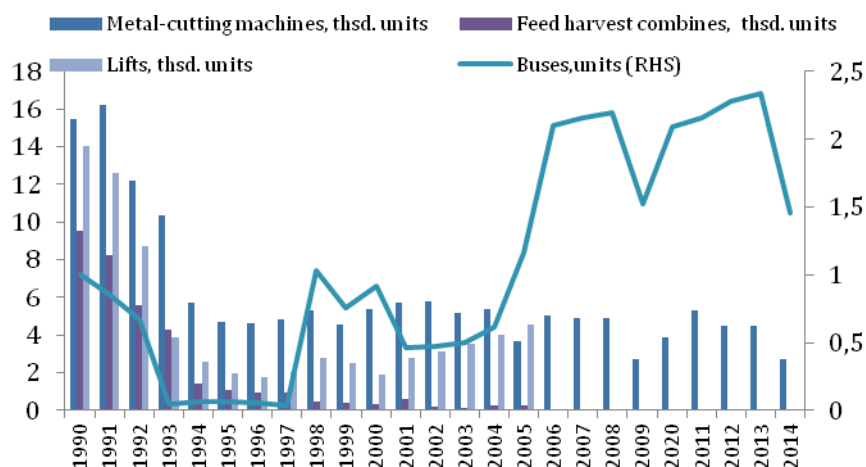
In Hungary, the car industry has not played a distinguished role, neither early in the transition process nor today (though its importance did grow after the late 1990s as new Suzuki, Audi, and Mercedes factories were built). The once successful company IKARUS was established already in 1895 as a coach factory, went on to become a car producer and has been producing buses since 1927. The company failed to transform effectively in the 1990s and lost its positions in the international market. By 1973 Ikarus had become the world's fourth largest manufacturer of buses. Irisbus, a French-Italian investing group invested in the company in 1999, but in 2006 it sold Ikarus Bus to Hungary's Műszertechnika group, which introduced new buses, for example the new Ikarus V187 in 2010. Since 2014 the company has also started to produce Ikarus-Skoda trolleybuses. The buses are produced in Székesfehérvár (Hungary), the engines come from the Czech Republic. However, the machine industry success stories in Hungary are typically linked to electrical equipments, electronics, and devices – companies like Flextronics, Electrolux, GE-Tungsum, Orion, Nokia and others.

Belarus

Machine building has been historically one of the sectors of specialization of the Belarusian economy and is quantitatively one of the most important industrial sectors in terms of employment and production. During Soviet times, administrative decisions were taken to place the most vital and most powerful machine building plants in the territory of what was then the former Soviet Socialist Republic of Belarus. Among the reasons were the qualified labor force there and the fairly well-developed road infrastructure. But such decisions had a significant strategic disadvantage for Belarus: Production was based on imported raw materials and components from other republics of the Soviet Union. Moreover, the main scientific and research bases were located in Russia, which resulted in the fact that a substantial share of research and innovations were sent to Russia [22]. As a result of this situation the country became a so-called "assembly shop" of Soviet industry. In the Soviet (command and control) economy, demand was guaranteed regardless of the quality of the product offered.

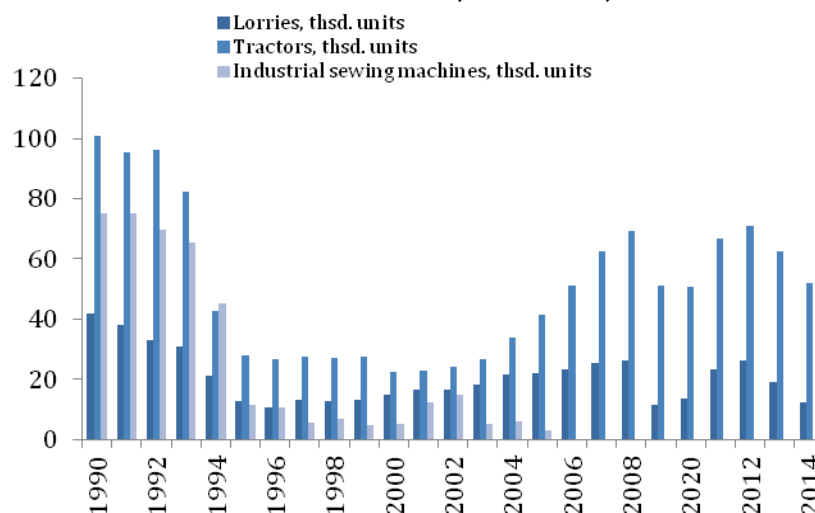
After the collapse of the Soviet Union, the production of many kinds of goods declined significantly due to the fact that the Belarusian machine building sector had specialized in the production of unsophisticated low-price products for the captive Soviet market, and particularly for Russia as the biggest Soviet and post-Soviet market. In 1990, the manufacture of machinery and metallurgical industry sectors accounted for 34.2% of all industrial output. By 1995 their share had dropped to 23.3% [9]. Due to the facts that i) Belarus' machine plants had to start performing independent marketing and contractual activities, ii) their products were of insufficient quality because of low-level innovation capacities, and iii) there was a rapid depreciation of fixed capital in key machine building factories, the share of the sector continued to fall in the 1990s. Figures 4 and 5 depict the production dynamics of key commodities produced by the machine building sector in Belarus between 1990-2014. These show that the years 2011-2012 were the peak years. Capacity utilization of key commodities indicates that machinery has partially recovered from the global crisis of 2009, but has been diminishing in a slow and gradual trend since 2012 (Figure 6).

Figure 4. Production of selected commodities in Belarus, 1990-2014, thsd. units (LHS), units (RHS)



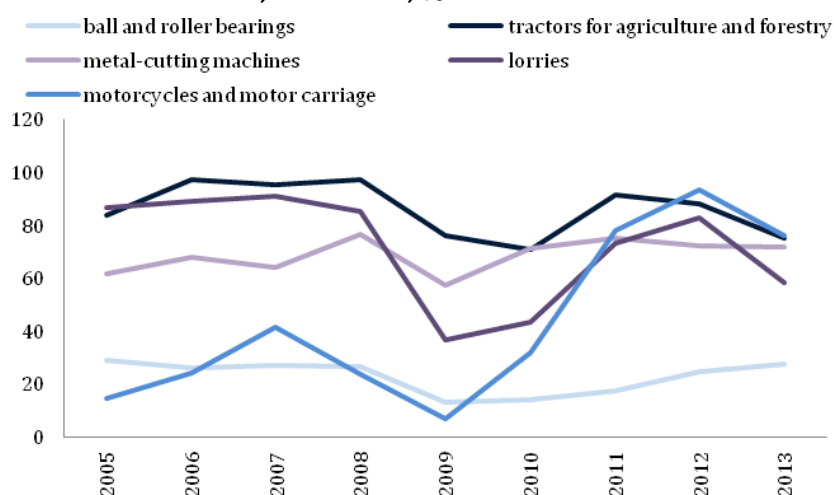
Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Figure 5. Production of selected commodities in Belarus, 1990-2014, thsd. units



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Figure 6. Capacity utilization in Belarus, 2005-2013, %



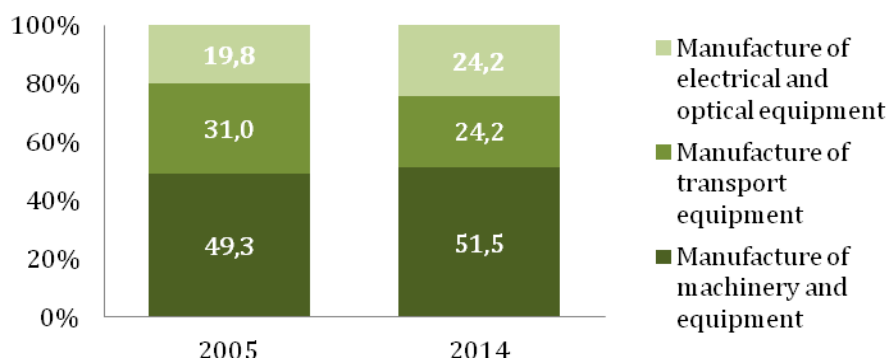
Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Some of Belarus machine companies were close to recovering their previous levels of production in the 2000s, mostly thanks to administrative support from the Belarusian government. Producing Soviet-type machines for the captive Russian market negatively influenced the business culture of such firms because they were not sufficiently familiar with the competition, offered poor after sale service quality and paid little attention to innovation or cutting costs [1]. In most cases, administrative measures taken by the Belarusian government proved most vital for the recovery of production in the 2000s, due to the following reasons: i) the sector has always been one of the major employers in the country, and the privatization and restructuring of this industry would have resulted in high social costs; ii) large industrial plants have been huge exporters and sources of foreign currency for the Belarusian economy, making them relatively important for macroeconomic reasons. Subsidized loans from state-owned banks and direct negotiations between the Belarusian

government and the Russian Federation or Russian regions⁷ made it possible for Belarusian machinery giants to expand their presence in the Russian market [42]. As far as advances are concerned, one might point to some improvements in quality (for instance the introduction of international quality certificates, such as the ISO 9001 in the early 2000s), the development of new products (in passenger transportation, for example) and some energy intensity improvements. For example, in the production of heavy trucks, by 2014 energy consumption per unit had dropped to almost a third of the 2005 level; in tractor manufacturing, it fell by a rate of 1.6. In the macroeconomic measure of toe per of \$2,000 PPP, Belarus' energy intensity level is 15-20% below the average of the post-Soviet states, though it almost twice as high as the OECD average [24].

As the result of government support programs, machinery structure in Belarus has remained almost unchanged. Today, the production of machinery and equipment remains the focal point of the machine building sector in Belarus, producing more than half of the sector's total output (Figure 7). Manufacture of transport vehicle equipment dropped from a 31% share in the sector in 2005 to 24.2% in 2013. Output of electrical and optical equipment climbed to a 24.2% share of machinery output in 2013.

Figure 7. Machinery output structure in Belarus, 2005 and 2013, %



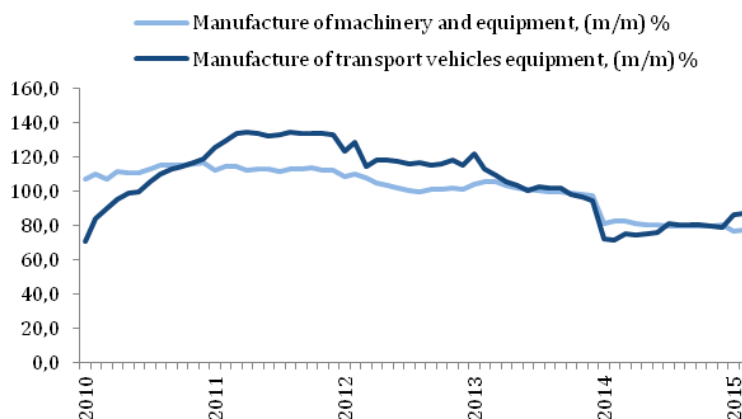
Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Today, Belarus' machine building sector finds itself in a very difficult position and requires new reforms. Huge investments in the sector have been used inefficiently and large enterprises still have worn-out capital assets, the quality of goods changes slowly, and price competitiveness remains highly dependent on the exchange rate of the national currency [40, 42]. There is a critical level of dependence on Russia on account of the high share of imported components and fossil fuels, as well as the high share of exports going to Russia. These reflect the general structural problems of the Belarusian economy and the absence of institutional reforms over the last 25 years [41]. As a result, after Russia joined the WTO and the Russian

⁷ For instance, in 2011-2012 Russia's biggest bank "Sberbank" issued over \$600 million in subsidized loans to Russian regions to finance the procurement of Belarusian machinery items after the Belarusian and Russian governments agreed on a corresponding deal (see <http://www.belta.by/economics/view/sberbank-rf-lgotno-prokreditoval-postavki-belorusskoj-tehniki-v-rossiju-na-summu-svyshe-600-mln.-97375-2012>)

ruble was devalued substantially in 2014, Belarusian machinery output dropped by 20% in the same year and has continued to shrink in 2015 (Figure 8).

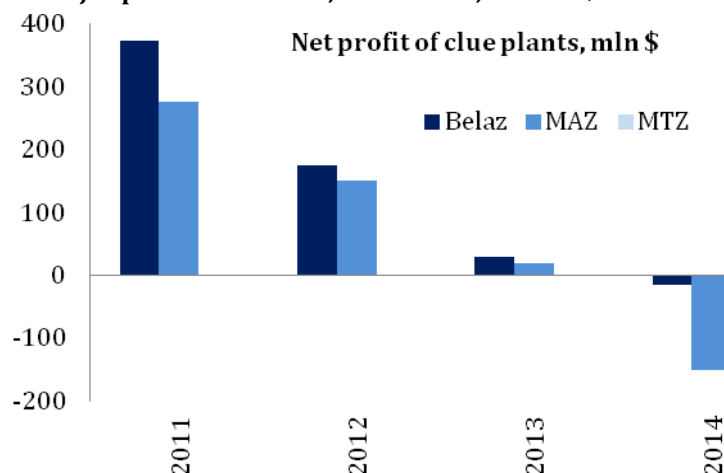
Figure 8. Manufacture of machinery and equipment and manufacture of transport vehicles equipment in Belarus, 2010 - 2015, m/m, %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

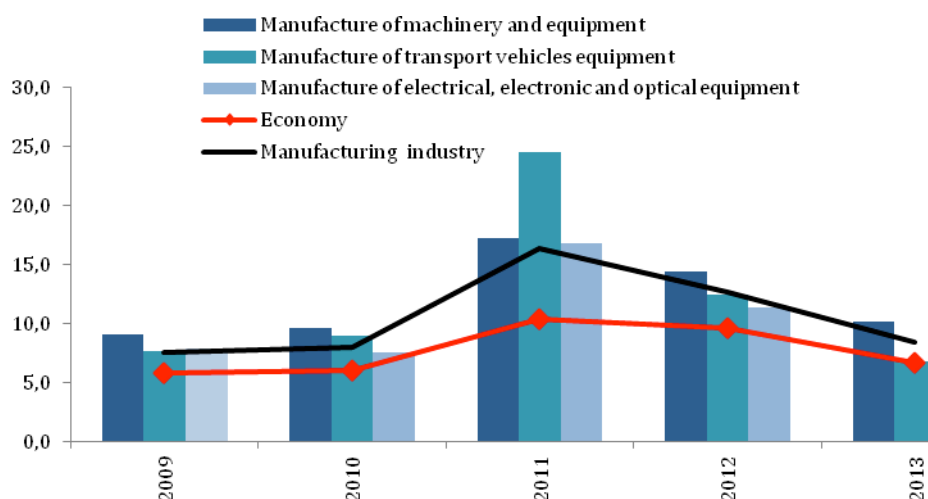
The financial results of machine producers confirm the critical state of machinery in Belarus. Net profits at the three major machinery companies (Belaz, MAZ and MTZ - Figure 9) have been declining significantly over the last years, and they morphed into steep losses in 2014. The return on sales indicator has also been following a downward trajectory since 2011, dropping near the level of 2009, the year when output dropped most precipitously in the wake of the world financial and economic crisis (Figure 10).

Figure 9. Net profit of major plants in Belarus, 2011-2014, million \$



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

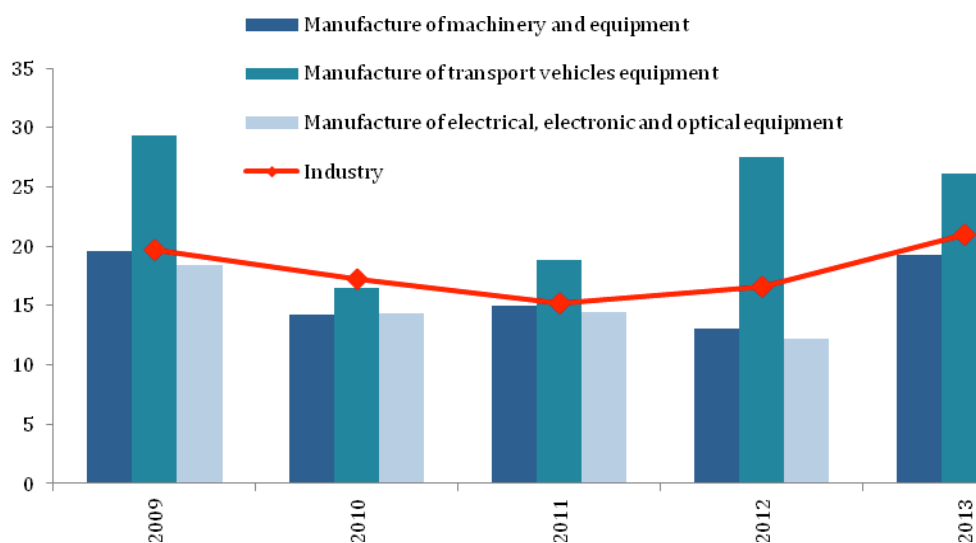
Figure 10. Return on sales in the machine building sector in Belarus, 2009-2013, %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

At the same time, the share of unprofitable machinery enterprises (Figure 11) is also near the level of the 2008-2009 crisis. The number of unprofitable companies in the subsector of transport vehicles and equipment is even higher than the average figure in the manufacturing industry overall, which indicates the critical state of this particular subsector.

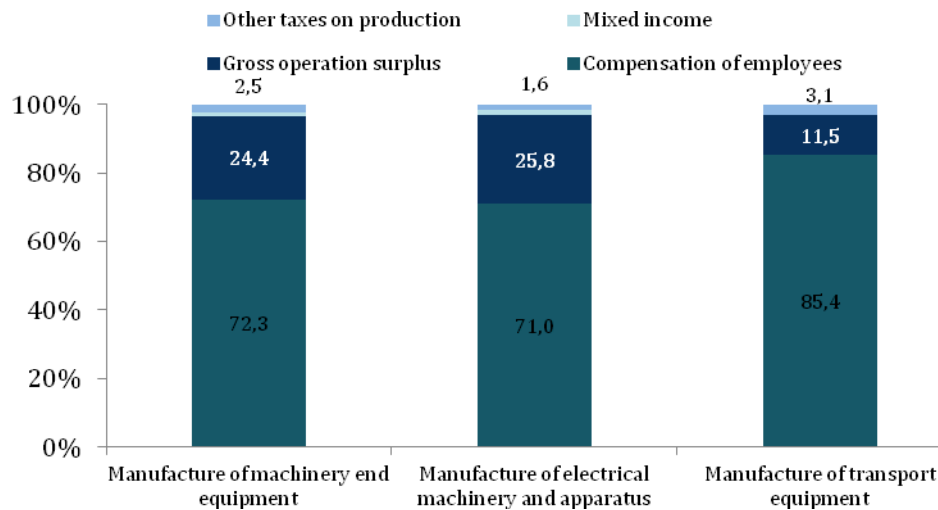
Figure 11. Share of unprofitable enterprises in the machine building sector in Belarus, 2011-2014, %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Excessive employment and the wage burden also constitute significant problems for the machinery sector in Belarus. Most of the machinery output is produced by large state-owned enterprises (SOEs), which enjoy privileged access to low-cost financing from state subsidy programs, often at a level of interest that is lower than inflation. Combined with administrative wage targeting at SOEs, this increases the share of labor in machinery products and contributes to its lacking export competitiveness. This is especially true in the case of the transport equipment subsector (Figure 12).

Figure 12. Added value of the machine building sector in Belarus by incomes, 2013, %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

To summarize, there is currently significant need for restructuring the machine building sector in Belarus. Sinking output, bad financial results, and excessive employment result in the diminished competitiveness of machinery products in terms of quality and prices, both domestically and abroad. Slow demand in the Russian market and an overvaluation of the Belarusian ruble may yield dramatic results in 2015 and beyond. New reforms are needed to change the status quo.

Ukraine

The Soviet Union left an impressive legacy for Ukraine, but in the 1990s machinery experienced a significant slump. During Soviet times, Ukraine was one of the key producers of energy and metallurgy equipment, machine tools, agricultural equipment, and railway cars in the USSR. In some of the subsectors, like specialized types of combine rotor excavators, Ukraine retained a monopoly in the market. Ukraine's comparative advantage was the presence of significant natural resources (mainly iron ore) for machinery production [5]. The more technologically advanced machinery sectors at that time included rocket industry, space industry, aviation industry, and mechanical engineering. The share of machine building in the output of the Ukrainian SSR in 1990 was below 30%, while its share of industrial employment was 35%.⁸

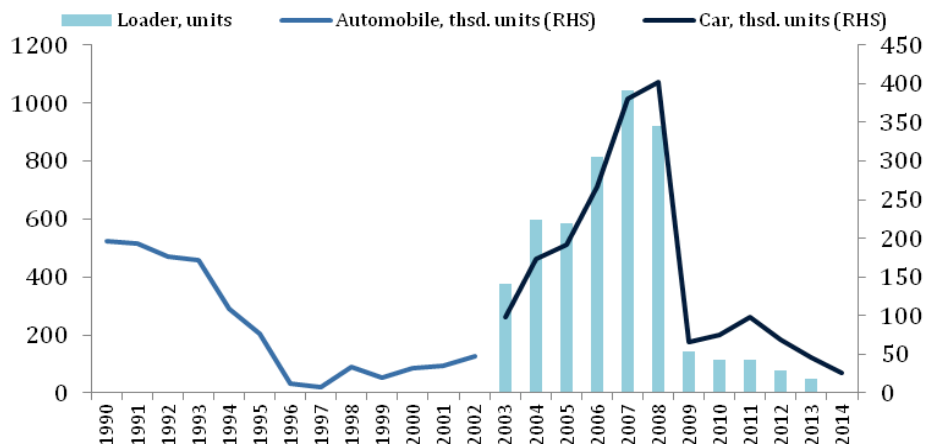
In the 1990s, after the fall of the USSR, economic collapse, problems with the supply of components from other post-Soviet countries, as well as changes in ownership structure pushed Ukraine's machinery into a decade-long slump. Large-scale privatization launched in 1995 triggered a process whereby private investors were competing for the acquisition of previously state-held machine production assets at significantly below market prices. By 1999, the specific situation of Ukrainian privatization resulted in a push for equity

⁸ According to the 1996 Ukraine Statistical Yearbook.

accumulation by investment funds and trusts, but this led to poor management and a lack of incentives for investments and technological recovery [44]. Also, the existence of enormous reserves of raw materials seems to contribute to the conservation of the status quo in machinery structure and discourages a transition to the production of more high-tech products.

