



Forced March to the Future: R&D and INNOVATION

June 2019

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In making an investment decision investors must rely on their own examination of the Company and the terms of the offering including the merits and risk involved.

Forces march to the future: R&D and Innovation

Over the last three decades, rapid evolution of information and communication technologies and internet have provided a new framework and opportunity for economic growth. As the cost of acquiring and sharing information drastically fell in this period, its application to production processes created immense changes in economic activity. Amidst shorter product life cycles, more demanding consumers and intensifying competition in global trade, companies continue to put increasing effort in generating new ideas and transforming their knowledge into commercial value, a procedure which is simply expressed as innovation.

Today, under the circumstances mentioned above, it is widely accepted that achieving a higher level of output is not dependent only on increases in the quantity or quality of production factors (land, labor, capital and raw materials), but also on the improvements in the technology available to the economy. New technologies coming to life through innovation exploit and further enable the development of new production methods, novel materials and products with unprecedented

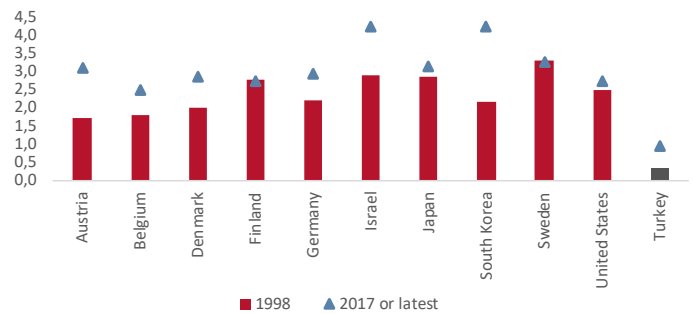
functionality or capabilities. They can reduce the reliance on raw materials, consumption of energy and diminish the adverse impact on the environment by limiting the volume of waste and pollution generated.¹

In the creation process of knowledge and innovation research and development (R&D) activities play a key role. R&D activities can be defined as activities that benefit from the human capital and existing stock of information with the purpose of having scientific and technical outputs and developing new products, services and processes to meet the needs of the market.

Countries determined to improve their economic growth performance put great emphasis on R&D expenditures. Between 1998 and 2017, in the 10 most innovative countries, R&D spending as a proportion of GDP shifted upward by 0.7% on average (Figure 1). Developing countries including Turkey, on the other hand, want to keep the pace with the dynamic global advancements in order to stay integrated and competitive.



Figure 1: R&D Intensity in Leading Innovative Countries and Turkey (%)



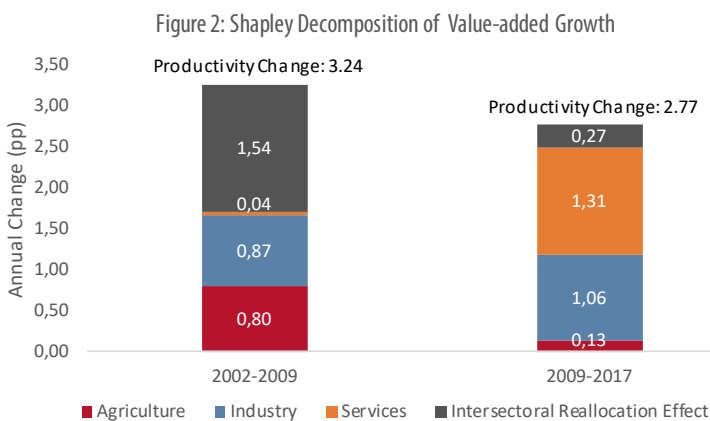
Source: World Bank, Turkstat, TSKB Economic Research

¹ Gkotsis, P., Vezzani, A. (2016); Advanced Manufacturing Activities of Top R&D Investors: Geographical and Technological Patterns

Turkey Continues on a Bumpy Road

After five decades of industrialization, Turkey accepted an export-oriented strategy in order to restructure and liberalize the Turkish economy and fight against high balance of payment deficit in early 1980s. Yet, policies combining export incentives with depreciation of currency yielded mixed results in the next two decades as the anticipated economic growth was interrupted with the financial crises of 1994, 1998 and 2001 mainly due to failed anti-inflationary policies, poor fiscal discipline and liquidity problems of banks. This strategy came to fruition only after the arrangement of a reform program combined with the execution of austerity measures and banking regulations in 2002.

