CHAPTER 6. FOSTERING TECHNOLOGY ADOPTION, INNOVATION, AND SKILLS

6.1 ***Productivity differences between countries and between firms within countries are affected by differences in levels of innovation, access to and capacity to adapt technology, use of quality standards, and the availability of a highly skilled labor force***. A significant body of international theoretical and empirical evidence demonstrates links between technology, innovation and skills (the *knowledge factors*) and total factor productivity (TFP) and economic growth.[157] The *knowledge factors* are also essential for attracting higher levels of Foreign Direct Investment (FDI). As cheap labor becomes less relevant to attracting FDI, availability of technologically advanced local suppliers and a highly skilled labor force become more important for influencing the location decisions of multinational companies (MNCs). Acknowledging the importance of the *knowledge factors* as drivers for productivity and growth, governments in recent years have tried to devise ways to foster technology absorption, increase innovation, encourage use of quality standards and improve the skills of the labor force. For Turkey, this is of the utmost importance, considering the need to ensure sustained fast long-term growth through increased TFP and FDI.

6.2 ***Harnessing the knowledge factors is a central element of the European Commission's policies and strategies to improve EU (and candidate) countries' competitiveness and growth.*** The EC has placed knowledge at the core of its economic policy objectives by issuing a Green Paper on Innovation in 1995 and by setting "make the European Union the most competitive and dynamic knowledge-based economy by 2010" as one of its key objectives at the 2000 Lisbon Council Summit. (See Annex 6.1 for a review of EU knowledge strategies and programs released since 1984.) Turkey has been a full associate member of EU Research and Development Framework Programs since the creation of FP6 in 2002. FP6 aims to contribute to the creation of a "European Research Area" (ERA) and promote research activities in support of implementing EU innovation policies and strategies. The 2003 Innovation Communication identified for the first time specific challenges that candidate countries need to address in the knowledge areas in order to improve the performance of the enlarged EU, including improving countries' institutional capacity to foster innovation, embedding innovation in several policy areas and strengthening the role of the private sector in innovation.

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[157] For a detailed discussion of the impact of technology, innovation and skills on productivity, see Chapter One of *Closing the Gap in Education and Technology* (World Bank, 2003).

6.3 **While the *Acquis* does not dedicate a specific chapter to the knowledge variables, several of its sections include requirements related to knowledge improvements with which Turkey will have to comply.** Key sections of the *Acquis* that cover issues that are related to, or that can influence, the *knowledge factors* include: Chapter 25 on Science and Research, which addresses institutional issues and countries' capacity to use EU funds for innovation; Chapter 6 on Company Law, which addresses issues related to protection of Intellectual Property Rights; and Chapters 1 and 4 on Free Movements of Goods and Capital (respectively), affecting technology adoption and quality standards. Other EU documents complement *Acquis* requirements by providing broader recommendations to improve Turkey's performance in the knowledge areas.

6.4 ***The objective of this chapter is to highlight critical issues related to technology adoption, innovation, quality standards and skills in Turkey by conducting a diagnostic of the country's performance in these areas and providing policy recommendations.*** This chapter comprises three sections. The first section focuses on technology adoption and innovation. The second section looks at quality standards and the Turkish National Quality System, and the third section provides an overview of Turkey's labor skills, with a focus on the specific needs of the private sector to improve its ability to adopt technology and innovate. For each topic, the chapter provides a diagnostic of the country's performance and provides policy recommendations, both to meet *Acquis* requirements and — more broadly — to improve the country's productivity and sustainable long term growth.

6.5 ***The analysis in this chapter is based on the premise that both the private and the public sector have essential roles to play in developing and managing the knowledge factors.*** The reason lies in market failures related to the *knowledge factors, which* have been well documented in existing research:[158] (a) knowledge is non-appropriable because it is a quasi-public good — that is, the knowledge developed by one individual or firm can easily be transferred to another; (b) knowledge generates specific positive externalities and spillovers; (c) investments in innovation are long-term and risky, which implies that private firms are unlikely to undertake them alone; (d) the process of innovation involves bringing various actors together and is subject to coordination failures and free rider behaviors; and (e) diffusion of knowledge is not appropriable. Thus, while adopting new technologies and improving productivity is ultimately the responsibility of firms, governments have important roles to play. This chapter dedicates specific attention to the interplay between the public and private sectors and focuses on the need to strengthen the government's capacity to catalyze knowledge development.

A. PROMOTING TECHNOLOGY ADOPTION AND INNOVATION AT THE FIRM LEVEL

6.6 ***Technology adoption and innovation are intertwined.*** Development of new technologies is mostly the prerogative of firms and institutions in high-income, scientifically- and technologically-advanced countries (often referred to as "core

[158] World Bank, *Closing the Gap*, page 134.

innovators").[159] Most low- and middle-income countries, on the other hand, innovate mostly by absorbing existing technologies.[160] However, the links between technology absorption and innovation are often blurred, with local innovation being an essential requirement to successfully absorb technologies and, equally importantly, to adapt them to the local needs.[161] Focusing on both dimensions is particularly important for a country like Turkey, which is growing rapidly, is very much in need of local innovation to adapt technology to local needs, and could strive to become a "core innovator" in areas in which it has comparative advantages. The sections below analyze key determinants of technology adoption, innovation and collaboration between research institutions and firms (an essential condition to improve both technology adoption and innovation) in Turkey and provide policy recommendations to improve Turkey's performance in these areas.