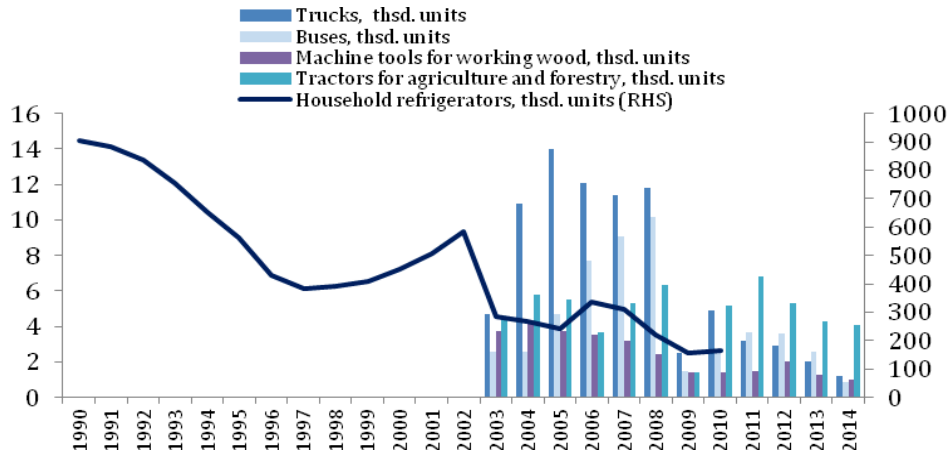
In the 2000s machine producing companies were recovering quickly, but the global financial crisis hit the sector severely (Figures 13-14). Among the key reasons for the recovery were rapidly growing internal demand combined with favorable external conditions that increased demand for Ukrainian exports [29]. For example, the production of agricultural machinery in Ukraine increased significantly because of the fast development of the agricultural sector and because foreign investors had acquired stakes in local production sites. However, the quality of domestically produced equipment and machines barely improved, while the product range had not changed much [29]. As a result, there was a significant reduction in manufacturing and machinery production in 2009 because of the global crisis, which led to a collapse in domestic investments in fixed assets. Since then, machinery has been following a new downward trajectory with few signs of recovery.

Figure 13. Production of selected commodities in Ukraine, 1990-2014, units (LHS), thsd. units; (RHS)



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

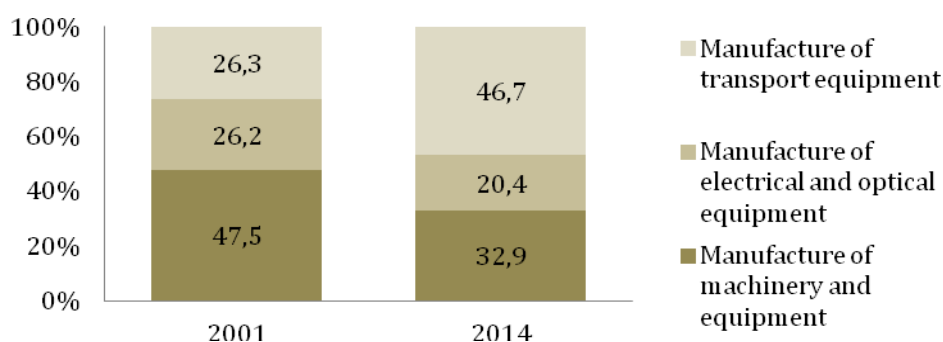
Figure 14. Production of selected commodities in Ukraine, 1990-2014, thsd. units



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

As a result of the transformation processes, the structure of machinery in Ukraine has changed significantly, with the transport equipment subsector producing half of all machinery output (Figure 15). The different pace of growth between 2001 and 2008 in some subsectors as compared to others, and a post-2009 decline of the three machinery subsectors, resulted in relatively better development of the transport equipment manufacturing subsector compared to the subsectors of manufacturing of electrical and optical equipment and machinery and equipment. In terms of output, transport equipment presently predominates in the structure of the sector, while the subsectors manufacturing of electrical and optical equipment and machinery and equipment saw their relative share of output diminish between 2001 and 2014.

Figure 15. Machinery output structure in Ukraine, 2001 and 2014, %



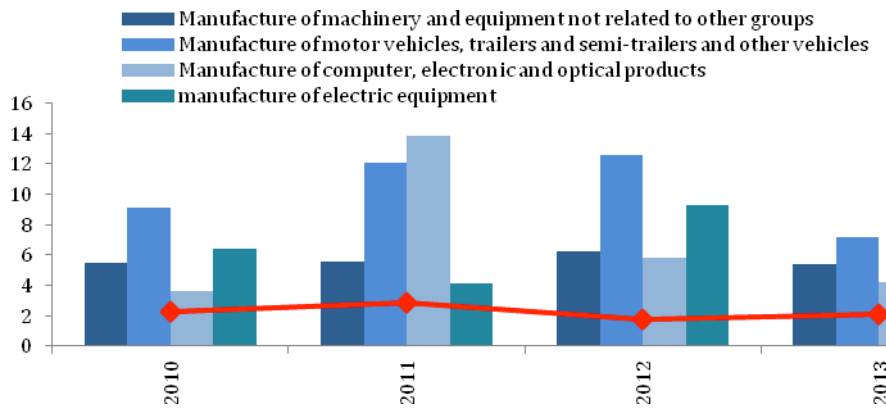
Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Today, the most developed sub-industries of the machine building sector in Ukraine are dependent on domestic raw materials and are located in the East of Ukraine in order to reduce the distance between production companies and the supplier of raw materials (mainly, steel) [29] (see Figure 1 in the statistical appendix). The sub-industries referred to above are railway machine building, heavy machine building and machine building for agriculture.

The average depreciation rate of fixed assets is close to 70%, but some sub-industries report even higher numbers [29]. A considerable share of Ukrainian enterprises still have Soviet era equipment and their technology, too, is from the same era [6]. For example, in the "Machine building for agriculture" sub-industry, between 70% and 90% of the domestic machine park of agricultural machinery is fully depreciated or obsolete. As a result, productivity in machine building is only two-thirds of the national average, which is an indication of capital and technology deficits, and also suggests problems with international competitiveness [7]. Results for 2014 illustrate that machinery overall has shrunk by over 20%, while some subsectors (mostly those oriented towards the Russian market, like railway machine building) have dropped by over 60%.

The financial results of machinery companies remain in the positive domain and indicate that profits have not been reinvested into acquiring new technologies, modern equipment, and know-how (Figure 16).

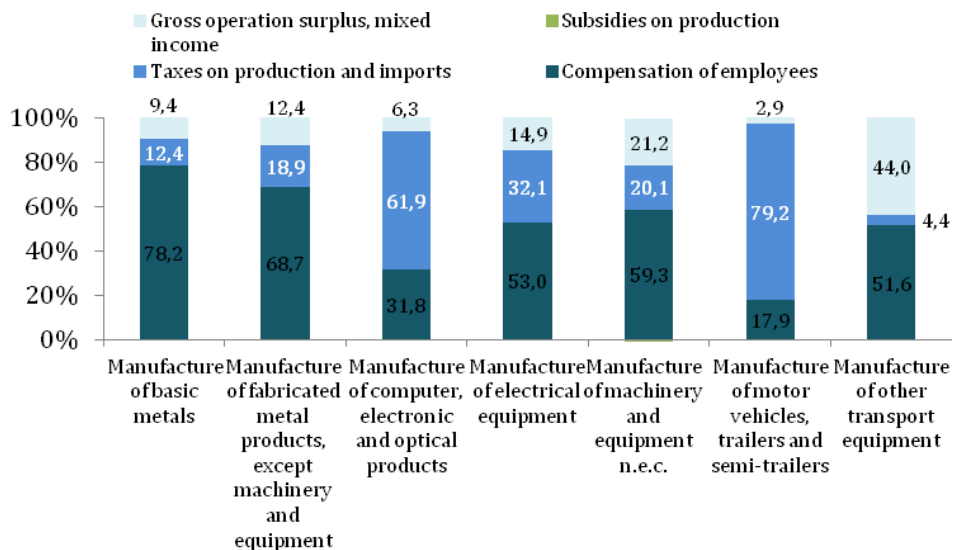
Figure 16. Profitability in the Ukrainian machine building, 2010-2013, %



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Statistical data on value added calculated by income in Ukraine’s machinery subsectors indicate that companies do generate operational surpluses, but their levels differ substantially across subsectors (Figure 17). Employee compensation also varies, but, unlike in Belarus, it does not impose a wage burden on the industry. Imported components provide major value added in the case of the manufacture of computers, electronic and optical products, and motor vehicles.

Figure 17. Added value of the machine building sector calculated by income in Ukraine, 2013, %



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Low productivity and the low level of technological progress make Ukrainian machinery sensitive to energy price increases, which undermines the competitiveness of Ukrainian machinery producers. Between 1991-1995 Ukraine’s economy energy intensity grew by 30%, then stabilized in the period 1995-1999, while between 2000-2005 energy intensity dropped by 40% [26]. As of 2012, it is about 45% more energy efficient than it was in 1990, based on IEA open source data. The existing improvements in energy intensity have not resulted from sectoral shifts in the economy but from technological improvements in individual sectors [26]. For instance, according to the energy balance of Ukraine, in 2014 energy consumption in industry fell by 60% as compared to 2007, while energy consumption in the machine32

building sector fell by a factor of 2.1 in the same period.⁹ However, there is a need for further reductions in energy intensity in the various sectors of industry, including machinery, in order to be competitive in domestic and foreign markets. Underinvestment in new technologies and energy-saving contribute to the fact that significant segments of the agricultural machines and metallurgy and mining subsectors mainly produced for the domestic market [29].

Box 6: "Smart Specialization" and the future of machine industry in the V4

The EU's current approach to increasing the competitiveness of the EU economy is based on the so-called Smart Specialization or RIS3 program, which is a strategic approach to economic development through targeted support for research and innovation. It involves a process of developing a vision, identifying where the greatest strategic potential lies, developing multi-stakeholder governance mechanisms and using smart policies to maximize the knowledge-based development potential of a region, regardless of whether it is strong or weak, high-tech or low-tech. It is then followed up by financial instruments and national cohesion funds, which support innovation in the companies.

The following table presents decisions taken by the V4 countries about the sectors that will receive the highest levels of support in the following years. Machine building industry is the key priority in all V4 countries, which underlines the importance of the sector for the economies of the countries involved.

Table: Areas of Economic Specialization in the V4

Czech Republic	Hungary	Slovak Republic
Manufacture of means of transportation and equipment	Healthy society and well-being	Automotive and mechanical engineering industries
Mechanical engineering	Advanced technologies in vehicle and other machine industries	Consumer electronics and electrical equipment
Electronics and electrical engineering	Clean and renewable energies	ICT and Services
IT services and software	Sustainable environment (natural resource management, advanced environmental technologies)	Production and processing of iron and steel
Electricity production and distribution	Healthy local food (food processing)	<u>Prospective area:</u> Automation, Robotics and Digital Technology
Drugs and medical products and methods	Agricultural innovation	<u>Prospective area:</u> Processing and increasing the value of light metals and their alloys
<u>Prospective area:</u> Natural resources, agriculture, and food	<u>Horizontal area:</u> ICT (info-communication technologies) & Services	<u>Prospective area:</u> Production and processing of plastics
	<u>Horizontal area:</u> Inclusive and sustainable society, viable environment	<u>Prospective area:</u> Creative industry
		<u>Prospective area:</u> Increasing the value of domestic raw material base

Source: RIS 3 of the V4 countries involved, 2014 and 2015.

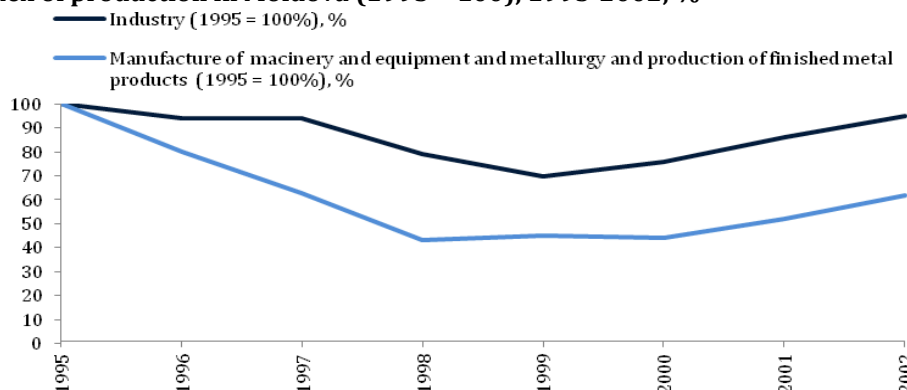
⁹ In thousands tons of oil equivalent.

Summing up, machinery in Ukraine currently seems to find itself in the process of structural and technological adjustment. Problems with internal demand and instability in the external markets have led to a significant decline in machinery production over the last decades. Good times in the 2000s have not led to the modernization of equipment or the introduction of innovations. Subsectors that rely on domestic raw materials produce the major part of machinery products and seem to lack an incentive to accelerate the transition to the production of more high-tech industrial products. Further proactive steps are needed both from machinery producers and the government in order to facilitate changes in the structure of the industry, in equipment modernization, and in the application of new technologies.

Moldova

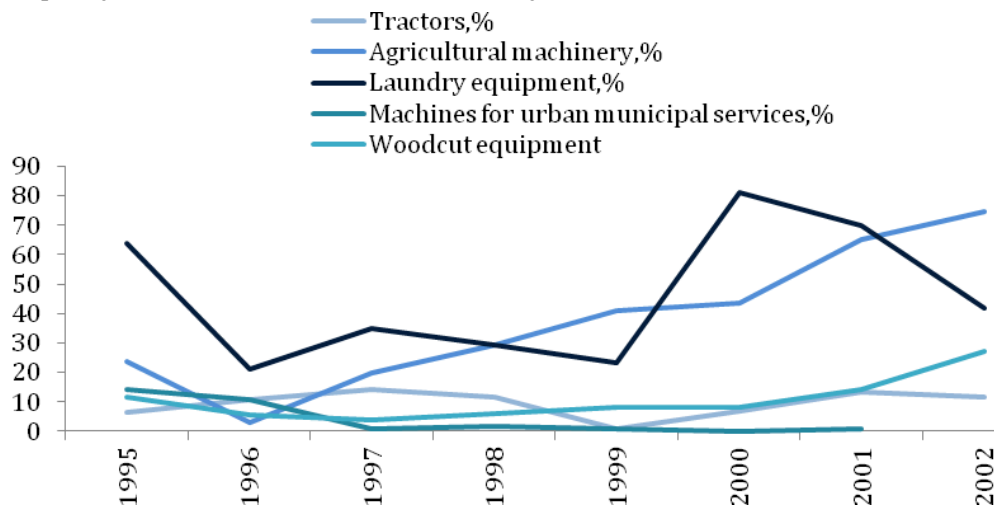
In Moldova, machinery has undergone significant transformation through privatization and changes in its output structure since the country became independent in 1991. The machine building sector in Moldova had been formed mainly in the 1960-1980s, during the time of the Moldovan Soviet Socialist Republic within the USSR. At the time it was primarily aimed at the development of the subsectors of agricultural machine building, and electronics and precise machine tools (later as a part of Soviet military industry) [45]. Throughout the 1990s, after the economic reforms were launched, there was a sharp decrease in Moldovan machinery production (Figure 18). As a result of coupon-based mass privatization, by 2001 93% of the machine building sector's output was produced by non-state enterprises, and 90% of the sector's workers were employed by private companies. Those numbers were higher than the average industry figures at that time, indicating the authorities' direct or indirect willingness to reform the sector. After privatization, the machine building sector registered only limited investment, which – with few exceptions – led to a decline in the competitiveness of the sector. Some of the companies in the sector switched from producing parts for military equipment and parts for industrial giants in Russia to manufacturing household goods. Many companies went through bankruptcy procedures, stopped producing, and rented out their assets to other private companies. The capacity utilization of some commodities in Moldova between 1995-2002 reflects the recession in machine building in the 90s, and also shows the first signs of recovery in the early 2000s, specifically in agricultural machinery (Figure 19).

Figure 18. Index of production in Moldova (1995 = 100), 1995-2002, %



Source: National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

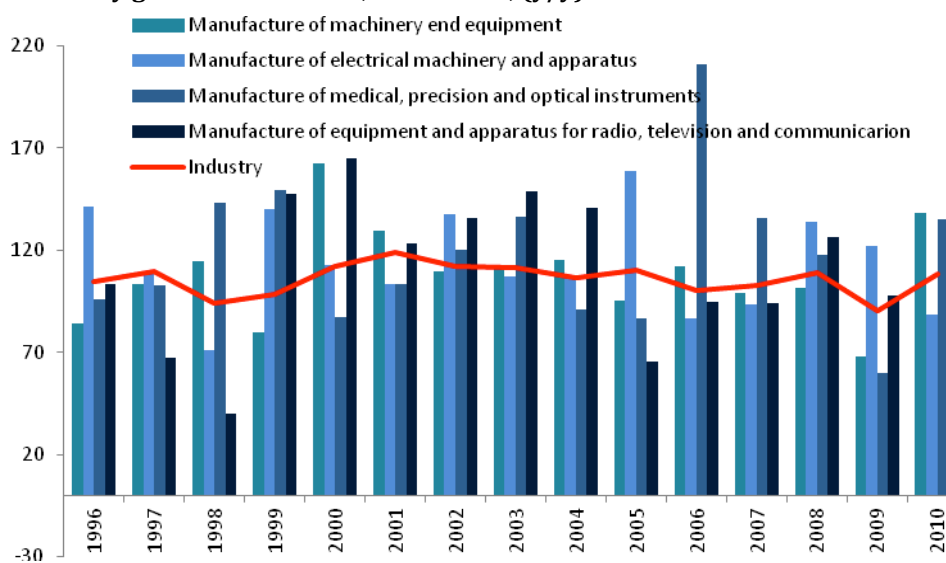
Figure 19. Capacity utilization in Moldovan machinery, 1995-2002, %



Source: National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

Machine building has achieved a more significant share of Moldovan industrial production since 2001, and there is an increased focus on the machine building sector as the engine of industrial growth in Moldova. Productivity growth in various machine building subsectors has exceeded the industry average in the 2000s (Figure 20). However, it seems rather difficult to pinpoint the key factor that was the main contributor of the growth of the machinery subsector during this time. Major investments by global automotive components producers in 2006, 2007, and 2010 were major drivers of growth. This resulted in sharp growth in the export figures of the electrical machinery and apparatus manufacturing subsectors, which jumped from \$53.1 million in 2006 to \$315.9 million in 2012. Figure 20 also depicts the negative impact of the 2008-2009 global financial crisis on Moldovan industry and machinery specifically. Industry productivity fell by 10% in 2009, while productivity in the manufacture of the medical, precision, and optical instruments subsector fell by 40%.

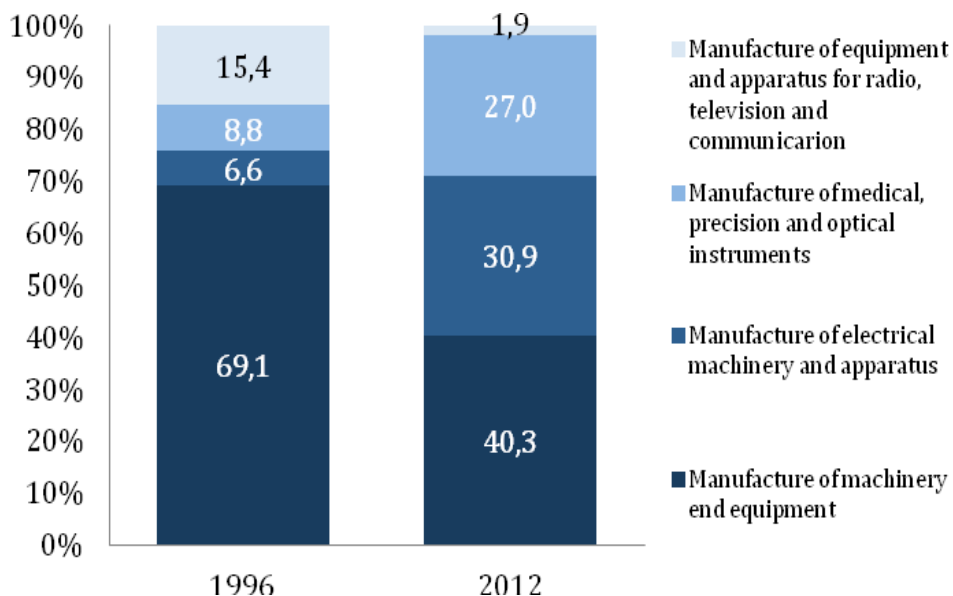
Figure 20. Productivity growth in Moldova, 1996-2010, (y/y)%



Source: National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

Deep reforms resulted in a transformation in the structure of the machinery sector, and pushed it towards a more balanced and technology-oriented output structure (Figure 21). The weight of the machinery and equipment subsector dropped from 70% to 40% of total output, while the subsectors manufacturing of medical, precision, and optical instruments and manufacture of electrical machinery and apparatus expanded to about 30% each.