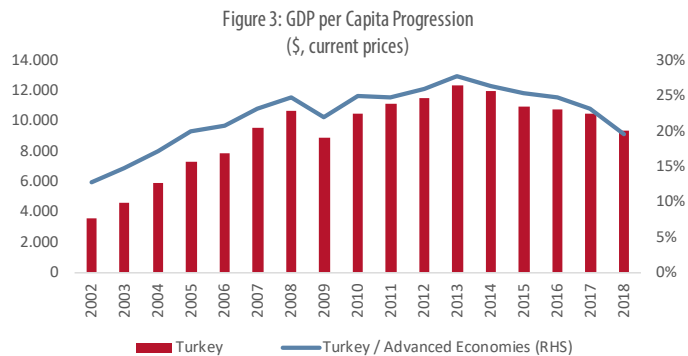
From 2002 to 2006, Turkey achieved an average growth rate of 7.6%. This performance was largely driven by investments in machinery and equipment as strong capital inflows and abundance of credits supported the economic environment. We also witnessed reallocation of resource from low-to high productivity sectors. The weight of traditional sectors like agriculture and textile gradually declined while export oriented automotive and electrical machinery sectors emerged. However, since 2009 due to the slow diffusion of productivity-enhancing know-how and techniques, efficiency gains stay limited (Figure 2). In addition, the share of high technology products remains low.



Source: World Bank Turkey Quick Scan (2019), TSKB Economic Research

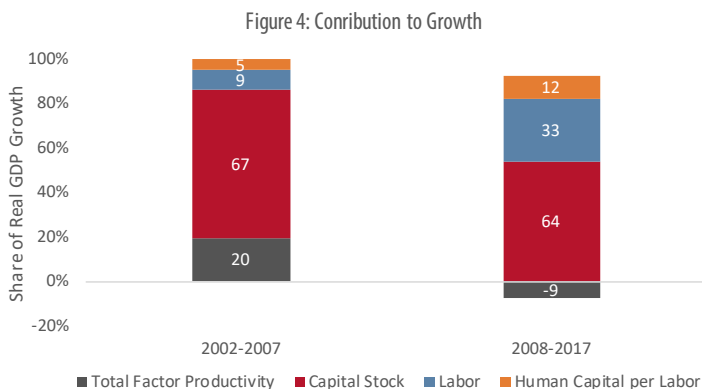
Although employment expansion, wage growth and improvement in infrastructure and social services helped narrow the income gap between Turkey and advanced economy until global financial crisis, convergence came to a halt in years ahead (Figure 3).² Following the global financial crisis, average growth in Turkey's national income slowed to 5.2% and showed increasing volatility.

In post-crisis period, despite the moderate speed of de-agriculturalization and improving labor force



Source: IMF World Economic Outlook (April 2019), TSKB Economic Research

participation, the surplus labor seemed to be allocated in construction and services sectors instead of industry. Industry's share in total employment fell from 22% in 2008 to 19.7% in 2018. De-industrialization threat made its presence felt in the sophistication and diversification processes of manufacturing sector. Figure 4 addresses the slowing structural transformation, embodied in decreasing contribution to growth from human capital and total factor productivity.



Source: World Bank Quick Scan (2019), TSKB Economic Research



² Acemoglu, D., Ucer M. (2015); The Ups and Downs of Turkish Growth, 2002-2015: Political Dynamics, The European Union and the Institutional Slide

An Unfinished Transition

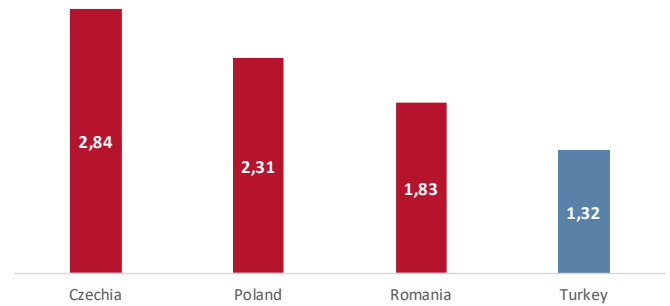
When middle-income countries fail to move up from low value added, labor intensive manufacturing to knowledge intensive manufacturing, they lose their comparative advantage against late industrializing low cost countries as surplus labor diminishes and real wages increase. In that way, they are forced into price competitions and have difficulty in keeping their market share. Since these countries lack the capabilities to produce knowledge and innovation intensive products, they are also challenged by high skilled manufacturers in the advanced countries. Inevitably, their growth rates decline and they become stuck in middle income trap.³ Figure 5 and Figure 6 illustrate Turkey's struggle to increase the value added in exports.

