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Industrial structure and the diffusion of ADP technologies

Executive summary

The diffusion of advanced digital production (ADP) technologies depends considerably on a country's productive structure. Countries in which technology and digitally intensive (TDI) industries account for a larger share of the economy tend to experience faster diffusion rates and to accumulate greater technological experience. ADP technologies, in turn, affect the process of structural change. Ever since patenting in ADP technologies has taken off, structural change towards TDI industries has accelerated.

Key findings

- The diffusion of ADP technologies is highly heterogeneous across industrial sectors.
- The productive structure of countries plays a key role in determining the diffusion of ADP technologies. Countries where TDI industries account for a larger share of total MVA experience faster diffusion.
- The emergence of ADP technologies amplifies the importance of TDI industries in the process of structural change.

Productive structures matter for the diffusion of ADP technologies

The diffusion of ADP technologies across countries is highly uneven. The Fourth Industrial Revolution has seen the world economy divided into frontrunners, followers and laggards. Yet even among the leading economies, the adoption of ADP technologies occurs faster in some industries than in others. Across European economies, there are marked differences between industries in the diffusion of key ADP technologies, such as cloud computing, 3D printing and robotics. Relative to the average rate of adoption across the entire manufacturing sector, the computer and electronics industry and the transport equipment industry, are the industries that more actively adopt new technologies (Figure 1).

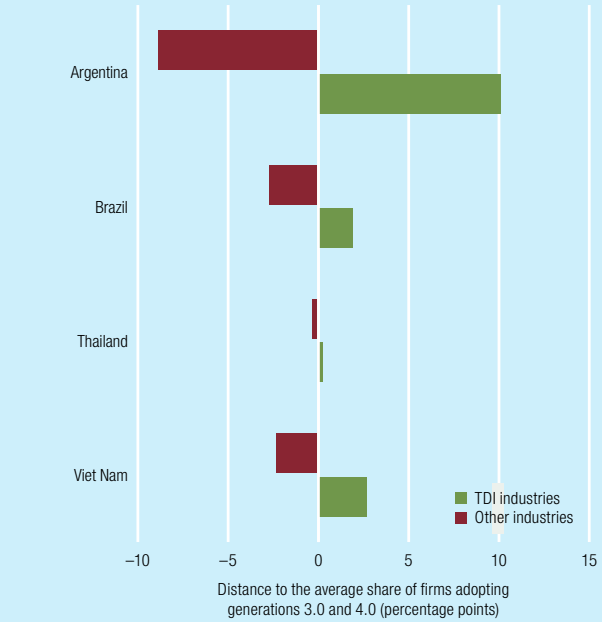
The industries that outpace the manufacturing sector as a whole in adopting ADP technologies are defined in the IDR 2020 as 'technology and digitally intensive (TDI) industries' (see Box 1). Micro-level data collected by UNIDO in emerging industrial and developing economies corroborates these observations. Firms that are active in TDI industries tend to be ahead of the adoption curve relative to firms in other industries (Figure 2).

Box 1. What are TDI industries?

The IDR 2020 classifies TDI industries as those that are using medium high- or high levels of technology and are simultaneously characterized by a high degree of digital intensity according to the OECD classification for technology and digital intensity (see, respectively, OECD 2011 and Calvino et al., 2018). Industries classified as TDI include computers and electronics; electrical machinery and machinery; and transport equipment.