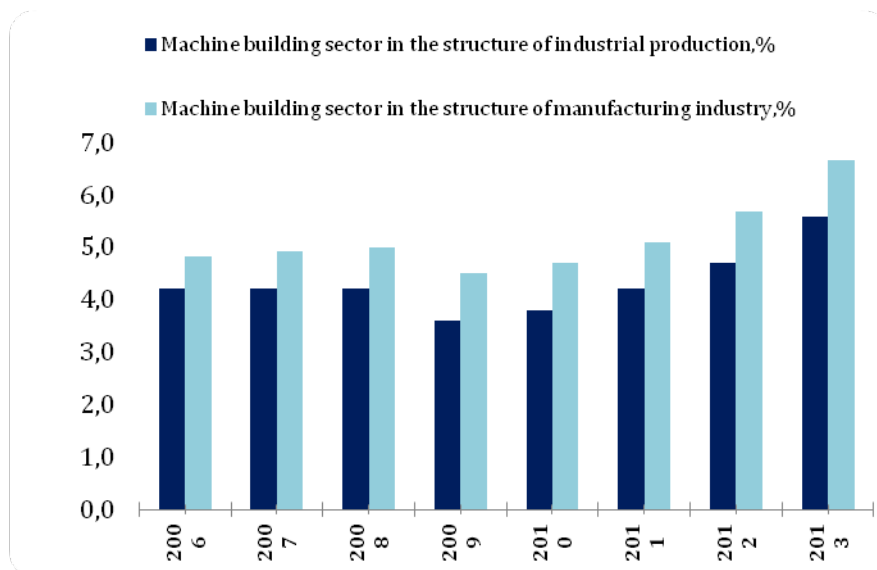
Figure 21. Machinery output structure in Moldova, 1996 and 2012, %



Source: National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

Since 2004, when Moldova joined the European Neighborhood Policy (ENP) and signed the Moldova-EU action plan in 2005, there has been a growing interest by European investors in Moldovan industry. After the EU – Moldova Association Agreement, including the Deep and Comprehensive Free Trade Area (DCFTA), was signed in 2014, Moldova became attractive for 2nd tier and 3rd tier suppliers of automotive components, as well as for the machine building sector [31]. Western companies are increasingly interested in the production of components, and also in outsourcing component production, assemblies, and machines. This is also apparent in the growing importance of machinery in both industry and manufacturing (Figure 22) in Moldova. As we will show later, Moldovan investments in fixed machinery assets are currently mostly directed towards the manufacture of electrical machinery and apparatuses. There is an increased interest in Moldova in the production of machinery components and tools based on licenses provided by Western companies (Italian and German companies are particularly active in these areas), which indicates that the country is turning into a component supplier for both Western and Eastern markets. Labor intensive production sites are attractive for foreign investment, as Moldova offers the most competitive labor costs in Europe, in competition with Ukraine [31].

Figure 22. Share of machinery in industrial and manufacturing output in Moldova, 2006-2013, %



Source: National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

Summing up, the machine building sector in Moldova has been contributing a growing share of industrial production since 2001. Compared with Belarus and Ukraine, the machine building sector in Moldova contributes far less to the country's GDP, but the sector has experienced a surge in its productivity and there is an increased focus on the machine building sector as an engine of industrial growth in Moldova. This indicates that the country's machinery has undergone deep structural changes and has managed to attract greenfield investments in the area of machinery components. Apparently, pragmatic economic policies, combined with the benefits of the country's geographical location, may attract new investments into the sector, which will serve to enhance machinery development and turn the country into an important regional player.

Box 7: V4 – lessons from the past 20 years – Case studies on increasing productivity and shifting focus on new emerging sectors of the economy

Case of ZTS VVU Košice, Slovakia

Established in 1976, the state-owned company developed commercial vehicles, heavy hydraulic manipulators, transport and handling systems, special technologies (rear arms and engineering hardware on automotive carriages), forming machines, high-speed stamping press lines, and stationary gear units. It was incorporated into ZTS Martin (a previously mentioned defense company) in 1981. In 1990, the ZTS concern was broken up and on July 1, 1990, ZTS VVU Kosice was formed as an independent state enterprise. As part of this transformation process, ZTS VVU Kosice was turned into a joint-stock company and was privatized in the first wave of privatization in the years 1992-1993. Subsequently, the enterprise stabilized, its production program was retained and it developed specialized purpose extensions for vehicles, handling equipment, assemblies for the paper industry, and transport containers for nuclear energy.

The year 2004 marked an important milestone for the company, as it then became a supplier of robotic devices for positioning cryo-magnets in the Large Hadron Collider at CERN in Geneva, Switzerland. The company is still in Slovakian hands, and its success hinges on its ability to adapt its production to customer needs and to specialize in meeting these specific needs. The company continues to enjoy a strong position in the defense industry, but after 1993 it was able to shift its production first to robot systems for nuclear plants, and later to the production of service & security robots. Currently the company is already involved in EU research in the area of smart mobility and ambient assisted living, developing the Personal Intelligent City Accessible Vehicle System (PICA-V) and the Freight Urban Robotic Vehicle (FURBOT). These could yield another new production program in the near future.

Case of SPINEA Prešov, Slovakia

The SPINEA company is a modern Slovak engineering company, engaged in the development, manufacturing, and sale of high-precision reduction gears, which are sold under the trademark TwinSpin. The impetus for the establishment of the company was the invention of a Slovak engineer in 1994. TwinSpin high precision reduction gears are serially manufactured based on an international patent. The company's products are suitable for mechanical and robotic applications of different kind. They are widely used in automation and industrial robotics, in the field of machine tools manufacturing, in navigation and camera equipments, medical systems, and in many other fields.

The company is growing rapidly thanks to the unique invention. It has only two major competitors in the world (one is located in the US, and another is in Japan). It exports its products worldwide and cooperates with such companies as KUKA, ABB, COMAU, RR Robotica, BMW, and many others. The company is an example of a success story, even though it is located in Eastern Slovakia, the poorest region in the Slovak Republic. The foundation of the company was also based on the tradition of robot development that began at the VUKOV Prešov factory in the 1980s – which was a state-owned R&D and production company at the time. Unfortunately, VUKOV had to lay off a lot of staff (it employed over 1,200 engineers in the 1980s) in 1991, when the company was transformed into a state-owned joint stock company. In 2005 it received a capital injection and the company was strengthened through a restructuring of its ownership and the arrival of a new owner. Since then the VUKOV company has been growing again.

Case of Pata Ltd., Hungary

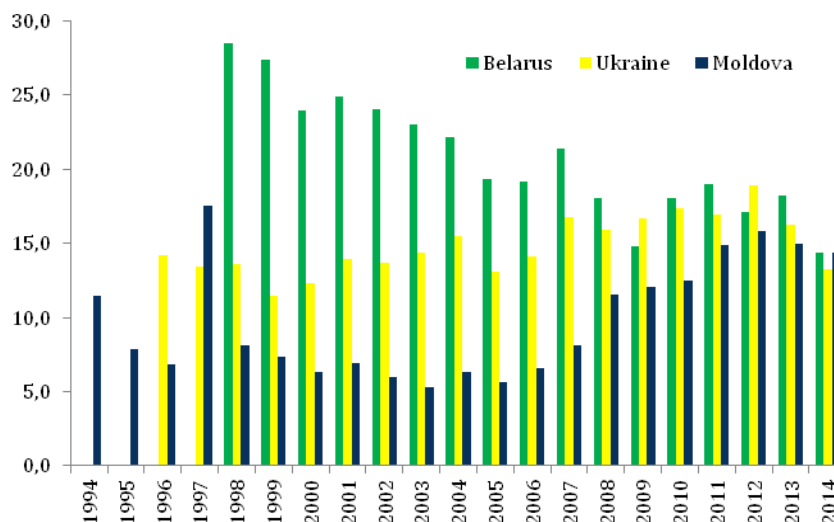
Established as a family-owned venture in a small Hungarian village (Fajsz) in 1988, the company specializes in manufacturing automotive body parts. The history of the company is the success story of a Suzuki supplier that has established itself as the most important domestic supplier of the Japanese automotive company's Hungarian subsidiary. Its success is based on continuous technological development, learning, and upgrading. Initially the company specialized in manufacturing parts for farming machinery. It signed its first supplier contract with Suzuki in 1992. Since then, its development has become an exemplification of the notion that supplier firms can grow jointly with their contractors if they adopt a long-term strategy and make sure to keep up with the ever-increasing requirements. Initially, Pata had supplied eight components, but by 2015 the number of product categories it supplied to Suzuki amounted to 170. Pata's turnover was €8.7 million in 2015: about 15 times higher than its sales volume in 2000. Currently, the company has 99 employees. This rapid development necessitated a continuous reinvestment of its earnings: It has invested in capacity expansion, process upgrading, and intangible assets (Kaizen, quality certificates).

The example of this company is especially instructive because of the role of technology-based upgrading: In an industry characterized by rapid technological change, the diffusion of advanced manufacturing solutions, automation, cyber-physical systems and ever-stricter regulations, a small Hungarian company managed to keep up the pace, grow, and increase quality and productivity, all the while it installed the most up-to-date robotic solutions (such as robotic welding) and expanded its product/activity mix (including assembly and design).

Export & import patterns

According to the UN Comtrade Database, the machine building sector's share of total exports has risen in Moldova, lost some of its importance in Belarus, and has been fluctuating in Ukraine (Figure 23). Though the trends in their machinery exports were different, their ratio has been converging around the same share of the total exports in all three countries. In 2014, the share of exports provided by the machine building sector relative to total exports was just below 15% for all three countries.

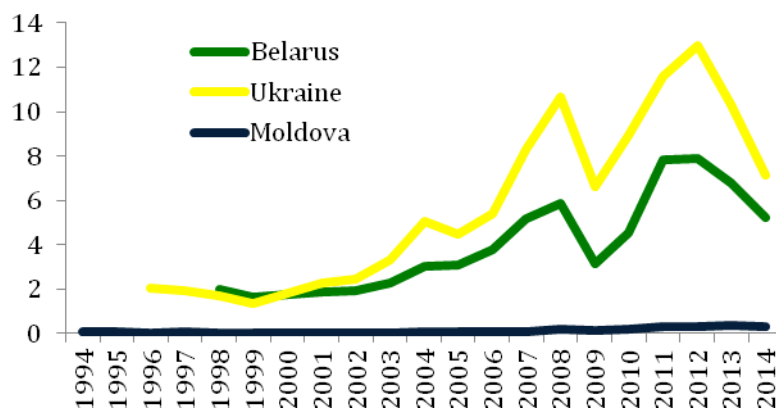
Figure 23. The share of machine building in the total exports of Belarus, Ukraine, and Moldova 1994-2014,%



Source: UN Comtrade Database (<http://comtrade.un.org/>)

In terms of absolute values, as of 2014 machinery exports in Belarus had grown two and a half-fold since 1998, while in Ukraine the corresponding figure is 3.5 times the value in 1996, and in Moldova it has grown five-fold as compared to 1994 (Figure 24, Table 14 in the statistical annex).

Figure 24. Exports of the machine building sector in Belarus, Ukraine, and Moldova 1994-2014, bn. USD



Source: UN Comtrade Database (<http://comtrade.un.org/>)

Belarus has maintained the lowest level of export diversification. Ukraine's dependence on Russia and the CIS has increased over the last years, while Moldova has substantially reduced the level of its Eastern machinery exports. Table 5 presents changes in the levels of export diversification over the last 15 years. It has changed only slightly in Belarus: in 1998, 86.4% of commodities produced by the machine building sector were sold in the CIS market, while 76.4% were exported to Russia. By 2013, export to the CIS market had increased to 90.6%, while during the same period the importance of the Russian market decreased by 3 p.p. (73.4%). In 1998 Moldova had the lowest level of export diversification (77.2% of its exports went to the CIS market). Nonetheless, by 2013 year this number has dropped significantly to 27.5%. The data indicate that Moldova's dependence on the Russian market has been relatively low (from 32.8% in 1998 to 21.3% in 2013). In Ukraine, the level of diversification of machinery exports to the CIS has slightly increased (61.2% to 62.8%), while dependence on the Russian market has increased by 8 p.p. (43.9% to 51.9%) since 1998.

Table 5. Export diversification in Belarus, Moldova, and Ukraine, 1998 and 2013

(HS Code)			Russian Federation	CIS + Ukraine+ Turkmenistan	World
Machine building sector	1998	Belarus	76.4	86.4	100
		Ukraine	43.9	61.2	100
		Moldova	32.8	77.2	100
	2013	Belarus	73.4	90.6	100
		Ukraine	51.9	62.8	100
		Moldova	21.3	27.5	100

Source: UN Comtrade Database (<http://comtrade.un.org/>)

According to Moody's report, Belarus, Ukraine, and Moldova are massively dependent on Russia as a result of a combination of factors, to wit export dependence, FDI dependence, and dependence on remittances. The risk map (Table 6) shows that Belarus' high level of dependence on Russia is explained by the huge share of its export going to Russia, while in the case of Moldova the high level of dependence on Russia is mostly explained by the high value of remittances. For Ukraine, it is explained by a combination of these factors.

Table 6. Risk map of dependence on Russia

Country	Degree of dependence on Russia	Export to GDP (2013),%	FDI to GDP (2013),%	Remittances (2013) to GDP, %
Belarus	25.2	23.5	1.2	0.6
Ukraine	10.6	8.4	0.3	1.9
Moldova	24.5	7.9	0.5	16.0

Source: Moody's (<https://www.moody.com/>)

	more than 10% GDP
	5-10% GDP
	less than 5% GDP

Box 8: V4 exports – value, main destinations, and experience with shifting the destination market from the former USSR to the EU/wider world

All V4 countries are currently economies in which foreign trade – mainly intra-EU trade – plays a pre-eminent role. This can be attributed to developments in the past two decades and is the result of the massive expansion of both, the exports and imports of V4 countries. The value of the region's exports of goods and services relative to their GDP has roughly doubled since 1993. In the case of the Czech Republic and Slovakia, this significant increase has been achieved despite a relatively high baseline value; even in the 1990s, exports accounted for about half of their GDP. Hungary, which, like Poland, had a lower level of exports relative to GDP in the 1990s, has been able to almost quadruple its exports of goods and services relative to GDP.

Figure: V4 Countries' Exports (Percentage of GDP)

Country/ Year	Czech Republic	Hungary	Poland	Slovakia
2015	74	82	40	86
1993	40	23	21	55

Source of data: CIA, The World Factbook

Decline in machinery production as a result of structural changes has caused a drop in the share of engineering products in the exports of V4 countries, mainly in the 1990s. Recently, the commodity structure of the merchandise trade of V4 countries has been dominated by trade in machine industry products and other processed industrial products.

Exports – main commodities (2012, CIA World Factbook and UNCTAD):

Czech Republic – machinery and transport equipment: 54.6%; fuels and chemicals 9%; raw materials 5%

Hungary – machinery and equipment: 53.5%; other manufacturing: 31.2%; food products: 8.7%; raw materials: 3.4%; fuels and electricity: 3.9%

Poland – machinery and transport equipment: 37.8%; intermediate manufactured goods: 23.7%; miscellaneous manufactured goods: 17.1%; food and live animals: 7.6%

Slovakia – vehicles and related parts: 27%; machinery and electrical equipment: 20%; nuclear reactors and furnaces: 12%; iron and steel 4%; mineral oils and fuels: 5%

After the collapse of the Eastern bloc, the trade ties of the V4 countries gradually shifted towards the West. The total export data for all transition countries without the former USSR show that while in 1989 40.4% of their exports went to other countries of the Eastern bloc (and 24.4% to the USSR) and 41.0% to the West, in 1999 it was just 18.8% to the former Soviet-led bloc (4.7% to the former USSR) and 75.5% to the West. Eurostat's calculation for 2002 show that the value of V4 machine industry product exports to Russia was only 4.51% of the value of V4 machine industry exports to the EU15.

The main export partners of the V4 include Germany, Austria, UK, France, Italy, and other EU markets. The German market serves both as a V4 final market and as a gateway to the outside world, as some V4 goods are only completed in Germany and are then relabeled as "Made in Germany" to be exported to non-EU markets. Of course there are significant mutual trade links between the countries of the V4 region. Even prior to their accession to the EU, the trade between V4 countries was substantial.

Belarus

Weak export diversification remains the key problem for the export of Belarusian machinery industry products. In fact, the situation has not changed much since Soviet times due to the fact that Belarusian machine building enterprises have been able to produce and sell low value added products and export them to Russia and other CIS countries [1]. Without institutional reforms and change in the country's geopolitical agenda, this share is expected to remain high on account of the fact that Belarusian machinery products are currently tariff free in Russia and the rest of the Eurasian Economic Union.

The Belarusian machine building industry is deeply integrated with Russia via a supply chain network and energy subsidies. With respect to the machine building sector, the economies of the two countries are highly integrated as much as 85% of the production volume is⁴¹

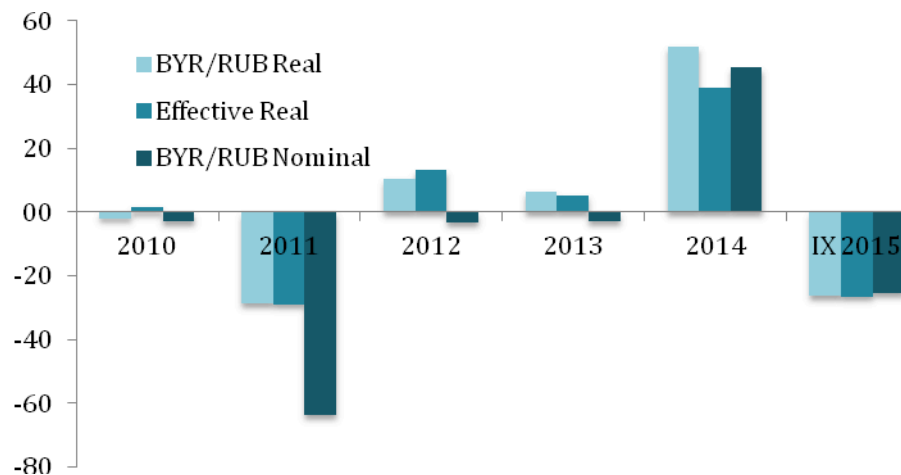
related in different forms to Russian counterparts [2]. Currently, about 800 Russian companies are in a manufacturing cooperation with Belarusian partners, which are based on a common history during Soviet times. Apart from historical links stemming from a common supply chain with Russia, an important channel of Russian influence over the Belarusian machine building sector is the privileged access to underpriced Russian energy supply. Energy-intensive Belarusian machinery giants receive the lowest gas price in the region, close to Russian domestic prices.¹⁰ Calculations have shown that the average level of Russian energy subsidies over the last two decades amounted to roughly 15% of Belarus' annual GDP [32]. However, it has been dropping over the last years.

The massive dependence of machinery exports on the Russian Federation has a negative impact on Belarusian machinery output, since any production or consumption slowdown in Russia is felt in Belarus. On the demand side, the Russian market is marked by high income elasticity of demand for quality equipment [1]. This explains why Belarusian machinery has lost market share in Russia, as the Belarusian machine building sector was not able to compete in terms of quality. In the heavy truck segment, Belarus' sales to Russia were stagnant for the second half of the 2000s, despite the fact that the Russian market for heavy trucks was growing at an average rate of 11% annually between 2000 and 2008 [1]. Demand for more sophisticated products in Russia has increased recently, fueled by imports of Western-made high quality products.

On the supply side, the competitiveness of Belarusian machinery products in Russia and worldwide remains highly dependent on the exchange rate of the national currency. Inefficient use of investments, excessive employment, and the low quality of goods make large machine building enterprises in Belarus dependent on price competitiveness achieved through the low exchange rate of their national currency. Over the last decade, the nominal exchange rate of the Belarusian ruble has been falling steadily, and the currency has undergone three significant devaluations over the last five years in 2009, 2011, and 2015 (see Figure 25 as an example for BYR/RUB exchange rate). However, in 2012-2014, the real exchange rate of the Belarusian ruble (both the real effective and the real rate for Russian ruble) has gone up (Figure 25). This has resulted in a reduction of the number of key machinery product items exported in recent years (Figures 26-27).

¹⁰ According to intergovernmental agreements between Belarus and the Russian Federation.

Figure 25. Changes in the exchange rate of the Belarusian ruble, 2010-2015, December/December ("-" devaluation, "+" appreciation), %



Source: National Bank of the Republic of Belarus (<http://www.nbrb.by/>)

The combined effect of changes in supply and demand has been a sharp decline in the market share of Belarusian machinery and transport in the total imports of Russia and other countries over the last years. For example, with a market share of 24% in 2010, Minsk Tractor Plant (MTZ) was the market leader in the Ukrainian tractor market. But after 2010 MTZ began to lose its leading position to its competitors John Deere and CASE [28]. Exports of lorries and tractors have been falling since 2013, indicating that there has been a significant decline in the competitiveness of the industry (Figures 26-27).