Figure 5: Turkey's Export Value per kg (USD)



Source: Turkish Exporters Assembly, Trade Map, TSKB Economic Research

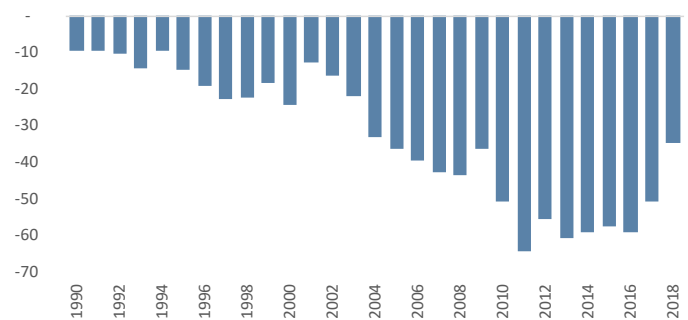
Figure 6: Export Value per kg (USD) in Selected Countries (2018)



Source: Trademap, TSKB Economic Research

A more competitive manufacturing sector, with more weight in the economy and higher net exports can contribute to rebalancing Turkey's growth path through external sustainability. Turkey's "technology deficit", which corresponds to the foreign trade balance in medium-high tech and high-tech manufacturing industries, widened steadily over the last two decades (Figure 7). The retreat in the last two years is largely owed to sluggish growth performance.

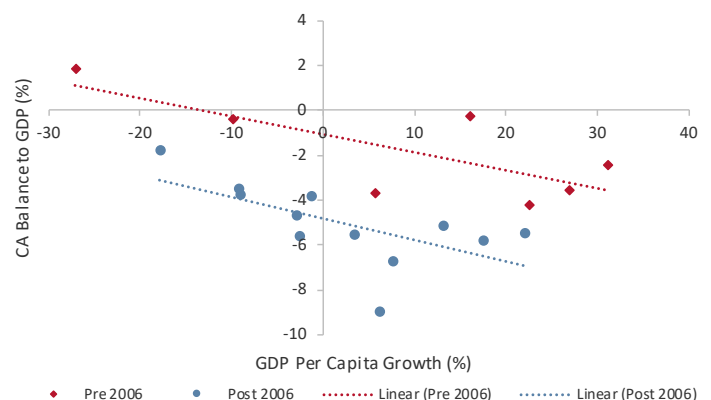
Figure 7: Technology Deficit of Turkish Foreign Trade (billion \$)



Source: TurkStat, TSKB Economic Research

Slow transformation process towards knowledge-based production has been threatening Turkey's macroeconomic stability for over a decade. An updated version of Rodrik's work on structural current account deficit shows that Turkey has had to suffer a wider current deficit for each unit of per capita GDP growth since 2006 (Figure 8).

Figure 8: Structural Current Account Deficit



Source: Updated from Rodrik by TSKB Economic Research
Rodrik, D.; "Turkish Economic Myths", April 2015, Dani Rodrik's Weblog