Figure 2

Firms in TDI industries tend to adopt ADP technologies more readily



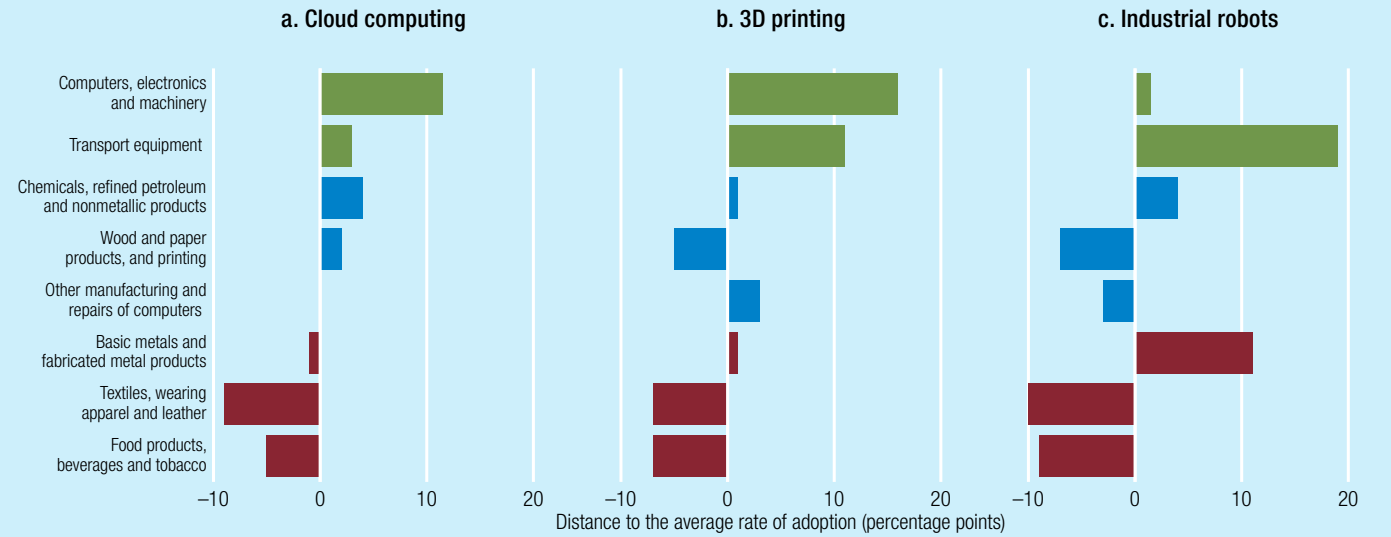
Note: The figure shows how the firm-level adoption of ADP technologies relative to the average rate of adoption across all manufacturing firms differs between TDI and non-TDI industries. Source: UNIDO IDR 2020, Figure 3.2, page 101.

Technology and digitally intensive industries are key

These inter-industry differences imply that countries' productive structures play an important role in determining the rate of diffusion of ADP technologies in the economy. Countries in which TDI industries account for a larger share of the economy—either in terms of employment or value added—tend to experience higher ADP adoption rates relative to countries whose productive structures are more reliant on "traditional" manufacturing, such as food and beverages or textiles. Indeed, the diffusion of ADP technologies is positively associated with the share TDI industries represent in a country's total manufacturing value added (MVA) (Figure 3, next page).

Figure 1

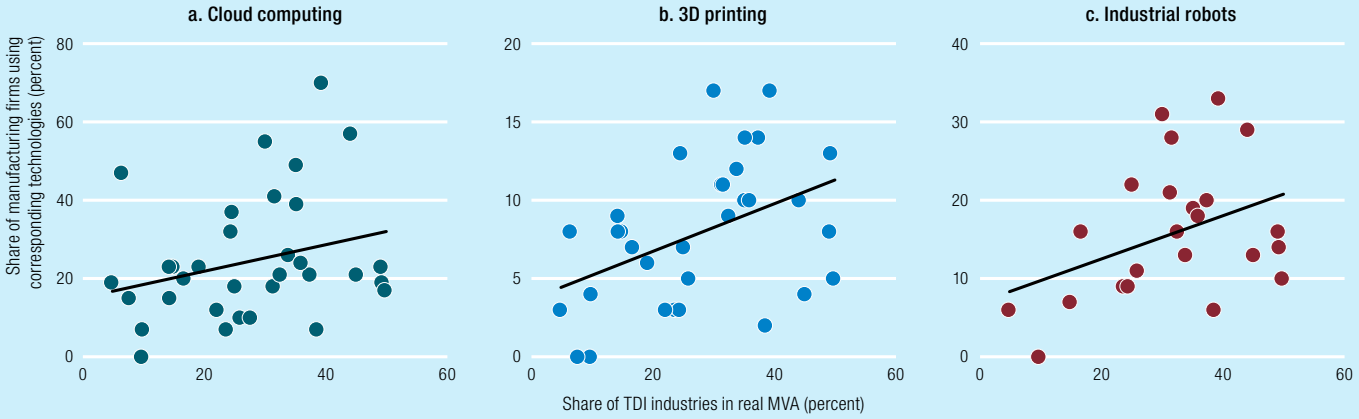
Adoption rates of key ADP technologies differ across industries in Europe



Note: The figure shows how the diffusion of key ADP technologies relative to the average adoption rate across the entire manufacturing sector differs between individual industries. Source: UNIDO IDR 2020 Figure 2.1, page 66

Figure 3

The adoption of key ADP technologies is positively associated with the share of TDI industries in MVA



Source: UNIDO IDR 2020, Figure 2.2, page 67

Technology and digitally intensive industries are the engines for the development of ADP technologies. The majority of R&D and engineering laboratories developing ADP technologies and their applications tend to hail from firms that are active in these industries. Possessing an industrial structure in which TDI industries carry greater weight, therefore, enables countries to learn and accumulate experience in the new technologies.