Figure 26. Change in the export of tractors by Belarus, 2010-2015, (y/y), %

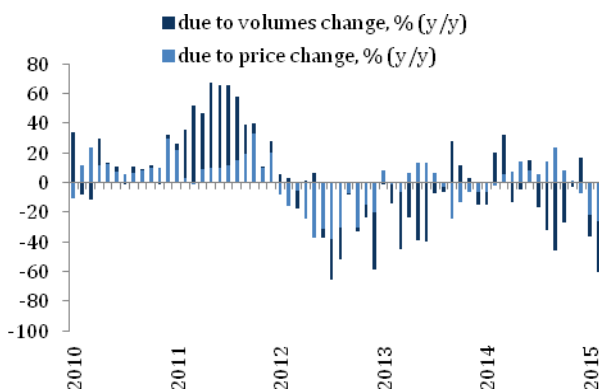
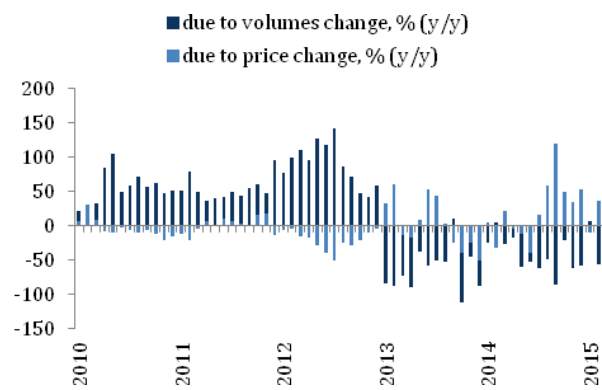


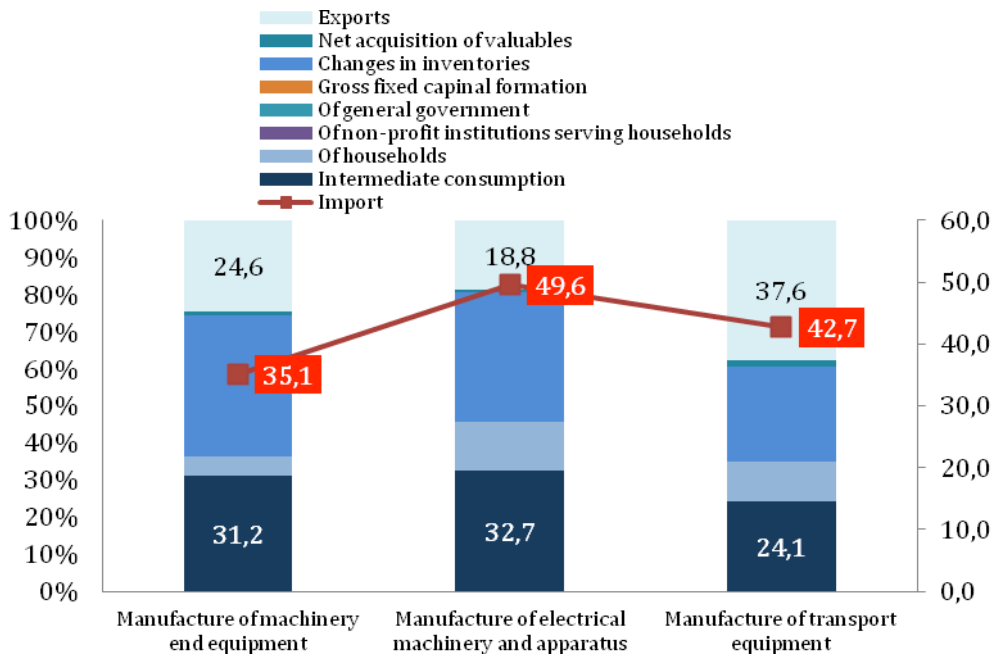
Figure 27. Change in the export of lorries by Belarus, 2010-2015, (y/y), %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

The high level of imported components is another problem for the Belarusian machine building sector, rendering it even more vulnerable. On average, roughly 40% of the supplies needed by the machine building sector stem from imports, both from the West and from the CIS (final and intermediate, Figure 28). Import components have the highest share in the manufacture of electrical machinery and apparatus.

Figure 28. Added value of the machine building sector by method of final use in Belarus, 2013,%



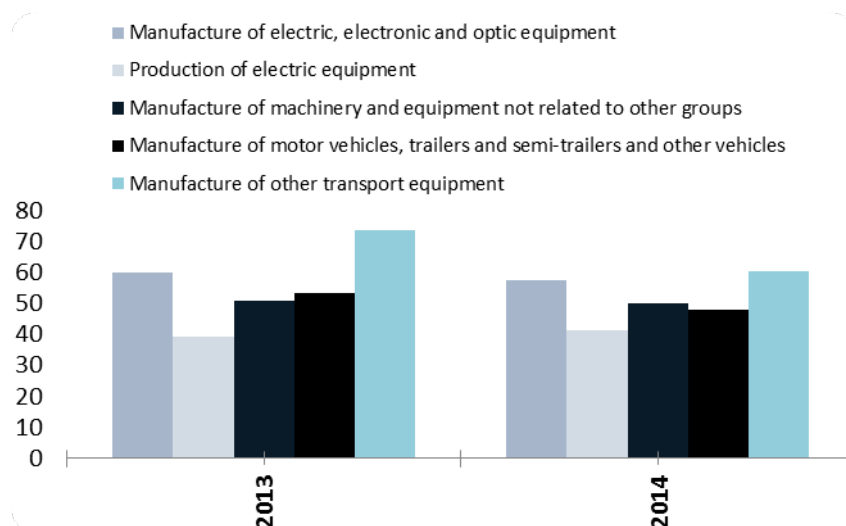
Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Low export diversification, the relatively low quality of products, and problems with external demand caused Belarus' machinery and equipment sector to lose export market share. The high ratio of imported components increases the external risks for domestic producers. The weight of the Russia factor has practically not changed over the last two decades. The Russian Federation remains the main importer of Belarusian products and the supplier of its energy needs at a relatively low price.

Ukraine

In Ukraine, the key export machinery products are railway cars, locomotives, turbines, and engines [29]. A significant portion of exports goes to the CEE, the Middle East, Africa, China, and India. Figure 29 shows that 40% to 50% of new orders are foreign orders, but in 2014 this share has slightly decreased. At the same time the capacities of some enterprises were fully tied up by foreign orders. But only few players sell machines globally [29].

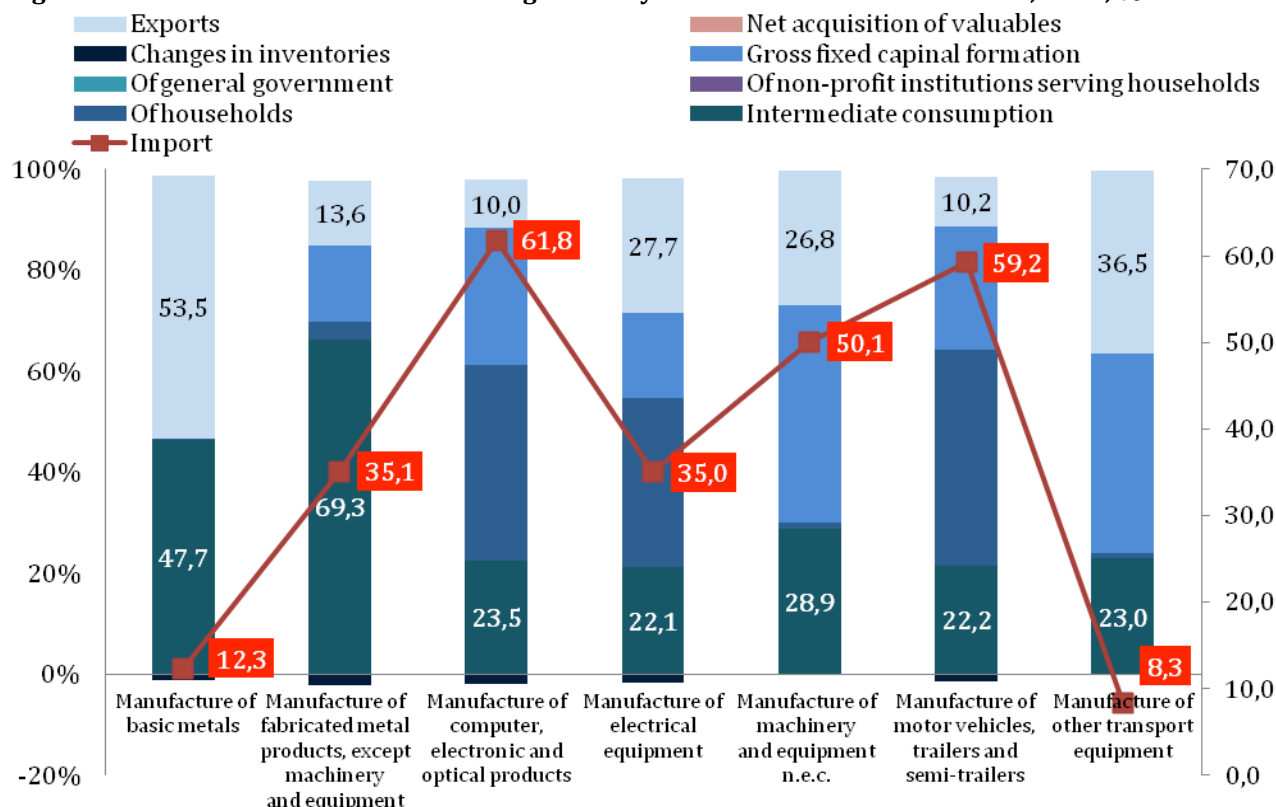
Figure 29. The share of foreign orders as a percentage of the total volume of new orders in Ukraine, 2013-2014,%



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>).

The "Input-Output" table shows that in terms of supplies, the most import-dependent subsectors are manufacture of computer, electronic, and optical products (61.8% of supplies are imported) and manufacture of motor vehicles, trailers, and semi-trailers (59.2% of supplies are imported). Manufacture of other transport equipment (8.3%) is least dependent on imports in covering its supplies. More than 36% of the output of this subsector is exported.

Figure 30. Added value of machine building sector by method of final use in Ukraine, 2013, %



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Following the country's WTO accession in 2008, import duties on Ukrainian products, including machinery products, were reduced by the member countries of the WTO to the level extended to most favorable nations (MFN). However, the expected export boom has not

materialized yet [46]. Trade liberalization has led to increased competition in the Ukrainian internal market and has also laid bare the low international competitiveness of Ukrainian products. Apparently, the Ukrainian trade balance has experienced fast growth over the past decade. Besides, the year of Ukraine's accession to the WTO coincided with the global crisis, which was followed by a domestic political and economic crisis in 2014-2015. These developments make it impossible to adequately assess the consequences of WTO accession for machinery and the economy in general.

Despite the fact that the exports of the Ukrainian machine building sector are more diversified than those of the corresponding Belarusian subsector, the Russian factor is still crucial in Ukraine, too, specially if one takes into account the current situation in Eastern Ukraine and the political tensions with Russia. Before the collapse of the Soviet Union, exports of machinery and equipment from Ukraine to Russia were 2.7 times higher than exports from Belarus. In 1999, the value of Belarusian exports to Russia was twice as high as the value of Ukrainian exports. However, since 2000 the gap has been gradually shrinking [23].

The total share of machine building sector output exported to Russia decreased by 7 p.p. from 51.9% in 2013 to 44.3% in 2014 (Table 7). Ukraine mostly sent commodities from two sections to Russia: 86 (railway or tramway locomotives, rolling stock, track fixtures and fittings, signals) and 84 (nuclear reactors, boilers, machinery and mechanical appliances, computers).

Table 7. Ukrainian exports to Russia

(HS Code)		Russian Federation	World
84	2013	57.9	100
	2014	56.4	100
85	2013	35.1	100
	2014	25.1	100
86	2013	70.8	100
	2014	71.7	100
87	2013	51.1	100
	2014	44.0	100
88	2013	14.5	100
	2014	29.4	100
89	2013	25.2	100
	2014	4.6	100
Machine building sector	2013	51.9	100
	2014	44.3	100

Source: UN Comtrade Database (<http://comtrade.un.org/>)

The significance of the Russian market largely stems from the historical economic ties between the two countries. Good knowledge of trade partners, shared production standards, and customized products usually make such long-standing trade relations mutually beneficial, and it is thus sensible for both parties to maintain these ties. At the micro-level of subsectors and enterprises, the Russian factor is sometimes crucial. For example, 62% of Ukrainian heavy

machine building exports go to Russia. Prior to the Ukrainian-Russian conflict, the Luganskteplovoz company used to sell around 94% of its locomotives to Russia, while less than 1% went to Kazakhstan and roughly 5% to other countries [29].

A possible loss of access to the Russian market would hit the sector hard, as export diversification and productivity are low in most subsectors. A relevant calculation suggests that a complete loss of machine building exports to Russia would directly reduce Ukrainian GDP by 1.1% compared to the baseline of 2012 [7]. Most imports from Ukraine will be readily replaceable by imports from other countries or domestic Russian production, although possibly at higher prices.

To summarize, despite the fact that some leading players have been negotiating export deliveries to new markets in Asia and Africa, which will increase the geographical diversification of sales and boost long-term growth, the level of diversification in Ukraine's machinery exports continues to remain relatively low. Taking into account the high share of Russia in the export of machinery products, the fact that a significant part of Ukraine's machinery is located in Eastern Ukraine, as well as the current political and economic tensions between Ukraine and Russia, the Russian factor appears to have emerged as the most crucial problem for Ukraine in the coming years.

Moldova

Moldovan machinery exports stagnated during the first decade of post-Soviet independence (1991-2001), but over the last ten years exports grew five-fold, reaching a record high in the country's history. Export data confirms that ownership changes in the machinery sector in Moldova in the 1990s paved the way for the subsequent expansion of exports. There are clearly two different trends in machinery export development: stagnation in the 1990s and early 2000s, and fast growth since 2003. The new ownership structure and the promotion of free economic zones [12] allowed for especially rapid growth in 2008 (63%). Poor external conditions interrupted growth in 2009, but the slump was followed by even faster growth in 2011 (74%). Despite the global crisis of 2008-2009, the share of Moldovan machinery in total exports kept increasing over that period, indicating that machinery products enjoyed a relatively strong position among all export items.

WTO accession in 2001 also contributed to the growth of Moldovan exports. Moldova joined the WTO on the terms that apply to a developed country, with a transitional period of just four years. To do that, the Moldovan government almost fully opened the country's market. In addition, Moldova joined most of the optional sectoral initiatives, with the exception of the initiatives relating to alcohol. Joining the WTO led to an increasing import dependence of the Moldovan economy, but over the years of WTO membership total foreign trade has grown five-fold [46].

Moldova has made significant improvements in machinery export diversification. Back in 1998, Moldova used to have a low level of export diversification (77.2% of its exports went to the CIS market). By 2013, CIS dependence had dropped to 27.5%. The country's dependence

on the Russian market, specifically, is also relatively low: 21.3% of Moldovan machine building exports were sold to Russia in 2013 (down from 32.8% in 1998).

However, the role of the Russian factor in Moldova merits a discussion with regard to the issue of ownership. Russian or Russia-related businesses own substantial stakes in enterprises in the metallurgy and machine building sectors on the both sides of the Dniester River, with an especially major impact on the left bank of the river [11]. Russia tops the list of countries that have FDI stock in Moldova, and Russians are also the top investors in each sector of the economy except for banking. The total stock of Russian investment exceeds \$200 million [47]. Nevertheless, the share of CIS countries in the total stock of equity capital FDI drops to 11.2%, far behind the EU countries' 52.1% share [47]. Earlier acquisitions of privatized Moldovan state enterprise by Russian investors resulted in limited technology transfer and know-how for specific industrial companies. Some companies went bankrupt and others are struggling to survive by investing their own capital into modernizing their businesses and looking for market diversification. In recent years, ca. 35% of the exports of Moldova's troubled Eastern rayons – the Transnistria region – were oriented towards the EU, while 40% went to Moldova and 15% to the Russian Federation [55].

Box 9: Export growth of the machine industry in the Czech Republic

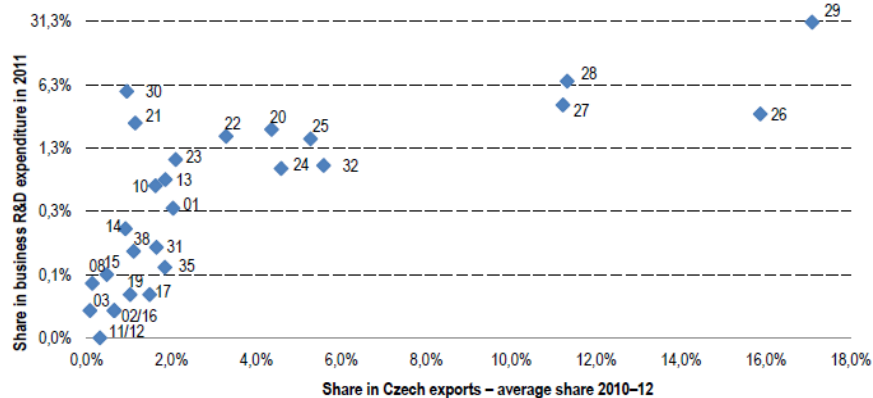
Export specialization of the Czech Republic

Table: SITC 2 classes with the highest share in Czech exports		Share of Czech exports (%)	
Export item		2002-2004	2011-2013
Code	Title		
78	Road vehicles	15.53	17.75
77	Electrical machinery, apparatus & appliances n.e.s.	10.20	9.31
75	Office machines & automatic data processing equip.	5.79	7.42
74	General industrial machinery & equipment, and parts	6.61	6.82
76	Telecommunications & sound recording apparatus	3.65	5.52
89	Manufactures of metal, n.e.s.	5.58	4.85
69	Miscellaneous manufactured articles, n.e.s.	4.20	4.82
67	Iron and steel	4.34	3.52
71	Power generating machinery and equipment	3.03	2.92
62	Rubber manufactures, n.e.s.	3.16	2.46
72	Machinery specialized for particular industries	2.29	2.37
82	Furniture and parts thereof	2.51	1.61
35	Electric current	0.66	1.48

Source: RIS3 – Czech Republic (2014).

The main drivers of Czech exports are the (i) automotive (SITC 78), (ii) electrical engineering and electronics (SITC 75, 76, and 77), and (iii) mechanical engineering (SITC 71, 72, and 74) industries. Items within the metal-working industry (SITC 69) and metallurgical industry (SITC 67) also have a significant share of exports. The extent and export power of the latter two industrial areas provides a strong background for the mechanical engineering, automotive, and electrical engineering industries. Especially the automotive industry – as a sophisticated customer – increases the transnational competitiveness of these traditional industrial areas, which also control a large share of employment. As a result, the dominant automotive, electrical engineering and mechanical engineering industries represent – to a large extent – the drivers of the internal restructuring of other traditional industrial areas. At the same time, they support exports from related areas, e.g. SITC 62 "Rubber manufactures, n.e.s.", which is largely the result of the high concentration of tire manufacturers (not only for vehicles).

Chart: NACE sections by their share in Czech exports and business R&D expenditure, 2010-2012



Source: RIS3 – Czech Republic (2014).

The Chart confirms the dominant role in exports of the automotive (NACE 29), electronics (NACE 26), mechanical engineering (NACE 28), and electrical engineering (NACE 27) industries. With respect to its share of business R&D expenditure, the automotive industry dominates the domestic economy, accounting for about one-third (30.6%) of R&D expenditure in the corporate sector. On the other hand, this position is largely attributable to Škoda Auto a.s., the biggest Czech exporter, which significantly contributes to total R&D spending. It is followed by mechanical engineering with a 7% share in business R&D expenditure, and manufacture of other transport equipment (5.3%). The combined share of the electrical engineering and electronics industries in business R&D expenditure amounts to 6.7%.

Investments in the machine building industry

The data illustrate different trends in total machinery investments between 2000-2013 (Figures 31-33). There is the downward trend of machinery investments in Belarus, an upward trend in Moldova machinery investments, and a rather fluctuating trend in the volume of investments going into the machine building sector in Ukraine.

Comparing the respective shares of machinery in manufacturing industry output and in investments, there is evidence of underinvestment in the machine building sectors of Belarus and Ukraine, while there are intense machinery investments in Moldova. In the case of Belarus, the gap between investment and output share has been increasing, which indicates that more investments are needed to maintain the high share of machinery in industrial production overall. In Ukraine, the gap has vanished in 2012–2013, which could be related to increased investment intensity after signing long-term contracts with the good export markets of Russia and Kazakhstan [29]. Investment intensity is much higher in Moldova, which goes a long way towards explaining growth in Moldovan machinery output and exports.