³Yilmaz, G. (2014); Turkish Middle Income Trap and Less Skilled Human Capital

Time for a Forced March

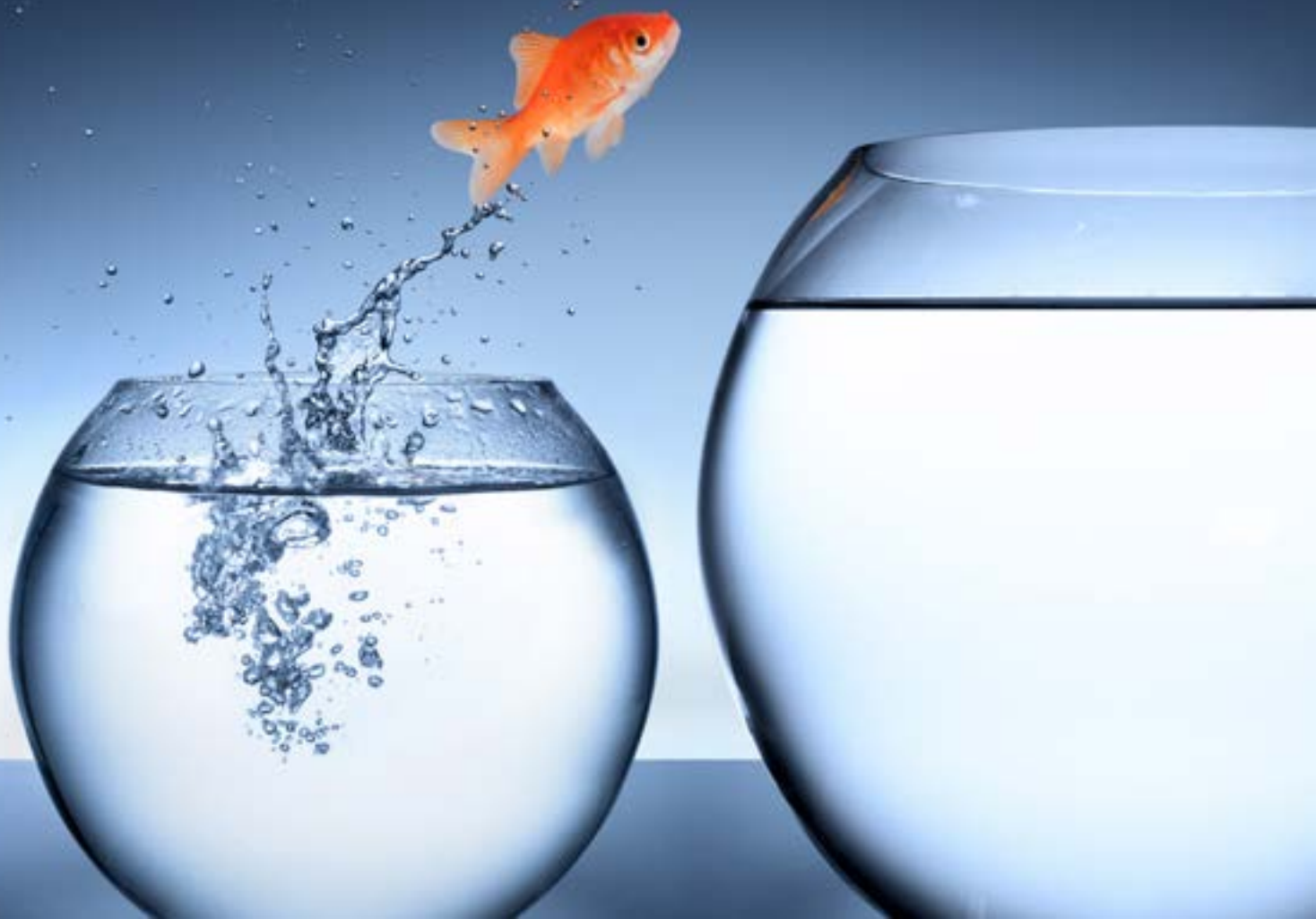
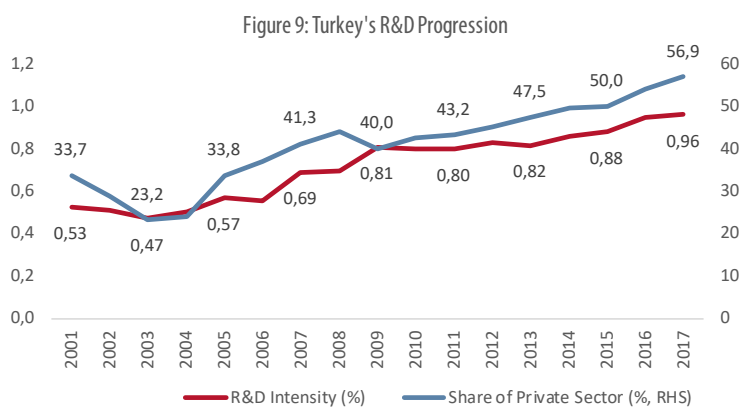
Moving away from labor-intensive manufacturing to gain productivity increases and reach a broad-based growth requires innovation. R&D expenditures are of vital importance in the generation of new knowledge and ideas, which form the basis of innovation. Turkey's R&D expansion started in 2000s and focused initially national missions in the areas of aerospace, defense and health technologies.⁴ Despite rapid increases in public and private expenditure, Turkey's R&D intensity stands at 0.96%, significantly lower than 1.78% in upper income countries.