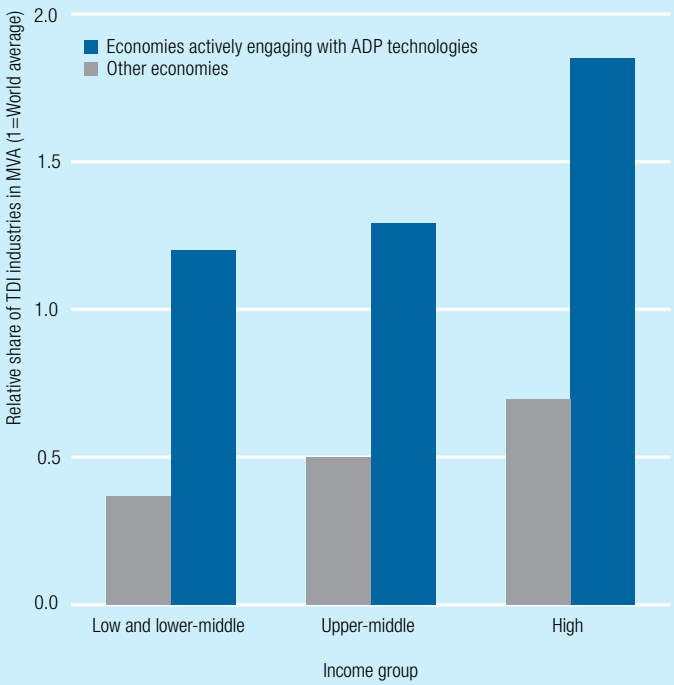
It is thus not surprising that a higher share of TDI industries in a country's MVA is not only linked to faster adoption rates, but also to a higher level of engagement with ADP technologies. Countries whose industrial structure revolves around TDI industries tend to patent and trade in these technologies much more than those countries where this is not the case. This observation holds in general, but also across income groups (Figure 4).

Structural change in a digital age

A country's industrial structure certainly matters for the diffusion of ADP technologies. But how does the diffusion of new technologies affect countries' industrial structure over time? Figure 5 takes 2005 as a cut-off point—patenting in ADP technologies seems to have started taking off at about that time—to evaluate how the distribution of MVA between different industries has changed over time. If adopting the new technologies entails a competitive premium, then countries' productive structure should move towards TDI industries. The evidence appears to substantiate this observation (Figure 5, next page).