Figure 31. Investment in and output of the machine building sector relative to total manufacturing industry in Belarus, 2000-2013, %

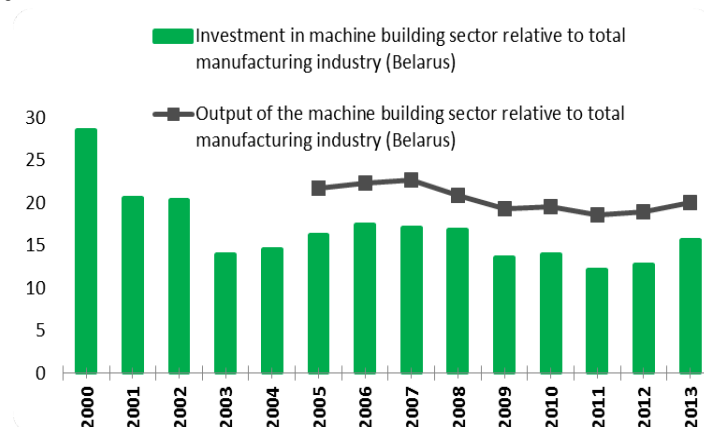
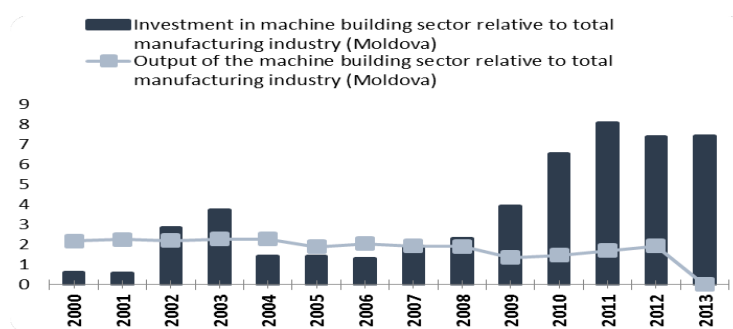


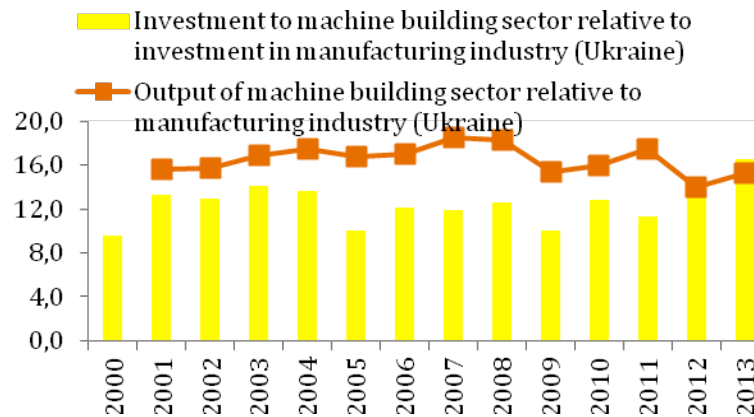
Figure 32. Investment in and output of the machine building sector relative to total manufacturing industry in Moldova, 2000-2013, %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

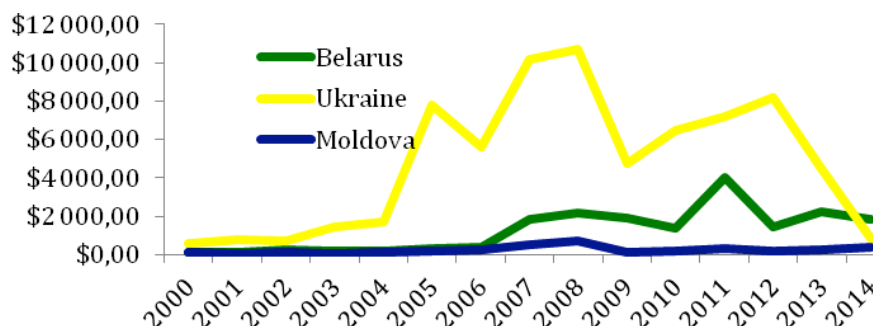
Figure 33. Investment in and output of the machine building sector relative to the values of the entire manufacturing industry in Ukraine, 2000-2013, %



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Foreign direct investment (FDI) intensity evolved differently over time in Belarus, Ukraine, and Moldova (Figure 34). In transition countries, FDI is perceived as an important source for accumulating assets (physical, organizational, market access) and capabilities. In post-Soviet countries, the level of domestic savings and investments is rather low and insufficient for stable economic growth, that is why the importance of attracting FDI increases [27]. As the biggest economy among the three countries, Ukraine has been attracting the highest amount of FDI, especially between 2005-2013. However, an economic downturn and an unstable political situation have caused FDI inflows to drop dramatically in 2014. The intensity of foreign investments in Belarus started to grow in 2007, spurred by major privatization deals with Russia.¹¹ FDI inflow in Moldova was seriously affected by the global economic and financial crisis in 2009, but a recovery took place between 2010-2014. However, in terms of the size of FDI stock relative to GDP, in 2014 Ukraine and Moldova attained ratios of 48% and 44% of GDP, respectively, while Belarus' ratio only stood at 23%.

Figure 34. FDI inflows in Belarus, Ukraine, and Moldova, 2000-2014, m USD



Source: World Bank's World Development Indicators

¹¹ First of all, Belarus sold its gas transmission pipeline system to the Russian Gazprom corporation for \$5 billion between 2007-2011.

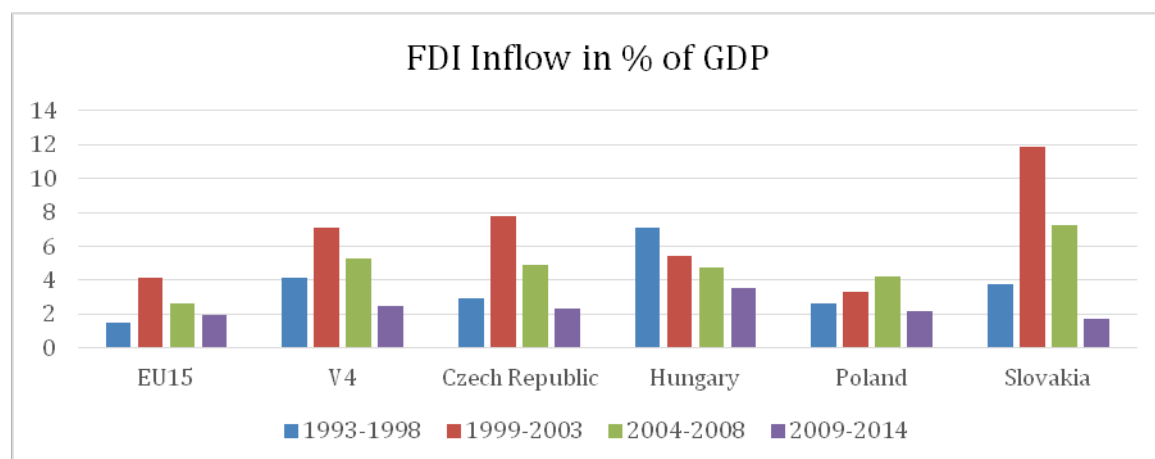
The role of FDI in the development of the machinery sectors differs in these three countries. Integration into multinational value chains, which leads to higher investment intensity and improved modernization processes, only seems to be prominently present in Moldova, it is less frequent in Ukraine and Belarus. Previous empirical studies have shown that in the manufacturing sectors of the economy, firms with foreign capital perform better in the region than domestic companies [see 51, 52, 53]. Based on national statistics and case studies, machinery remains an important destination sector for FDI in all three countries, as it generates substantial export flows. However, only in Moldova are investments in the machine building sector associated with large and sustainable greenfields and substantial equity flows from multinational companies.

As a result, investments seem to influence innovation capacities differently in these three countries. In Belarus and Ukraine, investment effectiveness is affected by low levels of capacity utilization, reduced productivity, a high share of imported machinery aggregates, and a high degree of dependence on the Russian Federation. In Moldova, higher investment activity in machinery enhances the development of knowledge-based subsectors, like electrical machinery manufacture. As Moldova offers one of the lowest labor rates, investment in electrical machinery manufacture is expected to grow further, also taking into account the new projects that have been announced. However, each country should be reviewed in detail to examine the specifics of investment effectiveness.

Box 10: The role of FDI in the V4 machine industry

Prior to the EU accession of the V4 countries, the level of FDI inflow and FDI stock in these countries hinged on their ability to create a stable, favorable, and encouraging environment for foreign investors, on the promptness of economic reforms as well as the speed with which individual V4 countries complied during the pre-accession period with the requirement of openness to international capital movements. Under Article 56 of the Treaty on European Union, there was a timetable for the gradual liberalization of capital flows, which was drafted and applied separately in each of the V4 countries. While the Czech Republic had begun de-regulating capital transactions as early as 1995, Hungary, Poland, and Slovakia were liberalizing capital flows gradually, practically until their EU accession. Another accelerating factor with regard to the de-regulation of capital were the V4 countries' efforts to become members of the OECD. The approach that these states took to privatizing state assets during the transition period also played a decisive role in influencing volumes of FDI inflow. Thus, while Hungary implemented privatization by directly selling assets to foreign investors, Slovakia in the 1990s preferred to leave former state enterprises in the hands of domestic owners. Nevertheless, FDI inflows received a major boost by the inclusion of the V4 countries in the group of states that acceded to the EU in 2004. In the context of V4 countries overall, the highest levels of FDI inflow occurred in the final years of the pre-accession period (1999-2003), mainly due to the massive increase of FDI in Slovakia and the Czech Republic. After 2009 there was a considerable drop in FDI inflow in all V4 countries (1.7-fold decline on average) – Slovakia experienced the steepest drop (a factor of 3.2), while Hungary was subjected to the mildest (a factor of 1.2).

Figure: FDI Inflow in V4 Countries (Percentage of GDP)



Source: FDI Statistics Database, UNCTAD

The relocation of industries (not only) from old EU members to the newly accepted member states was most striking in the case of the automotive industry, which emerged as a dominant industry in the V4 countries. In the early 1990s, the existing automotive industry capacities in the Czech Republic, Slovakia, and Poland were privatized and acquired by Volkswagen and Fiat. Hungary became a popular greenfield investment destination in the mid 1990s. During the late 1990s and early 2000s, FDI inflow in the automotive industry was dominated by greenfield investments, while investment incentives played an ever increasing role as the offers of mutually competing V4 states were usually similar. Approximately 75% of V4 automotive assembly plants and suppliers are now located within a 200km radius centered on the border between the Czech Republic, Slovakia, and Poland.

Belarus

In Belarus, a significant share of machinery investments come from state-directed lending programs. The Belarusian authorities have actively relied on a variety of state programs and measures for developing priority sectors in the economy, and this effort included the machinery sector, which has plenty of major state-owned enterprises. Most of the programs⁵³ have been sustained by credit from state-owned commercial banks. Lending involves a

combination of various types of public sector subsidies, such as earmarked funding provided by the public sector to commercial banks, subsidized interest rates, and government guarantees [48]. There are also direct subsidies for particular projects or individual companies.

Directed lending programs hamper the efficient use of capital in the targeted sectors and negatively influence management practices in participating state-owned enterprises (SOEs). Large-scale lending at below-market rates promotes inefficiency and the misallocation of resources in the economy [48]. Misallocation often leads to reduced investment efficiency. Directed lending programs with subsidized interest rates do not create incentives for the managers of SOEs to ensure the efficient allocation of capital to the most profitable projects, and in fact they erode the culture of investment. Directed lending programs have also interfered with the development of a sound risk management culture, precluding the proper pricing and efficient allocation of money in accordance with risk.

FDI flowing into Belarus' machinery could positively affect the sector due to new technologies, new markets, and improvements in strategic management and operations. However, the positive impact of FDI emerges slowly, if at all. The presence of foreign capital in the Belarusian machine building industry is rather limited because the sector is mostly composed of large state-owned enterprises and holdings. Foreign investment in the industry predominantly manifests itself in the creation of joint enterprises with Belarusian companies¹² and only rarely in the form of greenfields.¹³ Privatization of state machine building enterprises is also a rare occurrence [39].

However, studies find that FDI has a positive impact on machine building industry output in Belarus. The reason is that this mostly export-oriented sector forces producers and investors to spend some of their assets on renovation in order to remain competitive [27]. This calls for launching a new modernization policy for the machine building sector in Belarus, which would combine restructuring with a partial sell-off of machine building SOEs to foreign investors. In any case, the role of foreign direct investments in the Belarusian economy is one of the burning issues nowadays.

Ukraine

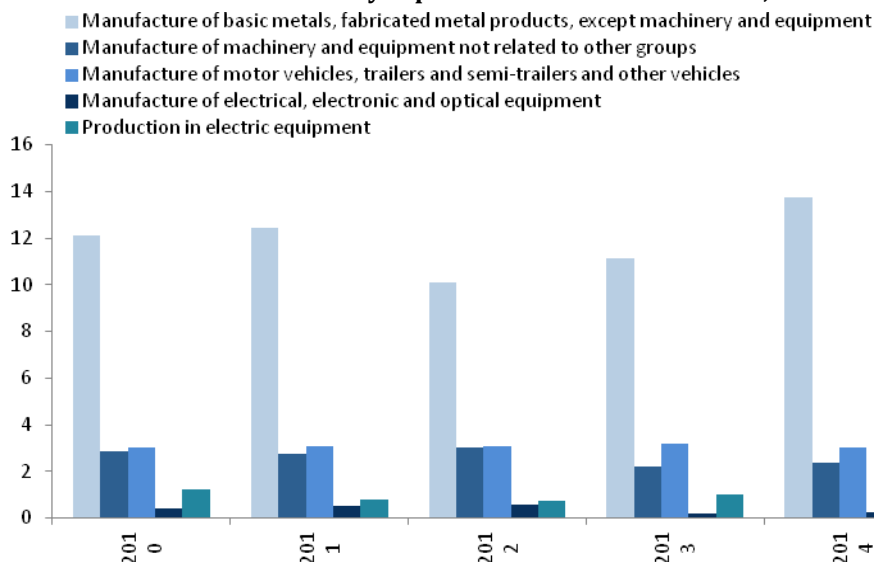
There is evidence that investments in Ukrainian industry are primarily flowing into resource-intensive industries, like metallurgy (Figure 35). The amount of investments flowing into the basic and fabricated metals industry exceeds the investments received by machine building subsectors by several orders of magnitude. In machinery, the highest share of investments goes to vehicle production companies. The subsector "production of machinery and

¹² For instance, Minsk automobile plant (MAZ) has a joint venture with the German truck producer MAN.

¹³ The latest example is "Stadtler Belarus": Initially, there was a joint venture between Stadtler Rail AG (60% share) and Bekommunmash Holding (40% share) to build a brand new facility for producing railway vehicles worth \$50 million. Two years later, Stadtler Rail AG performed a buyout of the company for about \$10 million.

equipment, not related to other groups," which includes companies in heavy machine building, railway machine building, as well as agricultural machine building, holds the second place. Manufacture of knowledge-intensive products like electronic, optic, and electric equipment are relatively insignificant in terms of investment flows.

Figure 35. The share of subsectors in industry capital investments in Ukraine, 2010-2014, %



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

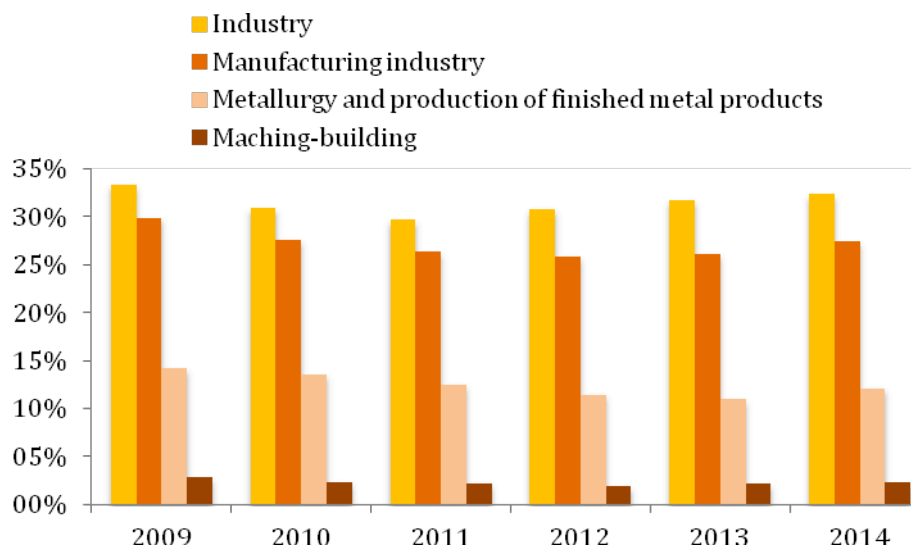
One possible explanation for underinvestment in machinery may be related to the weak culture of corporate governance in the country's industry, which stems from certain specific aspects of the transition process. Leading market players are mainly controlled by local and Russian business groups, while only a few companies are state-owned [29]. As Andrey Movchan, Director of the Economic Policy Program of Carnegie Moscow argues,¹⁴ Russian-style corporate development relies on a strategy of "cash-flow" maximization rather than "equity" development. Even though the shares of some Ukrainian machinery giants such as Kryukiv Car, Stahanov Car, Luhanskteplovoz, and Motor Sich are actively traded on the national stock exchange, corporate development may take years and needs stimuli to achieve change.

FDI statistics also show that machinery remains relatively underinvested in Ukraine, as it attracts roughly 7% of all industry investments. Compared to metallurgy and manufacturing of fabricated metals, machine building is 5.5 times less likely to receive foreign investment. In terms of the distribution of FDI stocks among manufacturing sectors, machine building ranks only fourth (metallurgy dominates, followed by food, beverages, and tobacco; oil processing, chemicals, rubber, and plastics). This makes Ukraine a special case with respect to the distribution of FDI when compared to the sectoral structure in other Eastern European countries, since Ukraine has attracted comparatively less FDI into export-oriented industries.

For further details see <http://carnegie.ru/commentary/experts/?fa=1057>

In particular, the main targets of FDI in Ukraine are not machine building and the chemical industry (which are the most important subsectors in both Poland and Romania) but metallurgy and food processing. Finally, the high share of FDI in the Ukrainian financial sector means that shareholder loans account for about 14% of the total reported FDI stock [54]. As a result, the share of machinery in total FDI stock has diminished from 2.8% in 2009 to 2.2% in 2014 (Figure 36).

Figure 36. FDI (paid in capital) in Ukraine, shares in total FDI stock, 2009-2014,%



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

The main sources of FDI flowing into Ukraine are Cyprus (30% of total stock), Germany (16.6%), the Netherlands (10%), the Russian Federation (6%), Austria (5.5%), and Great Britain (4.7%). In industry, the most active investors are from Germany (\$5 billion), Cyprus (\$3.3 billion), and the Netherlands (\$1.9 billion). In machinery, foreign interest is manifest in both greenfields and brownfields. For example, investments in machine building for agriculture take the forms of new plants, purchases of company shares, and debt financing [29]. However, the pre-dominant position of Cyprus as a source of FDI raises doubts about the quality and actual origin of such investments. First, Cyprus-based investment inflows are often linked to Russian or local oligarchs or their businesses, and are quite often the results of tax evasion or tax avoidance. Second, as experts from the German Advisory Group in Ukraine believe, FDI originating from Cyprus points to the presence of "round-tripping" funds that were previously withdrawn from Ukraine (or perhaps other CIS countries, e.g. Russia), and are now channeled to Ukraine via Cyprus. The presence of "round tripping" is also supported by a glance at Ukraine's outward FDI stock, where Cyprus commands an impressive share of 92%¹⁵ [54].

¹⁵ Of course, Cypriot FDI in Ukraine and Ukrainian FDI in Cyprus are not comparable in absolute terms, as the latter is much lower since most outflows are probably not officially recorded.

The underinvestment in Ukraine's machinery explains the intense depreciation rate of fixed assets, which equals about 70%. Underinvestment also leads to the slow adoption of contemporary technologies and to lagging modernization in the fixed assets of machine building companies. Taking into account output decline and low export diversification, the modernization prospects of Ukraine's machine building sector are uncertain at best.

Moldova

Foreign investments in Moldova were directed into the financial, wholesale and retail, manufacturing industry, energy, transport, and communication sectors. FDI intensity has contributed to changes in the structure of the Moldovan economy [33]. According to data provided by the National Bank of Moldova, as of mid-2015 manufacturing industry accounted for 22.3% of FDI stock in Moldova. The top five investing countries (not counting investments in the financial sector) are Russia, the Netherlands, Italy, the US, and Cyprus. WTO accession had a positive impact on FDI flows. Statistical data on foreign direct investment shows significant growth: FDI increased seven-fold between 2002 and 2008 [46].

Free economic zones (FEZs) and industrial parks have emerged as major factors in attracting investment to Moldova. There are currently seven free economic zones and six industrial parks in Moldova. By the end of 2013, total investment into FEZs amounted to roughly \$200 million [12]. Large industrial investors include Draexlmaier (Germany, wire harnesses), the Lear Corporation (USA, automotive seating, car seat covers), Gebauer&Griller (Austria, wires and cables), Euro Yarns (Belgium, synthetic fibers), LaTrivinetaCavi (Italy, wires and cables), Ceccato Production, and Eastsord Production (both from Italy, machinery-building components). FEZs employ about 7,000 people in total [12]. Since 2010, industrial parks are being actively developed as instruments to promote export and industrial potential. Nevertheless, thus far industrial parks have registered less investment activity by international companies than FEZs.

Reinvestments have become an important source of innovation. According to the Moldovan Statistical Office, investments in fixed assets are relatively high in the manufacture of electrical machinery and apparatus subsector, where foreign investors tend to be very active.

FDI in Moldova appears to force changes in the ownership structure of Moldovan industry and mitigates the impact of the Russian factor, since Russian businesses control several strategic enterprises in the metallurgy and machine building subsectors [11]. The share of active Russian businesses has been decreasing, especially since the signing of the Association Agreement between the EU and Moldova in 2014. Apart from the electrical machinery and apparatus subsector, machine building also registers increasing investments and outsourcing opportunities from EU companies. FDI into the Moldovan machine building sector seems to have paved a definite path for the country's inclusion into global value chains.

Box 11: "The FDI battle" – the case of the Jaguar Land Rover investment in Slovakia

In 2015 Jaguar Land Rover decided to invest £1.1 billion (ca. €1.4 billion) into a new car factory in Nitra, Slovakia. The company will create 2,800 jobs – directly. The first cars will be produced in 2018, and in the first phase the plant is expected to produce 150,000 vehicles. It will produce lightweight luxury vehicles; the British media have speculated that the product manufactured will be the next generation Land Rover. The contract between Jaguar Land Rover and the Slovakian Government was signed on December 11, 2015. It is the largest investment in Europe in the last seven years.

The company had performed analyses of several possible factory sites in Europe, the United States, and Mexico in 2014. In early 2015 the shortlist included Mexico, Poland, and Slovakia. Official talks with Slovakia commenced in February 2015. The final "battle" was between Poland and Slovakia, and in August 2015 unofficial sources claimed that Slovakia had come out on top.