2023 targets set by Turkish government point to an R&D intensity ratio of 3%. Additionally, the share of private sector is intended to constitute two-thirds of the total expenditures. Although these targets are too ambitious to fulfill until 2023, they will be crucial to attain sustainable growth in the long term. The contribution of product sophistication to the efforts to escape middle income trap is well documented in literature. In two of these studies, Eichengreen et al. (2013)⁵ point out that middle income countries with higher tech export share are more resistant to slowdowns, while Kharas and Kohli (2011)⁶ argue that skill intensive manufacturing lay the ground for productivity improvements and market expansion.

⁴ OECD (2016); OECD Economic Surveys: Turkey

⁵ Eichengreen, B., Park, D., Shin, K. (2013); Growth Slowdowns Redux: New Evidence on the Middle Income Trap

⁶ Kharas, H., Kohli, H. (2011); What is the Middle Income Trap, Why Do Countries Fall into It, and How Can It Be Avoided?



Focus: An Evidence on R&D's Role in Competition

Hausmann et al. (2005) presented a measure called Prody, to rank individual products' sophistication levels. Hausmann's Prody suggests that a good which is produced with more efficiency by a high income country is more sophisticated. The measure accepts revealed comparative advantage (RCA) as the indicator of efficiency.

$$P R O D Y_p = \sum_c \frac{R C A_{c,p}}{\sum_c R C A_{c,p}} Y_c = \sum_c \frac{(X_{c,p}/X_c)}{\sum_c (X_{c,p}/X_c)} Y_c$$

$$R C A_{c,p} = \frac{X_{c,p}}{\sum_p X_{c,p}} / \frac{\sum_c X_{c,p}}{\sum_{c,p} X_{c,p}}$$

$X_{c,p}$: Country c's export value for product p

$\sum_p X_{c,p}$: Total export value of country c

$\sum_c X_{c,p}$: World-wide export value of product p

$\sum_{c,p} X_{c,p}$: Total export of the world

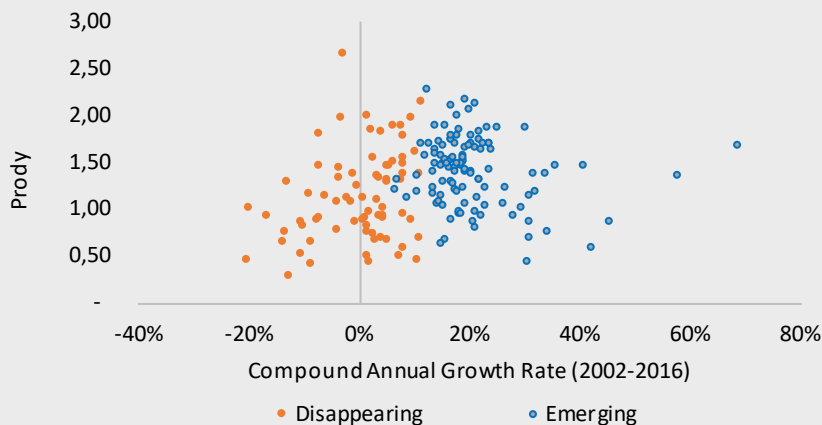
X_c : GDP per capita of country c

In our study, we replaced GDP per capita variable with countries' R&D intensity (R&D expenditure / GDP) value to create R&D intensity indicator (RDII). According to this indicator, goods produced by more R&D intensive countries with higher efficiency is more R&D intensive.

Using data of 73 countries, we calculated RDII for 1225 products (4-digit Harmonized System). R&D intensity ratio and export data are provided from World Bank and Cepii respectively.

After obtaining RDII for each product we examined Turkey's economic structural transformation of the in terms of comparative advantage between 2002 and 2016. The products for which Turkey gained comparative advantage are categorized as "emerging" and the products that comparative advantage is lost are categorized as "disappearing". As shown in the Figure 10, average RDII level of emerging products are higher than disappearing products. Our work materializes the idea that Turkey can abstain from competition from late industrializing countries as well as middle income trap by emphasizing the production of sophisticated goods.