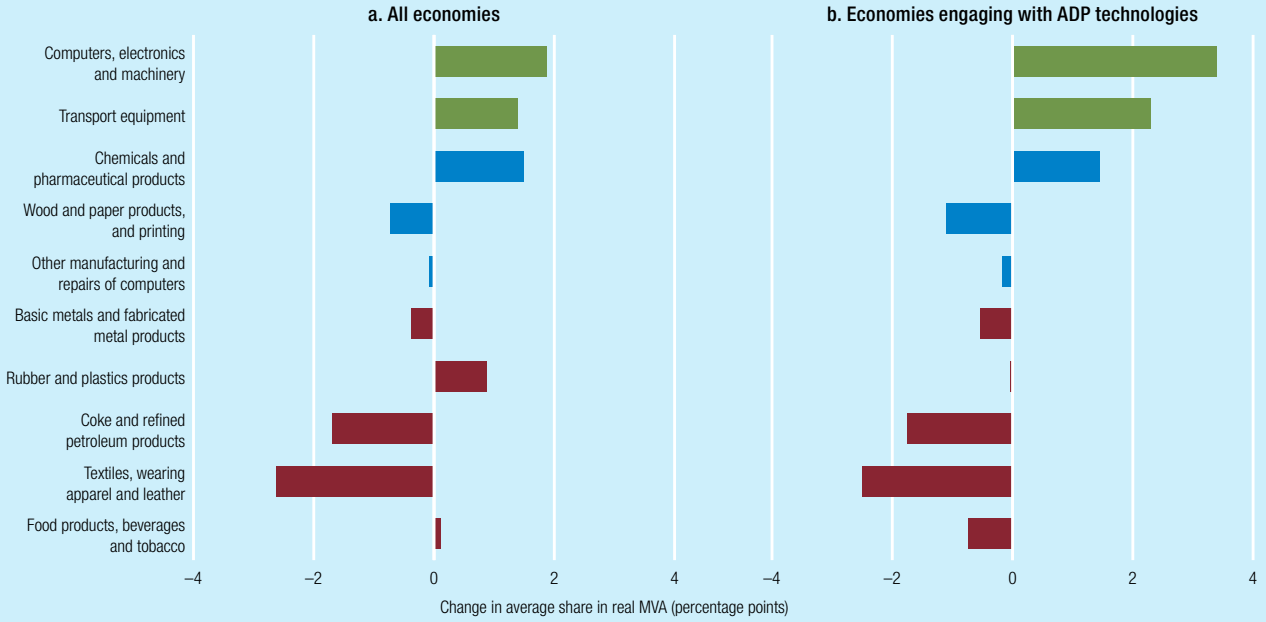
Figure 4

Across income groups, economies that actively engage with ADP technologies also have a larger share of TDI industries in MVA



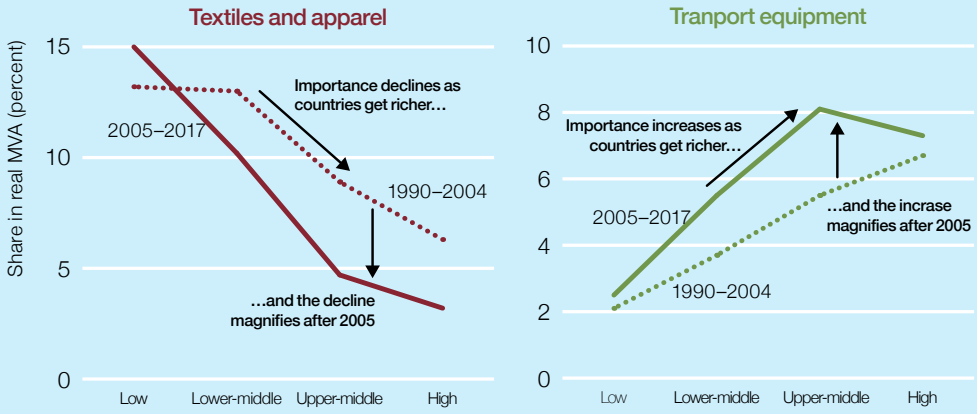
While structural change towards TDI industries is particularly rapid in economies that actively engage with ADP technologies (Figure 5, panel b), structural change is taking place across the board. The importance of TDI industries over the course of economic development is clearly increasing. When we compare trends before and after 2005, we observe that since patenting in ADP technologies took off, the share of TDI industries—such as transport equipment—in countries' MVA has increased, whereas traditional industries, such as textiles, have decreased in importance (Figure 6, next page).

Figure 5
The average share of TDI industries in MVA is increasing



Note: The figure illustrates the change in the average share of different industries in real MVA between 1990–2004 and 2005–2017. Source: UNIDO IDR 2020, Figure 2.5, page 69.

Figure 6
As ADP technologies started to take off, TDI industries began playing a more prominent role in structural change



Note: The figure presents average MVA shares for the two periods 1990–2004 and 2005–2017. Income levels are defined according to the World Bank classification for the year 2005, the mid-point of the complete range being considered. Source: UNIDO IDR 2020, Figure 2.6, page 70.

Conclusions

- Countries' productive structures matter for the diffusion of ADP technologies;
- Technology and digitally intensive (TDI) industries are the engines of the Fourth Industrial Revolution;
- The rise of ADP technologies has amplified the significance of TDI industries in the process of structural change.

References and/or suggestions for further reading

Calvino, F., Criscuolo, C., Marcolin, L. and Squicciarini, M., 2018. A Taxonomy of Digital Intensive Sectors. OECD Science, Technology and Industry Working Papers 2018/14. Paris: OECD Publishing.

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