Poland opposed the Slovakian policy of offering massive state incentives for investment and refused to continue to compete with Slovakia in that regard. The Slovakian government approved a subsidy to the tune of €130 million for tangible and intangible assets provided by the carmaker. The subsidy amounts to 9% of the total investment volume. This amount is also the ceiling that the Slovakian government can offer investors as an investment incentive for the particular region and type of investment. The Act on the Rules for Investment Incentives and State Aid rules, which has been approved by the European Commission, specifies the maximum level of aid that may be allotted to investments in each region. For Western Slovakia and the Nitra area, the maximum level of state aid cannot exceed 25% of the investment value. However, if the total investment volume exceeds €50 million, then the level of subsidies that may be awarded must be reduced based on a formula set by the European Commission. Furthermore, in the case of the Nitra site the Slovak government also cannot grant a contribution to the creation of new jobs. It may only grant a tax relief or offer the investor state or municipal property at a discounted price.

It must also be added, however, that the amount of public funds to support this project will exceed the currently set amount. Thus the state will perform road construction to connect the industrial site to the R1 expressway, which is estimated to cost about €10 million.

But Jaguar Land Rover's final decision was not only based on government subsidies. Though the average hourly wage in Polish industry is 8.50 euros, while in Slovakia it is 10 euros, the latter is still only half of the expected labor costs in the UK. Moreover, Slovakia is also a member of the Euro Zone, which eliminates risks stemming from currency exchange. The official announcement of the car-company also referred to a strong network of suppliers and good logistics infrastructure. CEO Mr. Ralf Dieter Speth said that "Slovakia is well established in the automotive market and has a good reputation globally for high-quality production."

Human capital in machinery

In Belarus, Moldova, and Ukraine there has been a trend of continuous reductions in the number of employees in the machine building sector, even as the respective industries remain among the largest employers in these economies. This suggests that the period of transition from more labor-intensive and technologically simpler products to more advanced products is still ongoing in all the three countries. Such a transition also requires intensive investments into human capital, since a skilled labor force is a key factor in machinery development and in productivity gains. Investment in human capital is one of the components of a successful transition to the production of higher value-added machinery.

Among the key assets of Belarus, Ukraine, and Moldova are the skilled labor force and the high level of technical education in these countries. In Belarus there are universities and colleges for training the specialists needed in the machine building sector. The Belarusian National Technical University is one of the largest and most famous. According to the industry overview posted on the website of the Italian Industrial Chamber of Commerce in Ukraine,⁵⁸ one of advantages of the Ukrainian machine building sector is its qualified labor force.

About 10,000 students graduate each year from machine building-related departments of Ukrainian universities and colleges [29]. There are many universities where students receive the education they need for working in the machine building industry. The following occupy leading positions among the country's technical institutions: the Taras Shevchenko National University of Kyiv, the National Technical University of Ukraine, also known as the "Kyiv Polytechnic Institute", the Donetsk National Technical University and the National Technical University of Ukraine, also known as the "Lviv Polytechnic Institute" [29]. Moldova maintains a strong industrial emphasis in its system of higher education (e.g. the Technical University of Moldova in Chisinau, polytechnic, technical and technology colleges in Chisinau and Balti, as well as vocational schools). In 2013 the Balti State University Alecu Russo launched a training program in partnership with Draexlmaier, which specializes on "Engineering and management in automobile construction." In partnership with Galati University (also known as "Dunarea de Jos"), Cahul State University trains students in specialized technical fields. Technical education continuously improves by adapting the curricula and fields of specialization[31].

Box 12: Using the university's R&D potential for business (ideas to market)

Case study: the **University of Žilina** (UNIZA) and the **CEIT Group**, Žilna, Slovakia

The history of the University of Žilina (UNIZA) began on September 1, 1953, when the University of Railway Transport was founded by slicing off a division from the Czech Technical University in Prague. Currently it has approximately 9,000 students who are studying at one of seven faculties: Faculty of Operation and Economics of Transport and Communications, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Civil Engineering, Faculty of Management Science & Informatics, Faculty of Special Engineering, and Faculty of Humanities.

In 1997 the University established the Slovak Productivity Center jointly with the Ministry of Economy and the Federation of Employers' Associations of Slovakia. The Center specializes on research in the area of lean manufacturing and digital enterprise. The year 2005 saw the creation of the first spin-off, SLCP Consulting, Ltd. The company focuses on the processes of innovation, education, and improving business processes. The second spin-off, CEIT SK, Ltd. was created in 2007 and focuses on product and technological innovation. Another special spin-off, CEIT-KE, Ltd., was created in 2010, with a focus on biomedicine. In 2011, the CEIT Group was created with a main focus on these areas:

- Process innovation - optimizing the workplace and increase its efficiency, improve processes in terms of production, logistics, and enterprise systems;
- Technical innovations - from design concept to production of the first series of products, workplace design and technological units, including verification and optimization based on simulation;
- Digital Factory - provide space to optimize workplaces, processes, and systems already in the stage of their development - in the digital environment without the existence of a real system or intervention in the real system;
- Industrial automation - designing and modeling the flexible, reliable, and economic production of cells, workplaces, and operations. Implementation of industrial automation and robotics in factories.
- Biomedical Engineering - research into new diagnostic methods in invasive implantology. Providing design, production, and diagnostics implants - particularly in the head area and the maxillo-facial region. They specialize in research on implant materials, solutions, and sophisticated computer analysis of the dimensional and mechanical properties, the proposal for a new methodology for the production of implants in terms of clinical applications.

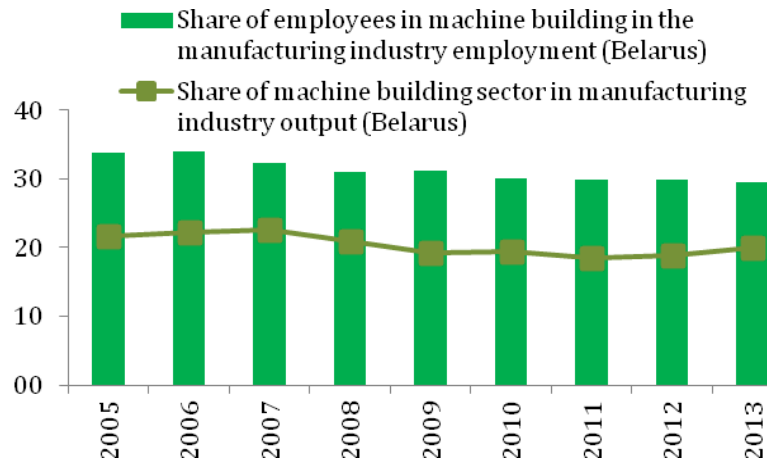
CEIT and UNIZA are not just using joint human capital for their joint research, but also have several joint laboratories, combining private and public resources for research and production. In 2015 CEIT Technical Innovation, another spin-off established in 2013, was estimated to be the 261st fastest growing technological company in the Europe, Middle East, and Africa in the Technology Fast 500 TM ranking organized by Deloitte.

Belarus

Despite a downward trend in employment, machinery remains a highly labor-intensive sector of the economy. The number of employees in machinery has dropped by over 15,000 persons (9.5%) since 2010. Today, around 30% of manufacturing industry workers in Belarus are employed in machine building, even though its share of manufacturing output is only about 20% (Figure 37). However, this gap has been modestly shrinking in recent years.

Overemployment remains an important issue for the Belarusian machine building sector. According to World Bank estimates, overemployment in state-owned-companies in Belarusian industry may reach 25% [49]. As most of the machinery enterprises in Belarus are state-owned, overemployment in the sector creates a financial burden for machine producers and influences their financial results.

Figure 37. The machine building sector's share of employment and output in the Belarusian manufacturing industry, 2005-2013, %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Figures 38-40 indicate that in recent years real wages in machinery subsectors grew faster than productivity. Excessive labor costs hinder growth, both in the industry specifically and the economy in general. Recent research done by CASE Belarus shows that a 1% increase in real unit labor costs in Belarus has led to 0.28% fall in the country's GDP [50].

Figure 38. Real wages and productivity change in the manufacturing of machines and equipment subsector in Belarus between 2006-2013, (y/y), %

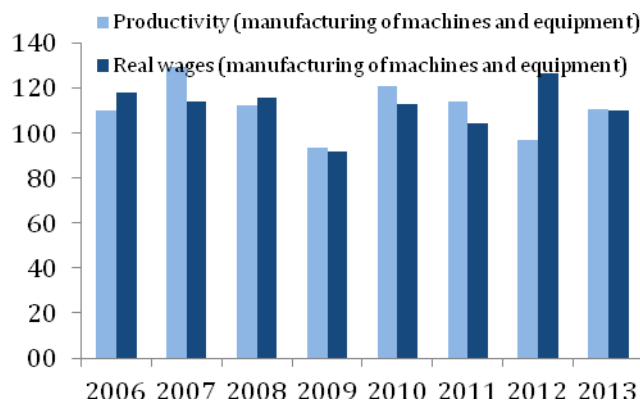
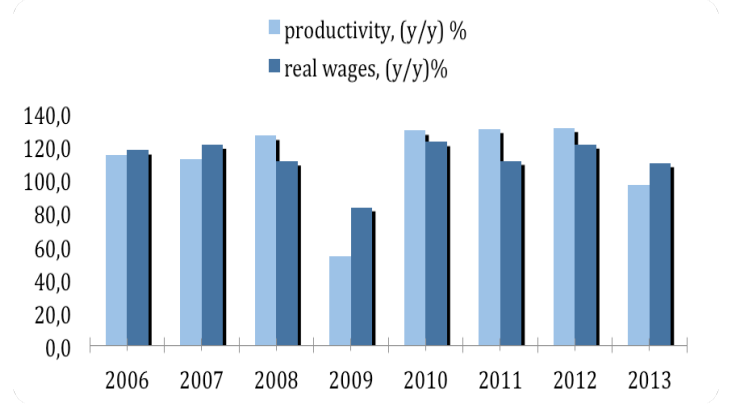
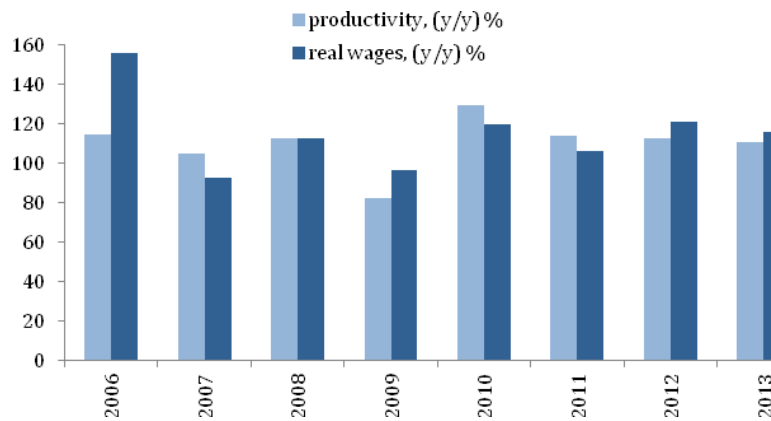


Figure 39. Real wages and productivity in the manufacturing of transport vehicle equipment in Belarus between 2006-2013, (y/y), %, (y/y), %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Figure 40. Real wages and productivity change in the manufacturing of electrical, electronic, and optical equipment subsector in Belarus between 2006-2013, (y/y), %



Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

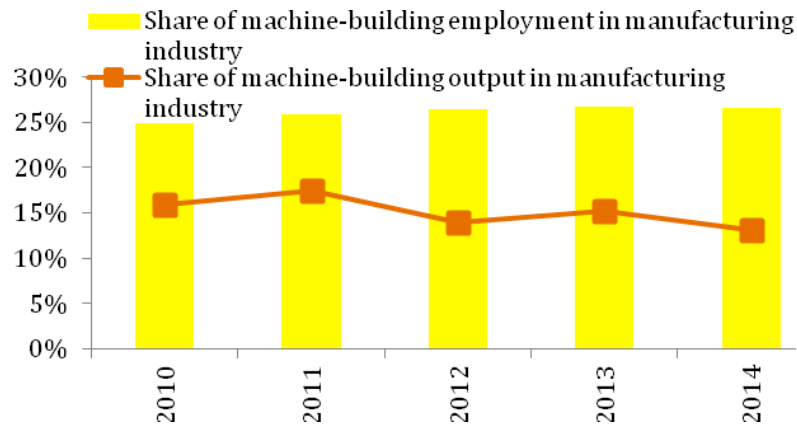
The existing employment policy in Belarus provides few stimuli for human capital innovation in companies. Due to the fact that the majority of machine building enterprises are state-owned, the Belarusian government has a significant influence over human capital development policy in the industry, including the wage policy, working time, as well as education and trainings. Under such conditions, employers and employees do not have sufficient incentive for intensive investments into human capital that lead to productivity increases.

Ukraine

The number of employees in the Ukrainian machine building sector has fallen by roughly 48,000 (11%) since 2010. But the reduction in machinery is slower than in the general industry or in the manufacturing industry in general, and as a result the sector has made modest (2 percentage points) gains in terms of its relative share of manufacturing employment (Figure 41).

Machine building in Ukraine remains labor-intensive and this intensity has been growing over the last 5 years. In 2013, machine building companies employed 27% of all manufacturing industry workers, even as they produced less than half that ratio (13.1%) of manufacturing output. Moreover, Ukraine's machinery is still in a process of structural adjustment, and its output and trade structure are in the process of being downgraded to produce more labor-intensive and technologically simpler products.

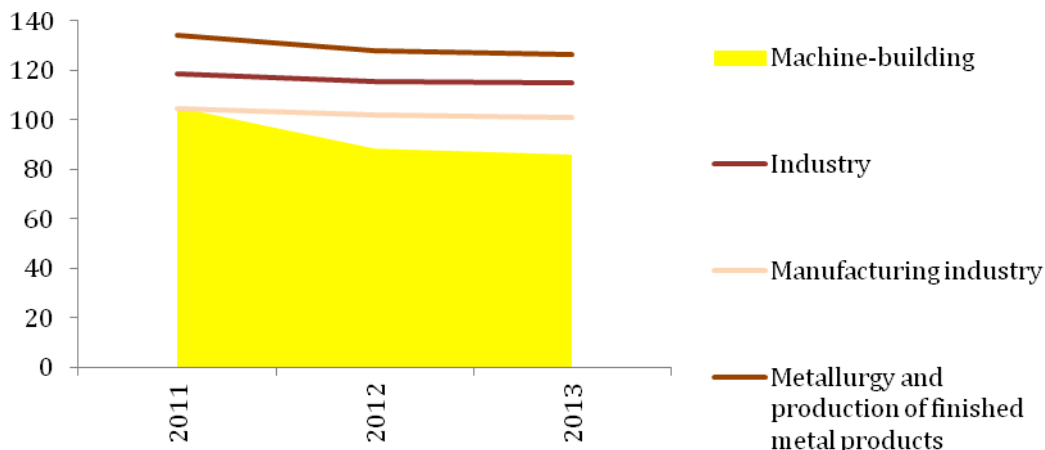
Figure 41. Share of employment and output of machinery in the Ukrainian manufacturing industry between 2010-2014, %



Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Unlike in Belarus, wages in the Ukrainian machinery subsector are not state-subsidized and remain lower than the average wages in the economy. Work remuneration in machine building is lower than the industry and manufacturing industry average, and significantly lower than in metallurgy, the leader in terms of nominal payroll numbers (Figure 42).

Figure 42. Average monthly nominal wages of employees in Ukraine, % of economy average, 2011-2013



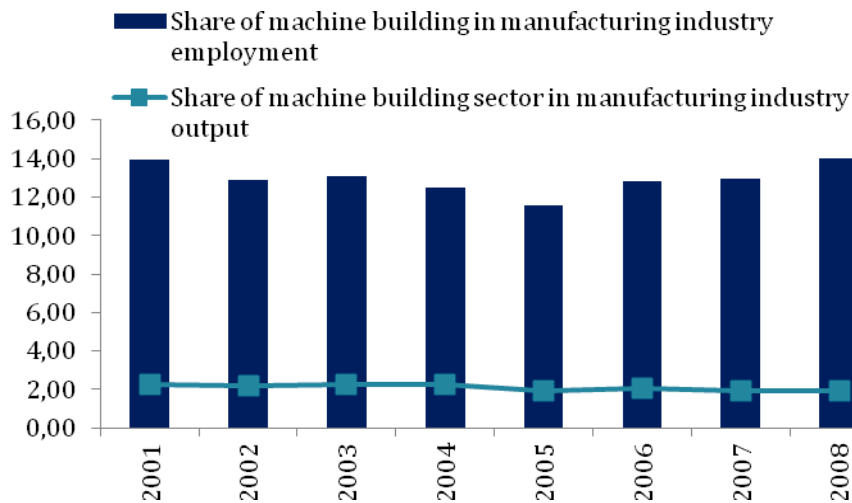
Source: State Statistics Service of Ukraine (<http://www.ukrstat.gov.ua/>)

Given the situation of significant labor intensity and below average wages in machinery in Ukraine, investments into human capital at the micro-level seem to be rather limited. A good engineering education is obviously not enough for technological advancement and better productivity. The collapse of the economy, high unemployment, and social tensions in Eastern Ukraine will contribute to the persistence of the current status quo, unless changes are initiated at the central government level and are then also consistently implemented.

Moldova

Around 6.58% of industry employees in Moldova are currently employed in the machine building sector. This indicator has been continuously growing in recent years. The machine building sector is also labor intensive, just like in Belarus and Ukraine. Since 2006, the majority of investments and new jobs were added in the subsectors electrical machinery and equipment, as well as components.

Figure 43. Share of machine building in manufacturing industry employment and output in Moldova, 2001-2008, %



Source: National Bureau of Statistics of the Republic of Moldova (<http://www.statistica.md/index.php?l=ru>)

Traditional employers in Moldova include companies producing electrical machinery and equipment, as well as their components; pump design and construction companies (even though these remain competitive in the CIS market, they have failed to penetrate the EU market); agricultural machines and equipment (their shareholders are local companies which are continuously investing in new equipment and product enhancement, and are also applying for CE certification in order to penetrate the EU market); and most recently the machine building for automotive industry subsector (for example, the manufacturing of seat frames for Van Hool buses, metal parts for Volvo and Caterpillar, etc.).

There is evidence of close cooperation between Moldovan universities and industrial producers. The share of employees with higher education in industry has gradually increased from 11.2% in 2000 to 21% in 2014.

One of the advantages of employment in Moldova is the low cost of labor – sometimes claimed to be among the lowest in the region –, which ensures cost-effective operations. Contrary to other Eastern European countries, Moldova’s unit labor cost is stable and only increases slowly [31].

The machine building sectors in Belarus, Ukraine, and Moldova are to a large extent a legacy of Soviet times, and, correspondingly, they have retained a significant role in industry. The three countries still find themselves in the process of structural adjustment as they transition from a Soviet-type industry to a market-based one, although the pace of transformation is different in each country. During the transition period, machinery in Belarus, Moldova, and Ukraine has been evolving from labor-intensive production of technologically simple products to capital-intensive machinery that produces more sophisticated products with relatively high value added and know-how content. Moldova appears to have the fastest track record in this process of transition, while Belarus and Ukraine lag behind, as their machinery remains more labor-intensive and underinvested. Machinery export data show that the machine building sector accounts for a relatively higher share of total exports in Moldova, which also indicates that exported machinery products produced in Moldova boast a comparatively higher value added than those manufactured in Belarus and Ukraine.