Figure 10: Sophistication and Export Performance



Firms Hit Financial Constraints

With the increasingly tough competitive conditions in international trade, companies not only have to quickly adapt their business system to internal and external changes, but also better predict and anticipate clients' needs and seek efficiency-enhancing solutions. This requires continuous effort in R&D activities. However, financing and credit constraints arising from the unique characteristics of R&D have an adverse and restraining effect on these investments.

Unlike most capital investments, R&D investments do not share common features across firms within the same industry. Consequently, creditors can derive little or no information about the productivity and value of a firm's R&D project by analyzing a similar project conducted by another firm.⁷ The lack of organized markets for R&D is the second obstacle to a healthy valuation. In the example of physical and financial assets, these markets convey the necessary information through prices.

Uncertainty is an important aspect of R&D projects. Technically, it might be unknown whether R&D outlays will lead to a working innovation or from a strategic perspective; a competitor firm might conceivably conduct a similar research. In these cases, the firm would miss out on the competitive advantage and gains which it projected before commencing the project.

Even when these uncertainties are solved, the firm faces profit uncertainty about whether its business model is able to capture the benefits related to the innovation.⁸ In addition to that, R&D investments create intangible assets that cannot be resold in secondary markets and that are hard to use as collateral. When R&D outlays do not lead to a marketable product, residual value is much less than any capital investment with similar size. Unless there is another type of collateral available, this makes external funds costlier.

By their very nature, innovative projects involve complex and firm-specific processes that enables the firms to obtain new products and services leading to long-term competitive advantage. These projects contain sensitive information on production methods and due to leakage fears firm representatives are likely hesitant to reveal the details to the creditors. Managers' knowledge on technology and appetite for risk can also evoke moral hazard and adverse selection problems. In that regard, the asymmetric information problem between the debtor and the creditor is more severe for R&D investments than for ordinary investments. Most financial institutions do not possess the scope and necessary skills to evaluate innovative technologies properly, thus, their monitoring can discourage such investments.



⁷ Aboody, D., Lev B. (2000); Information Asymmetry, R&D, and Insider Gains

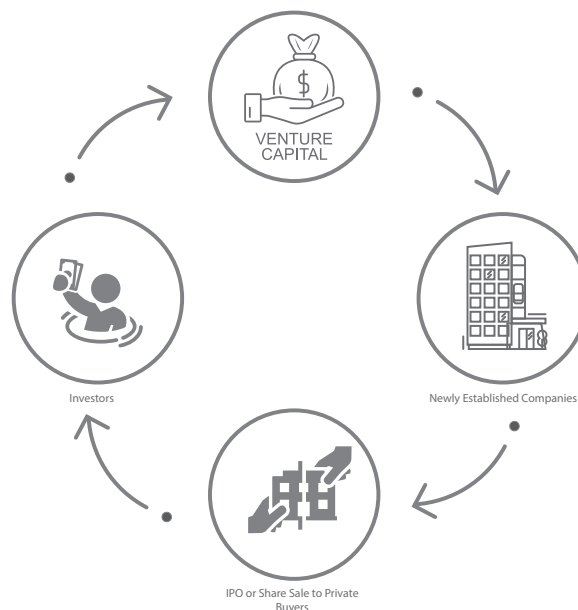
⁸ Bakker, G. (2013); Money for Nothing: How Firms Have Financed R&D Projects Since the Industrial Revolution

As briefly discussed above, R&D activities are associated with outcome risk, long investment cycle and low collateral value. Credit financing of R&D is impacted by these elements of uncertainty as the lender does not participate in the profits generated from the investment and interest rate is not tied to the project outcome. The only way for the lenders to compensate for the uncertainty is to increase interest rates charged on R&D-related loans.

The pecking order theory by Myers and Majluf (1984) explains that investments with high information asymmetry is primarily financed by internal funds. In line with the hierarchy suggested by the theory, when the firms fail to gain required funds internally, they depend on debt financing and security markets. The tendency to prefer internal funds to debt is attributable to the fact that firms tend to avert financial and administrative pressure associated with fixed repayment schedules in cases where it takes years of investing before the cash flows are realized.