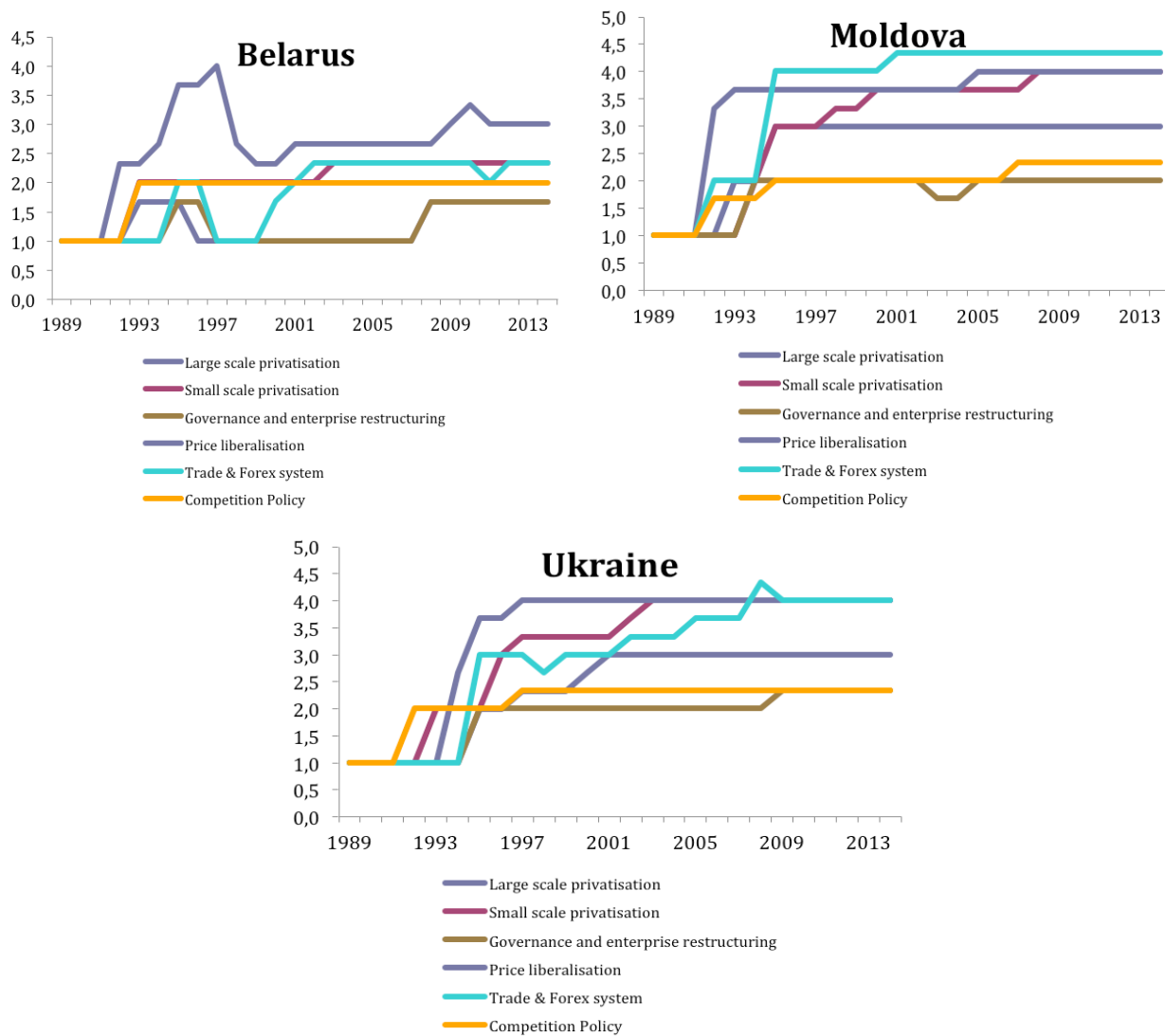
The key vulnerability factors that apply to both Belarus and Ukraine are low capacity utilization, weak export diversification (including a high dependence on the Russian market), the relatively low quality of products, outdated equipment and technology, and resource intensive production. For Belarus, machinery-related issues are the dominant positions of state-owned large producers, excessive employment, and the high level of imported components in high-tech subsectors. In Ukraine, machinery remains highly dependent on Russia, and is characterized by high power consumption and a rather weak corporate culture. Unlike in Belarus and Ukraine, machinery in Moldova is transforming into a supplier of components with a focus on electrical machinery and apparatuses. It also boasts a significantly improved level of export diversification. However, the Moldovan machine building sector is highly concentrated in free economic zones and industrial parks. The industry on the left bank of the river Nistru is more of dependent on Russian or pro-Russian business, though the share of exports going to the EU is constantly growing.

Institutional analysis based on micro-level data and case-studies

Institutional analysis is used to identify possible constraints within the machine building sector in Belarus, Moldova, and Ukraine, in its subsectors and in companies that significantly influence sector performance. Chapter II also explains the differences in machine sector development across the three countries. The different pace of reforms in Belarus, Ukraine, and Moldova since independence in 1991, and the different models these countries have pursued, have contributed to different structural transformations of their economies,

including the underlying industrial specifics. As the EBRD Transition Indicators¹⁶ (Figure 44) show, Belarus remains the least advanced in all six components of transition reforms. Moldova has fully opened up its economy to foreign trade, and has almost completed the process of small scale privatization and price liberalization. Ukraine has also advanced in price liberalization, trade reform, as well as small scale privatization. However, all three countries show poor performance as for governance and enterprise restructuring and competition policy as those indicators range between low levels of 1.7 and 2.2 for the three countries.

Figure 44. EBRD Transition Indicators for Belarus, Moldova, and Ukraine



¹⁶ The measurement scale for the indicators ranges from 1 to 4+, where 1 represents little or no change from a rigid centrally planned economy and 4+ represents the standards of an industrialized market economy [ebrd.com].

Energy subsidies, macroeconomic policy, ownership issues, and the quality of corporate governance are some of the issues that will be considered in this chapter. The chapter will conclude by presenting SWOT tables for machinery in Belarus, Moldova, and Ukraine as a summary of the institutional analysis together with conclusions from the comparative analysis in the previous chapter.

Institutional regulation/economic policy

The governmental system for regulating the machine building industry in Belarus, Moldova, and Ukraine has changed significantly since the Soviet period, and today the respective systems in these countries each have their own distinguishing features. In the 1980s there were dedicated ministries to regulate the machine building sector. Among them were the ministries of Heavy Machine Building Industry, Medium Machine Building Industry, Automobile, Tractors, and Agriculture Machine Industry, etc. Today, machinery in Ukraine is generally regulated by the Ukrainian Cabinet of Ministers and the Ministry of Economic Development and Trade. In Moldova it is generally regulated by the Moldovan Cabinet of Ministers and the Ministry of the Economy. In Belarus it is regulated by the Council of Ministers, the Ministry of Industry (MOI), and the Ministry of the Economy. In Belarus the MOI is the main governmental body that coordinates and regulates the activities of industrial enterprises in which that state has any kind of ownership stake. As of 2011, 164 joint stock companies (JSCs) and 85 fully state-owned enterprises were subject to the Ministry's economic governance [1].

There are no special laws regulating the machine building industry in Belarus, Moldova, and Ukraine. However, laws aimed at stimulating these industries are often used in the legislative practice of these countries. For example, in Belarus there are so-called Rulings of the President of the Republic, which are sometimes partially classified documents that are not made fully available to the public.¹⁷ In Ukraine, one should mention the laws like "On the stimulation of the development of native machine building for the purposes of agricultural complex", "On measures of state support for the shipbuilding industry in Ukraine", and "On the development of the aircraft industry", which determine the basic policies for governmental support in these subsectors. Moldova has used legal acts to set governmental action towards the development of machinery. This includes the acts on free economic zones and on industrial parks, which set tax rates and incentives for the residents of these zones/parks.

¹⁷ The recent Ruling No. 284, which was signed by the President on June 29, 2015, is a case in point. It contains measures involving financial support for the state-owned machinery giants "Minsk Tractor Plant (MTZ)" and "GomSelMash." According to the ruling, MTZ will be able to issue corporate bonds worth \$150 million and will receive tax exemptions to cover its losses in 2014. GomSelMash in turn will receive a preferential loan worth roughly \$425 million from the Ministry of Finance in Belarus. Parts of the ruling are not available for public review (see <http://news.tut.by/economics/454262.html>)

Following both global practice and common sense, machine building companies in these three countries do not require special licenses for production. Special licenses are obligatory only for the production of rockets, space crafts and their spare parts, and other weapon-related products. However, it is obligatory and sometimes quite costly to obtain certain permits from the authorities related to such issues as labor, fire, sanitation, and ecological safety, which are required in order to operate these businesses.

Table 8. Government support instruments in Belarus, Moldova, and Ukraine

Subsidy instruments	Belarus	Ukraine	Moldova
Energy subsidies	<p>YES</p> <p>Assuming that Belarus receives Russian energy subsidies for over two decades, and attains a comparatively high level of energy intensity in machinery, then the machine building sector receives substantial benefits through the underlying Russian subsidies.</p>	<p>NO</p> <p>After the escalation of the geopolitical conflict between the two countries, Russia increased the prices of oil and gas for Ukraine. Today Ukraine receives energy resources from Russia and the EU at global prices.</p>	<p>NO</p> <p>Moldova receives oil and gas from Russia at a price that reflects global prices.</p>
Export subsidies	<p>YES</p> <p>There are preferential conditions for exporters in Belarus. Due to the fact that most machine building companies are exporters, they have access to export subsidies. Companies can get export credit from banks or loans from the budget. Enterprises also secure themselves against export risks by using government insurance companies [34]. The most important document regulating export support is Presidential Decree № 534 of August 25, 2006 "On the promotion of exports of goods (works, services)."</p>	<p>NO</p> <p>There is no evidence of direct export support for Ukrainian machine building companies.</p>	<p>NO</p> <p>There is no evidence of direct export support for Moldovan machine building companies.</p>
Policy of import substitution	<p>YES</p> <p>Policy of import substitution is widely used by the government in Belarus, including active support of local producers in the machine building sector¹⁸.</p>	<p>YES</p> <p>Import substitution policy is currently used in the agricultural machinery and solar energy (panels) subsectors. But it is rather narrow in practice.</p>	<p>NO</p> <p>There is no evidence of import substitution policies in Moldova.</p>

¹⁸ Starting in 2009, Russia's biggest car producer "VAZ" has significantly reduced its imports of components from Belarus-based companies like BATE Borisov, "Avtogydrousilitel" Grodno, and "BelKart." Those state-owned companies took part in the import substitution program for components, which was initiated by the Belarusian government using financial, organizational, and technical measures. The whole package of measures allowed those companies to increase their sales and to gradually recover from the crisis [14].

Protectionist policies	YES Protectionism is commonly used in Belarus ¹⁹ .	NO There is no evidence of protectionist policies in Ukraine as it is the member of WTO.	NO There is no evidence of protectionist policies in Moldova
Preferential access to credit	YES An expansive credit policy and soft monetary policy have been at the core of the Belarusian macroeconomic model. State-owned companies have direct access to credit under preferential conditions. See examples in Chapter 1.	YES The Ukrainian economy used to feature state-backed loans [35]. Currently preferential credit policies are used to subsidize the aircraft industry. State guarantees for loans are also used in a few industrial sectors (defense, nuclear).	YES Currently there is some preferential access to credits with lower interest rates for certain programs financed by international donors.
Low interest rates	YES A substantial level of support has been provided through the state-owned banking sector. This also includes interest rate compensation to make export products and domestic consumer electronic goods more attainable for customers [14].	NO Ukraine used to support local producers of agricultural vehicles and machines, including the partial compensation of the interest they paid on loans [29]. But they seem to have abandoned this practice for the time being.	YES Low interest rates are applied to support big projects financed with funds provided by international donors.
Tax benefits	YES Tax benefits for state-owned machinery producers have been widely used by the government in Belarus. This distorts competition in the sector for both local and foreign machine-builders. There are also special economic zones in Belarus, including newly created industrial parks (the Belarusian-Chinese industrial park, for instance).	YES Some machine building enterprises (space, aircraft subsectors) are seen as priority areas for economic policy and are expected to receive tax benefits [19]. Ukraine has made some modest use of the practice of special economic zones, and has implemented direct tax benefits in that context.	YES Tax benefits in Moldova are provided through the creation of free economic zones.
SOE	YES Almost all large enterprises in the Belarusian machine building sector are state-owned or controlled by the government ²⁰ .	YES State-owned companies in Ukraine remain only in strategic subsectors of machinery like aircraft building, defense machinery, and nuclear technology.	NO There are only few SOEs in Moldova, and the government intends to privatize these, too, in the near future.

¹⁹ The macroeconomic policy of stimulating internal demand was widely used in Belarus between 2011-2015. However, to a significant extent it was based on protectionism, which limited competition and further distorted the country's macroeconomic balance [41, 50].

²⁰ A finished product of a firm within a vertically integrated conglomerate is an intermediate product for another member of the conglomerate. Its price is thus often not subject to a clear market benchmark. According to procurement law, a tender is not required if the procurement of intermediary products is performed within a vertically integrated chain. Similarly, according to certain laws, the prices of internally traded goods and services are based on rigid unit costs rather than on market reference prices. Prices cannot be lower than a predetermined unit cost estimate, which is typically based on the existing cost structure of the enterprise. As such, enterprises with higher excess labor are able to pass on these excess labor costs and other inefficiencies along the vertically integrated supply chain. These sources of potential inefficiency are very difficult to offset [1].

Other forms of government support	<p style="text-align: center;">YES</p> <p>Current instruments of support are:</p> <p>a) Government support for machinery sometimes takes an implicit form and is not readily apparent due to the fact that enterprises in the machine building sector are mostly organized as vertical networks. Vertical integration of machinery production serves to ensure the better governance of state-owned enterprises [9].</p> <p>b) Leasing mechanisms have been used as a support mechanism for the domestic machine building sector during the time of crisis[14].²¹</p> <p>c) The Belarusian government often determines marketing and export policy with a view towards the interests of the largest enterprises in the machine building sector.²²</p>	<p style="text-align: center;">YES</p> <p>The following are among the recent forms of government support programs in Ukraine:</p> <p>a) State guarantees and state insurance for exporters.</p> <p>b) State acquisition of new railcars.</p> <p>c) Partial compensation of the costs of domestically produced agricultural machinery.</p> <p>d) The acquisition of domestic agricultural machinery and equipment under a national financial lease program [29].</p>	<p style="text-align: center;">YES</p> <p>Government support can be used in the FEZs and, in limited forms, in the Industrial Parks.</p>
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Source: Based on all available sources

Governmental regulations on machinery manifest themselves through different forms of economic stimulus, subsidies (hidden and open), soft budget constraints, and provision of preferential lending. Enterprises in the machine building sector benefit directly and indirectly from such conditions. It is rather difficult to identify all subsidy instruments along the value chain, what we can do, however, is to compare the key support instruments in the three countries.

As is apparent in Table 8, of the three selected countries Belarus uses the widest range of potential instruments. In Ukraine, there has been a reduction in the number of subsidies and state programs, although the Ukrainian government still uses a relatively higher number of support mechanisms compared to Moldova. Moldova seems to have most European-type system of government support for machinery, based on free economic zones and without any kind of hidden channels.

Government support often results in the inefficient allocation of resources and reduces the incentives for companies to introduce new technologies and innovations, as was discussed in the context of Belarus in the previous chapter. Moreover, any financial support, be it implicit

²¹ The state-owned leasing company "Promagroleasing" was created in Belarus to support industrial producers operating in both domestic and foreign markets. The company offered a 5-year lease for buying costly equipment at a low rate of interest.

²² Starting in 2009, Russia's biggest car producer "VAZ" has significantly reduced its imports of components from Belarus-based companies like BATE Borisov, "Avtogydrousilitel" Grodno, "BelKart." Those state-owned companies took part in the import substitution program for components, which was initiated by the Belarusian government using financial, organizational, and technical measures. The whole package of measures allowed those companies to increase their sales and to gradually recover from the crisis [14].

or explicit, results in a burden on the budget. The volume of government support always depends on what kind of fiscal policy is used in the given country, of course, and on the availability of sufficient funds in the state budget for a particular year.

Box 13: V4 Institutional regulation/economic policy

There are no specific governmental regulations concerning the machine industry in the V4 countries, especially since the EU accession. Specific tax benefits and other forms of governmental support mainly relate to FDI. We assume that in most cases investors first look at the V4 countries as a general region or cluster, and then analyze country-specific conditions, factors, features, and policies.

- A skilled and abundant *labor force* is commonly understood as an important factor in attracting FDI in manufacturing. Over the last two decades, the percentage of those in the general population of the V4 who are aged 15-64 and have at least upper secondary education ranged between 70% to 85%. Research by the PricewaterhouseCoopers Automotive Institute shows that in comparison with the EU15, the labor cost advantage of V4 countries in manufacturing will remain significant for several decades to come (PricewaterhouseCoopers 2007).
- With regard to the level of *transport infrastructure*, the most developed country in the region is the Czech Republic, followed by Hungary and Slovakia. With the exception of the Southern Polish regions, which are competing for strategic manufacturing investments, Poland is the least developed V4 country when it comes to (motorways and railways) transport infrastructure.
- In terms of *taxation*, the V4 countries have occupied an interesting position in the Paying Taxes Ranking as published in the framework the World Bank Group's Doing Business project. All of these countries derive a significant competitive advantage from their tax systems and from the changes they have enacted in these systems. The Paying Taxes 2016 report shows that in terms of taxation, as of late the most attractive V4 country has been Poland (Overall Paying Taxes 2016 Ranking: 58), followed by Slovakia (73), Hungary (95), and Czech Republic (122).
- *Investment incentives* represent an important competitive tool, especially in a situation when investment sites offered by candidate countries and other conditions are on par with those offered by V4 countries. The EU sets an upper ceiling for the total amount of incentives that may be granted to an investor in the motor vehicle industry. This may not exceed 15% of the total investment value. The European Commission has to approve the amount of investment incentives proposed by the member state's government to a strategic investor. In order for an incentive to be exempt from the 15% rule as a so-called indirect incentive, it has to qualify as a public good. The nature of the investment agreement itself can also be part of the bidding, since the EU authority only approves the total value of incentives offered rather than the agreement itself. Apart from EU constraints, each V4 country also has its own rules for the provision of investment incentives. The general reasons for adopting national rules for the provision of investment incentives include increased transparency and credibility towards foreign investors – negotiations without any general guidelines limiting state aid are not acceptable politically, and they are also problematic with regard to the potential fiscal effects of incentives. Nevertheless, despite the detailed incentive schemes, V4 countries usually allow for the special treatment of strategically important investors, which gives governments flexibility in negotiations with significant investors.

Ownership issues and corporate governance

Almost all large enterprises in the Belarusian machine building sector are state-owned (SOE) or controlled by the government. According to official statistics, roughly 85% belong to the private sector (Table 9), but in fact the government controls a majority of corporatized large machine building plants and interferes substantially with their operations. The corporatization of Belarusian machine building plants by transforming SOEs into joint stock

companies occurred in the late 2000s as a preliminary step in the process of privatization, but ultimately it did not yield real private ownership nor did it improve the level of corporate governance. The process of privatization in Belarus currently proceeds as follows. First, a unitary state enterprise (owned by the state) is transformed into an open joint stock company (JSC). Initially, all of the shares are still owned by the state. After corporatization, however, there is a possibility that a portion or all of the assets will be sold to a private investor. However, in most cases the corporatization process (as the first step of privatization) only implies a formal change – all economic decisions remain in the hands of the government [37]. In theory, corporatization implies that SOEs are subject to the same laws that govern private corporations, and thus such a step substantially improves transparency by separating the accounts of the enterprise from those of the ministry. In practice, however, the experience of Belarus and several other countries shows that corporatization is not a sufficient condition for insulating public enterprises from government interference or soft budget constraints [1]. Under such conditions, all critical aspects of an enterprise's operations, including the choice of factors of production, output, and distribution, are affected directly and indirectly by government policies at the central, ministerial, or local levels. Numerous legislative acts by the government or by the competent ministry specify key aspects of corporation operation – management of reserves, use of investment funds, and efficient use of spare parts. For example, the Belarusian Ministry of Industry (MOI) has a special committee to oversee the efficient use of energy and other material supplies used by enterprises under its jurisdiction. Another rule specifies input norms for various production technologies, the purpose of which is to ensure the efficient use of resources in the production process. Formally, the state follows a decentralized management model, where firms are controlled by the ministry that is responsible for the policy area under which they products fall. Even so, in practice there are significant overlaps between the responsibilities of various ministries, with the result that they frequently interfere with one another in their control activities [1].

Table 9. Types of ownership in Belarus (as % of output), 2013

	<i>Manufacture of machinery and equipment</i>	<i>Manufacture of transport equipment</i>	<i>Manufacture of electrical, electronic and optical equipment</i>
Total	100	100	100
State	35.0	3.7	9.5
National	34.6	3.7	9.3
Municipal	0.5	-	0.2
Private (including primarily corporatized)	63.8	95.3	86.0
Foreign	1.2	1.0	4.5

Source: National Statistical Committee of the Republic of Belarus (<http://belstat.gov.by/>)

Most machine building enterprises in Belarus are organized as vertical conglomerates controlled by the government (Ministry of Industry). This structure conceals the economic inefficiency that manifests itself predominantly in the form of cross-subsidizing unprofitable firms (see Box No. 5 above). Moreover, SOEs in the Belarusian machine building industry⁷²

are less productive than private enterprises because of inefficient resource allocation. The total factor productivity (TFP) of firms that do not report to a government ministry substantially exceeds the corresponding figures of their state-controlled counterparts [4]. Moreover, managing companies of vertical conglomerates with lower capacity utilization tend to experience higher increases in their employee figures [3]. This results in excess employment and requires large amounts of money for salaries (see Figure 17). As a result, Belarusian machine building enterprises become less competitive in both domestic and international markets. However, there are signs that the Belarusian government understands the existing problems with the management of state-owned machinery companies. There is a promise that vertical systems will be reformed in near future, and that ownership functions exercised by the government will be separated from management functions. Also, the elimination of overlapping responsibilities between various ministries is expected. But thus far these are only promises, and no real plans have been publicly presented yet.

During the transition period that followed the collapse of the Soviet Union, Ukrainian enterprises were privatized and corporatized. Stock corporations have emerged as the most common form of business organization, and corporate ownership is the most common form of ownership in the machine building sector today.[30]. The specific features of Ukrainian privatization have led to a situation in which the leading machine building enterprises are mainly controlled by local and Russian (or pro-Russian) business groups, while there are only few state-owned enterprises among the top players: Zorya-mashproekt, Turboatom, Artem, and Antonov [29].

The current state of corporate governance in Ukraine is characterized by a low level of corporate culture, a discrepancy between the existing corporate governance practices, and generally accepted principles of corporate relations, poor and inadequate legislation, and weak protections for small shareholders [15]. A significant deficit with respect to corporate relations in the engineering sector in Ukraine is the almost complete absence of committees on the supervisory boards, even though Ukrainian and international principles of corporate governance imply that such structures should exist, and also recommend the existence of corporate secretaries on the supervisory boards [30]. Solving this problem is very important for the machine building sector and in fact for industry overall because better conditions will improve competition, efficiency, the attractiveness of investment opportunities, the development of the stock market, and will ultimately boost national wealth. The most effective form of corporate governance in Ukraine prevails at enterprises owned by foreign investors, specifically those where the share of foreign capital is no less than 30%. However, local corporate managers rarely trying to attract external financing by selling their shares [30].

Corporate governance in Ukrainian companies is regulated by a number of legal acts, including the Act on Companies (the core regulatory instrument), the Civil Code, the Economic Activity Code, privatization programs, etc. But still, many aspects of corporate governance are not covered by legal regulations and, according to international surveys, Ukrainian laws are among the least compliant with international standards of corporate governance regulation [16].