In Turkey's case, where the financial system continues to develop, debt financing is much more important for R&D persistence. With the absence of a dynamic market for initial public offerings, Turkish companies are denied the chance to access a substantial source of finance. Unsophisticated financial markets also limits the role of venture capital in the solution to the funding problem. Besides providing the required finance to innovative activity, venture capital can contribute to companies' level of professionalism and business model. Despite

Figure 11: Simple Overview of How Venture Capital Works



its advantages, venture capital requires a liquid equity market that allows investors to exit by selling their shares.

All in all, despite the presence of more suitable financing options, developing countries like Turkey has to rely on debt financing in R&D until their security markets mature enough to undertake their role in the financing of R&D activities. In that time, it is banks' responsibility to build up their capabilities to assess these investments. The recent empirical research on credit market and R&D activity is summarized in Table 1.

Table 1: Empirical Literature on Credits-R&D Relationship

Author(s)	Year	Country	Conclusion
Akıncı, Akıncı, Yılmaz	2014	OECD	Domestic credits --> R&D intensity Domestic credits --> R&D workforce per million people
Helhel	2016	E-7	Domestic credits --> R&D intensity
Ilyina, Samaniego	2010	US	R&D intensive industries tend to be the main beneficiaries of financial development

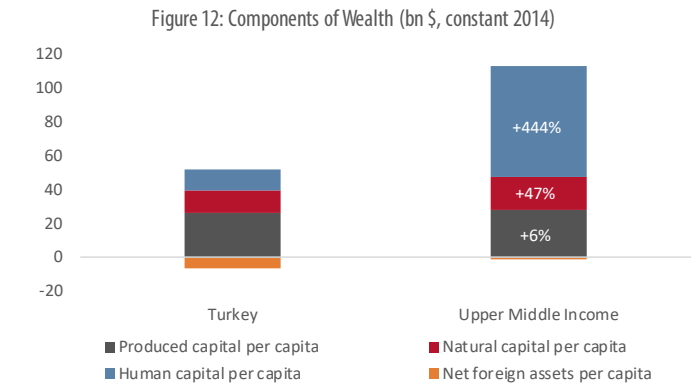
⁹ Micucci, G., Rossi, P. (2013); Financing R&D Investments: Relationship Lending or Financial Markets?

Human Capital, the Greatest Asset

In order to maintain the ability to produce superior products and services, an economy must accumulate human capital in the form of skills. Stagnant structural transformation and limited human capital accumulation has the potential to trigger a vicious cycle impeding growth. A World Bank study published in 2018, *The Changing Wealth of Nations*, brings light to the composition of wealth for each individual country. The study presents striking results regarding Turkey. Turkey's human capital level is 5 times lower than upper income countries. Its share in total wealth stands at only 26% in Turkey, well below 59% in the rest of the group. The figures imply a much more severe drawback in human capital than physical and natural capital.

In efforts to escape the middle income trap, Turkey needs an education system that prioritizes skills required for technology and innovation based growth. The collaboration of educational institutions with innovation-centered industries and equal educational opportunities for different population groups will absolutely enhance the transformational process.

Training is also an essential tool for adopting new technologies and shifting from low to high skill jobs. On-the-job training (OJT) can support human capital accumulation even when there is limited R&D activity. OJT, if given a larger part in businesses, allows workers to continually learn and produce broader set of goods. With the introduction of new goods, managers and workers can move up the "quality ladder" more easily.



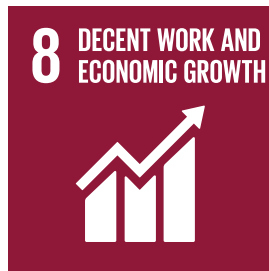
Source: World Bank *The Changing Wealth of Nations* (2018), TSKB Economic Research

Final Remarks

Amidst a more stagnant growth outlook and fierce global competition, Turkey has to put greater emphasis on scientific and technological policies than ever before. In order to abstain from the middle income trap, both the government and private sector have roles to play. R&D investments are the main determinant of the high-value-added production and thus, cannot be left to their own dynamics.

A new paradigm prioritizing R&D will not only revitalize Turkey's growth performance, but also narrow down the gaps between country's different regions. R&D spillovers and backward linkages created in the production process can result in new and better employment opportunities if social and infrastructural requirements are met.

Achieving success in this crucial area will contribute to two of the UN Sustainable Development Goals.





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