There is also the issue of small shareholders in Ukraine, which is similar to that of other countries with transition economies. In particular, there is an issue of employee ownership. Employees, as a rule, are not involved in corporate control. Their shares are either controlled by managers, or are mitigated and form an amorphous structure of stockholdings. As a result, the activity of small shareholders-employees is traditionally low, and their interests are mainly focused on various payouts.

In Moldova, the structure of corporate ownership was changed by the mass privatization program of the mid-1990s. Mass privatization was followed by a wave of consolidation and struggle for control at many Moldovan companies. These have resulted in control being distributed among a variety of owners, including the former privatization investment funds (FINNs), management, and new local investors [45]. At those companies where consolidation was associated with conflicting interests competing for strategic control, a variety of corporate governance abuses were used to gain the upper hand, including share dilutions and inadequate notifications of shareholder meetings [38]. As a result, key enterprises are now controlled by local business groups, while foreign strategic investors are only present to a smaller degree. After the privatization process, the majority of former industrial giants became uncompetitive and many companies resorted to renting out industrial and office premises as their main business activity. Strategic investors prefer to invest in start-ups rather than taking over existing manufacturing plants.

EBRD and World Bank indicators show that the domestic transposition of the OECD Principles of Corporate Governance, which lay down the rights of shareholders and the rules concerning their equitable treatment, the role of stakeholders in corporate governance, the rules on disclosure and transparency, and the responsibility of the board, remains inadequate in Moldova. Among the key corporate governance issues that are still on the agenda in Moldova today are the adoption of legal requirements for shareholders to disclose their beneficial ownership and control positions, removing the authority of boards to increase capital without shareholder approval, establishing clear rules concerning the liability and duties of board members, requiring annual independent audits for joint stock companies, and the protection of small shareholders' rights [38].

Among the positive changes in the three countries one should note the existence of associations and member-based organizations which aim to contribute to the development of the machine building industry, to further the protection of members' interests, as well as to lobby for legislative proposals and other activities. The "Belarusian Scientific and Industrial Association," the "Republican Association of Industrial Enterprises," and the "Belarusian Chamber of Commerce" are among such organizations in Belarus. In Moldova the Employers Association of the Manufacturing Industry and the "Chamber of Commerce" are key players. In Ukraine there are several important organizations, such as the "Ukrainian League of Industrialists and Entrepreneurs," "Ukragromash," the "International Machine Building Union," the "Association of Technologists and Machine Building Specialists of Ukraine," and the "League of Ukrainian Machine Builders". They aim to represent and protect members' interests in relations with state and local authorities, and other institutions and organizations, as well as during dispute resolutions in courts of any authority or jurisdiction.

Box 14: V4 Ownership issues and corporate governance

After several waves of privatization in the 1990s, the vast majority of companies in the V4 machine industry sector are privately owned. Only few state-owned companies remain in the V4 countries, mainly in the energy and resources, consumer business, and transportation sectors. Since the V4 countries are members of the OECD, they are required to domestically implement the OECD Principles of Corporate Governance. The recently published OECD Corporate Governance Factbook shows several considerable differences between V4 countries when it comes to the rights of shareholders and key ownership functions, and institutional, legal, and regulatory frameworks.

As a matter of corporate ownership structures, most of the listed companies in any V4 country have a controlling shareholder, which means they are deemed to have a concentrated ownership structure. Specific corporate structures that differ from the previously mentioned structure can be found in Hungary and Poland. In the case of Hungary (where one finds both concentrated and dispersed ownership structures among listed companies), the average size of the free-float is about 47%, and a third of all listed companies are controlled by a majority shareholder. In Poland, 30-60% of shares belong to the controlling shareholders and 15-20% are held by pension funds or investment funds.

Companies with concentrated ownership structures may be more likely to engender horizontal agency problems that arise between controlling and minority shareholders, while vertical agency problems – which arise between managers and shareholders – may be mitigated. In general, in the V4 countries there is traditionally very little opposition to the management's position on resolutions at corporate meetings. The relatively low level of average dissent during the discussions of resolutions at annual general meeting is the highest in Hungary (4.51%) and Poland (4.15%), while it is much lower in the Czech Republic (0.68%) and Slovakia (0.06%).

In addressing issues of corporate governance, all V4 countries have applied corporate governance standards in company law and security law. In the Czech Republic the key regulatory framework consists of two laws, specifically the Business Corporations Act and the Capital Market Undertakings Act. The Hungarian jurisdiction uses the Civil Code and the Act on the Capital Market

The main public regulator of corporate governance in Poland is the Polish Financial Supervision Authority. In Slovakia corporate governance is supervised by the Ministry of Finance. In the Czech Republic and Hungary, the role of the main public regulator is played by the respective national banks. The implementation mechanisms of domestic corporate governance codes and principles vary slightly among the V4 countries.

Innovation-driven reforms

The analysis of the machine building sectors in Belarus, Ukraine, and Moldova carried out in this report indicates the existence of a technological gap between companies in Belarus, Ukraine, Moldova, and the V4 countries. Closing the gap requires a broad restructuring program, up-front investments, transfer of innovation and "know how". The share of expenditure spent on research and development in the industrial sector is very low. In Belarus, for example, where the machinery sector has experienced the highest level of investment among the three countries analyzed here, 65.5% of expenditures described as spending on technological innovations in 2010 were spent on purchases of new equipment, 21.4% were spent on research and development, while only 0.4% were spent on the acquisition of new technologies [2]. Sometimes the problem in these countries is complicated by the fact that managers of large enterprises have little incentive to innovate, sometimes they do not want to innovate at all, and at other times they believe that innovation has actually been acquired successfully.

All three countries employ government-initiated programs to promote the development of industry in general and of the machine building sector in particular. In Belarus, there is "The program for the development of industry in the Republic of Belarus until 2020"; "The75

state scientific and technical program "Development of the machine building industry between 2011-2015"; a program between Russia and Belarus that provides the framework for the production of category Euro-4 diesel engines, and "The program for the development of the Russian car industry until 2030," which was adopted jointly by the Ministry of Industry and Trade of the Russian Federation and the Ministry of Industry of the Republic of Belarus, which set up a joint working group for the development of the machine building sector. In Ukraine there is "The Industrial Development Program of Ukraine," but currently the program does not offer any funding. Its goal is to encourage and support the activities of enterprises to improve the technical level of production. Among other things, they propose various kinds of tax incentives in order to carry out large-scale projects aimed at modernizing of production facilities. They also seek to help in developing an innovative infrastructure, establishing industrial parks and developing their network. The most important program in Moldova today is the "Strategy for the development of industry until 2015," which is still a timely strategy. These programs are hugely important because many enterprises either do not produce enough profits for investments (Belarus), do not want to reinvest profits (Ukraine), or have only limited access to external funding (Moldova), which leads to suspend any efforts aimed at expanding and modernizing their production, and leads them to stick with their highly worn fixed assets. The issue needs to be addressed with properly integrated government support programs.

As a result of the Soviet traditions of technical education, Belarus, Moldova, and Ukraine have well-educated and well-qualified employees in machinery. Huge machine building companies (BelaAZ, MTZ, and MAZ in Belarus; Azovmash, Motor Sich, Mining Machines, Turboatom, Dniprovagonmash in Ukraine) have their own R&D departments, which are active in developing products and training staff. Still, the technological level of the sector requires significant R&D expenditures and innovations. There are strong domestic scientific institutes and organizations that work to develop new technologies and train highly skilled staff. In Belarus these are the National Academy of Sciences, the Belarusian National Technical University, etc. In Ukraine these include, among others, the Physical-and-Technological Institute of Metals and Alloys, the G. Pysarenko Special Design and Technology Bureau Institute for the Problems of Strength of the National Academy of Science of Ukraine, the Paton Electric Welding Institute of the National Academy of Science of Ukraine. In Moldova these are the Technical University of Moldova, the Technical College, which is part of the university, and the Academy of Sciences of Moldova and its specialized institutes for technology transfer and research. In all three countries, the abovementioned institutions also seek to foster cooperation between scientists, experts, and representatives of industrial enterprises from various different countries, as well as the arrangement of scientific seminars and conferences dedicated to machine building.

Box 15: International cooperation and clustering – opportunity for SMEs, but also for big companies (creating value added chains for global markets)

Case: Cluster for automation technologies and robotics, Košice, Slovak Republic

The Cluster for Automation Technologies and Robotics (Cluster AT+R) was established in Košice in 2010. The cluster founders – six innovative manufacturing companies, as well as the research centers at the Technical University in Košice and the University of Žilina, supported by the Self-Governing Regions of Prešov and Košice, provide the development of research, training, manufacturing, and supply capacities in the field of automation and robotics technology. The AT+R cluster already established three joint research centers: the Center of Mechatronics, the Center of Robotics and Modules, and the Center of Automated Production Systems. All of them have several laboratories that are available to cluster members and are used for joint projects.

Case: Aviation Valley in southeastern Poland

The Aviation Valley Association was launched on April 11, 2003, as a non-profit organization. It was set up as a means of furthering the rapid development and growth of the aerospace industry in southeastern Poland. Significant funding for the Association has been provided by Pratt & Whitney, a world leader in the design, manufacture, and service of aircraft engines, space propulsion systems, and industrial gas turbines. The Aviation Valley Association currently represents 125 companies in the region. The long-term objective of the Aviation Valley Association is to transform southeastern Poland into one of Europe's leading aerospace regions, which would be able to provide a diverse cross-section of products and services for the most demanding clients.

Hírös Supplier Cluster in central Hungary

Established in 2008 in the South Great Plain region (Kecskemét), the cluster specializes in machinery, electronics, and automotive industries. Its mission is to enhance the collaboration of regional companies, regional science centers, and R&D services providers, and to promote the innovation-based upgrading of the region's economy. A further objective is to facilitate the integration of regional SMEs into global value chains and make them capable of becoming suppliers to multinational companies. As of the end of 2013, the cluster became an accredited innovation cluster (AIC), and is entitled to submit tender applications to support programs designated specifically for AICs.

Coordinated by the Chamber of Industry and Commerce of Bács-Kiskun County (the cluster manager), Hírös cluster currently has 25 members including local subsidiaries of flagship multinational and domestic-owned, rapidly developing companies, regional education centers, engineering offices, consultancy firms, and R&D services providers and banks.

SWOT analysis of machine building sectors in the countries analyzed

We use SWOT analysis to summarize the results of our comparative analysis of the main machinery trends in Belarus, Moldova, and Ukraine, and of our institutional analysis of the developments in these countries. The SWOT analysis will help to summarize these countries' weaknesses and strengths, the common problems for and opportunities of their machine building sectors. We will consider each country individually in order to identify the key country-specific points. This approach makes it possible to define the current situation of machinery in Belarus, Ukraine, and Moldova, as well as to propose key directions and strategies for machinery development, drawing on their opportunities and strengths, and to overcome the weaknesses and threats that machinery faces in these countries.

Table 10 – SWOT analysis of machinery in Belarus

		Internal Factors	
		<i>Strengths (S)</i>	<i>Weaknesses (W)</i>
		<ul style="list-style-type: none"> -Access to preferential financing mechanisms -Well-educated staff -Own research base and deep cooperation with national research institutes -Renowned machinery history and goodwill towards Belarusian machinery products in the region 	<ul style="list-style-type: none"> -Low capacity utilization -High level of imported components -Outdated equipment and technology -Labor-intensive production -Overemployment -Relatively low quality of products -High volume of finished product stocks -Low export diversification -High level of government interference in strategic management -Lack of innovation incentives for top management -Vertical organization of huge state-owned companies into holdings
		External Factors	
Belarus	Opportunities (O)	<ul style="list-style-type: none"> -Comparatively low energy costs -Preferable export conditions to the large market of the Eurasian Economic Union (EEU) and specifically Russia -Zero-tariff import of ore and components from the countries of the Eurasian Economic Union and specifically Russia -Strong technical education in the country -Strong machinery lobbying circles in the government 	<p style="text-align: center;"><u><i>1. SO Strategies</i></u></p> <p>a) More efficient utilization of investments b) Increasing share of high value added and engineering products</p> <p>Both strategies aim to improve the competitive positions of Belarusian machinery producers in the EEU market and to diversify the range of products available for export. Both could be used to utilize the sector's education potential .</p>
	Threats (T)	<ul style="list-style-type: none"> -High importance for the economy in terms of share in GDP -Social vulnerability due to high number of employees -Decreasing export volumes -Decreasing share in the country's exports -High level of dependence on Russia -Increasing dependence on the CIS market -Lack of national iron ore resources -Excessive number of state subsidy instruments 	<p style="text-align: center;"><u><i>2. ST Strategies</i></u></p> <p>a) More efficient utilization of investments b) Development of machinery components</p> <p>A combination of the two strategies is needed to diversify the sector's export and import risks. The development of components could yield improvements in trade balance and export diversification. This, in turn, could mitigate the vulnerability of the sector in Belarus.</p>
			<p style="text-align: center;"><u><i>3. WO Strategies</i></u></p> <p>a) Quality improvement and price reduction b) Improving corporate governance and eliminating state intervention</p> <p>This approach could be used to unload existing stocks and to ensure a better position in the EEU market as the producer of "cheap but reliable machinery products." Improving corporate governance in line with the relevant OECD principles, in both state-owned and private companies, would ensure the sustainability of this approach.</p>
			<p style="text-align: center;"><u><i>4. WT Strategies</i></u></p> <p>a) Structural change in machinery through privatization (partial or full) b) Improving corporate governance and eliminating state intervention</p> <p>This constitutes the most radical approach for machinery reform in Belarus. Changes in ownership and in the structure of the sector, along with improvements in the quality of management, would allow for attracting foreign investors and technologies, increasing productivity, and cutting cost, which would in turn contribute to improved product quality, launching new products, and expanding into new markets.</p>

It seems that currently the Belarusian government has been implementing the first set of SO strategies by using mainly administrative instruments in order to exploit sector strengths and external opportunities. At the same time, the government appears to pay less attention to threats and ignores all kinds of weaknesses. Addressing these would be necessary to change the core situation in the sector. To overcome the difficulties that Belarusian machinery faces today, the WT strategies in Belarus appear vital. The government might directly apply the scenario set out in the WT strategies (the ideal scenario), or move gradually by using the ST and WO approaches.

Table 11 – SWOT analysis of machinery in Ukraine

Internal Factors		<i>Strengths (S)</i>	<i>Weaknesses (W)</i>	
		External Factors		<ul style="list-style-type: none"> -Convenient geographic location close to ore sources and metallurgical plants -Wide range of machine building products -Competitive price of domestic machine building products compared to world prices -Relatively low labor costs -Well-educated staff -Own research base and deep cooperation with national research institutes -Long machinery history and ties with key clients in the region
Ukraine	Opportunities (O)			<ul style="list-style-type: none"> -Developed metallurgy industry in combination with significant reserves of raw materials that are sufficient to cover the needs of production -Access to European markets within the framework of the DCFTA agreement -Recent marketing successes in Africa and Asia -Significant potential of national technological research -Strong technological education -Broad national market - Migration of EU machine building companies to Eastern Europe
	Threats (T)	<ul style="list-style-type: none"> -Highly significant for the economy in terms of GDP share -Social vulnerability due to high number of employed -High level of dependency on Russia -Decreasing share in total exports over the last years -Ukrainian economic recession -Labor migration -Complex system of intellectual property rights protections -Lack of energy resources 	<p style="text-align: center;"><u>2. ST Strategies</u></p> <p>a) Increasing share of high value added and engineering products b) Increasing productivity in the sector Increasing productivity and enhancing the output of higher value added products are the core steps that need to be performed during times of economic downturn and diminishing exports. These strategies contribute to export growth and create a foundation for sustainable output growth in the future.</p>	<p style="text-align: center;"><u>4. WT Strategies</u></p> <p>a) Improving corporate governance b) Increasing productivity in the sector As in the case of the WO approach, the stimulation by the Ukrainian government of improvements in corporate governance seems to be the core of WT strategies. In combination with government efforts to promote increased productivity in the sector, this would contribute to attracting foreign investors and technologies, improved product quality, the launching of new products expansion into new markets.</p>

Bearing in mind the economic recession in Ukraine, as well as political and economic tensions with Russia, it seems reasonable to launch comprehensive but sustainable reforms using the WT strategies. Improvements in the management of machinery companies in Ukraine is the area where the Ukrainian government's attention is most needed. However, there is also the need to stimulate productivity increases in the Ukrainian economy, including the machine building sector. These are rather radical efforts that require a targeted approach by the government but could contribute to sustainable economic growth in the future.

Table 12 – SWOT analysis of machinery in Moldova

		Internal Factors	<i>Strengths (S)</i>	<i>Weaknesses (W)</i>
				External Factors
Moldova	Opportunities (O)	<ul style="list-style-type: none"> -Better sector performance after deep structural change -Increasing share of the country's total exports -Increasing investments in the sector -Access to European markets within the framework of the DCFTA agreement -Interest from EU companies and investors -Strong technical education - Migration of EU machine building companies to Eastern Europe 	<p style="text-align: center;"><u>1. SO Strategies</u></p> <p>a) Stimulation of subsectors with high value added and engineering products</p> <p>b) Expanding access to the EU market</p> <p>Greater access to the EU market seems to provide new opportunities for Moldovan machinery products. The further optimization of the structure of machinery by developing advanced products will boost machinery exports and utilize a greater share of the local labor force.</p>	<p style="text-align: center;"><u>3. WO Strategies</u></p> <p>a) Improving corporate governance</p> <p>b) Modernization of assets</p> <p>Just as in the case of Ukraine, improving corporate governance based on the relevant OECD principles seems to be the core goal for WO strategies. It is necessary to enforce the principles of corporate governance at public companies in order to achieve greater accountability and better investor relations. This will contribute to increasing investments in technologically advanced assets.</p>
	Threats (T)	<ul style="list-style-type: none"> -Concentration of machinery production in special economic zones -Russian factor in ownership -Labor migration -Lack of energy resources and iron ore -Narrow national market 	<p style="text-align: center;"><u>2. ST Strategies</u></p> <p>a) Targeted cooperation with European investors</p> <p>Cooperation with EU investors seems to be the only reliable strategy for overcoming existing threats. This strategy is rather easy to implement for the Moldovan government and will contribute to Moldova's expansion into the EU market, increase productivity, and improve ownership structures and management quality.</p> <p>b) Create new state incentive programs and improve the business environment. Attract EU companies to relocate production to Moldova. Subsidies and incentives are necessary to manage tough competition from the region (subsidies offered for job creation in Serbia, Macedonia, etc., and for capital investment (equipment, buildings, etc.) in Romania. Also, the business environment needs to be improved all over the country to offer similar conditions as the ones that prevail in FEZs for all regions.</p>	<p style="text-align: center;"><u>4. WT Strategies</u></p> <p>a) Improving corporate governance and productivity and productivity improvement</p> <p>b) Stimulating small and medium-sized machinery producers</p> <p>If we assume that principles of corporate governance are implemented as part of a strategy pursued by the government of Moldova, some targeted efforts at increasing productivity in the sector are needed to draw foreign investors and technologies into the economy. At the same times policies should aim to stimulate the creation of new businesses by providing opportunities for small and medium size machinery producers. This is the definite way to improve the quality of products, launch new products, and increase exports.</p>

The best course for Moldova would seem to be a continuation of reforms with a targeted use of corporate governance best practices, in combination with stimulation for SMEs that are active in the machinery sector. These appear to be radical measures and are the best way to attract foreign capital into the economy and spur development in the sector and in the economy overall.

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Statistical annex

Picture 1. Allocation of key machinery producers in Ukraine (taken from: InvestUkraine, Deloitte. Machine building industry/ Industry overview/ downloaded from http://ccipu.org/ua/industry_analysis/machine_building/)

Table 13. Exports of the machine building sector in Belarus, Ukraine, and Moldova, 1994-2014, bn. USD

	Belarus	Ukraine	Moldova
1994			0.07
1995			0.06
1996		2.04	0.05
1997		1.91	0.10
1998	2.01	1.72	0.05
1999	1.62	1.33	0.03
2000	1.76	1.80	0.03
2001	1.86	2.26	0.04
2002	1.93	2.45	0.04
2003	2.30	3.30	0.04
2004	3.05	5.06	0.06
2005	3.09	4.49	0.06
2006	3.78	5.41	0.07
2007	5.20	8.28	0.11
2008	5.89	10.66	0.18
2009	3.15	6.61	0.15
2010	4.56	8.93	0.19
2011	7.86	11.61	0.33
2012	7.89	12.98	0.34
2013	6.79	10.31	0.36
2014	5.22	7.13	0.34

Source: UN Comtrade Database (<http://comtrade.un.org/>)

Table 14. Export diversification by subsectors, 2013

(HS Code)		Russian Federation	CIS + Ukraine+ Turkmenistan	World
84	Belarus	73.8		100
	Ukraine	57.9		100
	Moldova	65.2		100
85	Belarus	76.7		100
	Ukraine	35.1		100
	Moldova	2.9		100
86	Belarus	66.3		100
	Ukraine	70.8		100
	Moldova	51.9		100
87	Belarus	72.3		100
	Ukraine	51.1		100

	Moldova	59.0		100
88	Belarus	-		-
	Ukraine	14.5		100
	Moldova	0.3		100
89	Belarus	63.8		100
	Ukraine	25.2		100
	Moldova	72.7		100
Machine building sector	Belarus	73.4	90.6	100
	Ukraine	51.9	62.8	100
	Moldova	21.3	27.5	100

Source: UN Comtrade Database (<http://comtrade.un.org/>)