A.1. Technology Adoption

6.7 ***The three main avenues for acquiring technology in an open economy are importing capital goods, FDI and licensing. Turkey's relatively low levels of capital goods import is a first indicator of the country's limited access to foreign technology.*** The importance of trade, FDI and licensing as drivers of technology absorption has been emphasized by endogenous growth theory.[162] Capital goods often embed technologies and productive applications that increase the stock of capital as well as its marginal productivity.[163] At the end of 2004, imports of capital goods in Turkey were low, at 26 percent of total investment, about one third of the proportion in Bulgaria and one fourth of that in Thailand (Figure 6.1). Direct import of capital goods embedding foreign technologies is an unexploited means that Turkish firms could use to tap into global knowledge, as demonstrated by the East Asian countries, for which importing of technologies through capital goods has been a key means for productivity improvements.

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[159] On the concept of core innovators and for a more detailed discussion of creating versus absorbing new technologies, see the World Economic Forum (WEF) *Global Competitiveness Report* (World Economic Forum, 2000 and following years), in particular, the section by M. Porter and S. Stern in the 2003-2004 *Global Competitiveness Report*, pages 91-111. The WEF defines "core innovators" as countries that have more than 15 US utility patents registered per annum per million population and "non-core innovators" as all other countries.

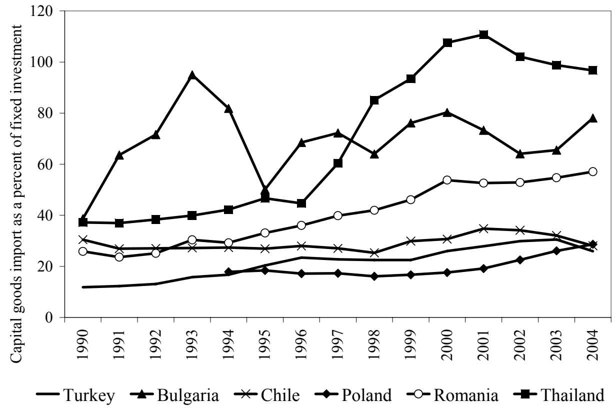
[160] See, among others, S. Lall, "Technology Absorption: An Overview" (presented at The World Bank Istanbul Knowledge Economy Forum, April 2005).

[161] See Cohen and Levinthal "On the importance of R&D for technology absorption" in *Absorptive Capacity: A New Perspective on Learning and Innovation* (1989). See also World Bank, *Poland and the Knowledge Economy* (2004), and World Bank, *Concept Note for a Regional Study on Access to Finance and Innovation in East European and Central Asia Countries* (2004).

[162] See Romer (1996, 1990), Lucas (1988), Grossman & Helpman (1990) and World Bank, *Closing the Gap.*

[163] On the importance of imports of capital goods, see Eaton et al. (2000).

Figure 6.1: Capital goods import/investment



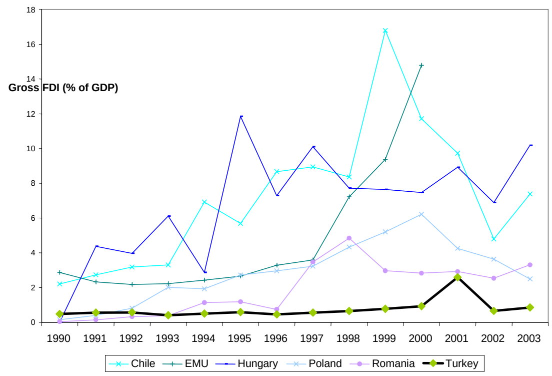
Source: World Bank Live Database, 2005.

6.8 ***Direct investment from foreign firms is a second means of acquiring advanced technology from abroad. In Turkey, FDI has been chronically low but prospects are improving after the rebound observed in 2005***. While worldwide FDI has increased by a factor of 12 in the last 15 years, FDI in Turkey has remained compressed since the mid-1990s, to less than 1 percent of GDP, compared with more than 3 percent in China, almost 7 percent in Bulgaria, and 10 percent in Hungary, for example (Figure 6.2). Although, as explained in chapter 1, FDI has boomed in 2005, to an estimated 2.6 percent of GDP, it is significantly lower than what would be expected considering the country's income level (see Figure 6.3). Several factors have limited FDI in Turkey, in particular weak investment climate conditions—including related to macroeconomic and political instability—and specific legal and institutional constraints.[164] Some of these constraints have been mitigated, and FDI is expected to grow in the coming years. This will increase non-debt creating capital inflows to Turkey, improve competition in the local market, and facilitate the country's integration with the global economy as well as technology absorption.[165]

[164] See Chapter One, The Product Market Regulations Chapter and S. Sayek, "FDI in Turkey: The Investment Climate and EU Effects," background paper (2005).

[165] Evidence about the impact of FDI on technology absorption is mixed. In some countries, FDI has been instrumental in increasing technology absorption among local firms, while in other countries multinationals (MNCs) have not created linkages with local firms, continuing to do business with their foreign affiliates. Key factors that have to be in place for local firms to integrate with local-foreign supply chains and take advantage of the opportunities offered by MNCs include a technically skilled and highly educated labor force and local firms' capacity to use advanced technology.

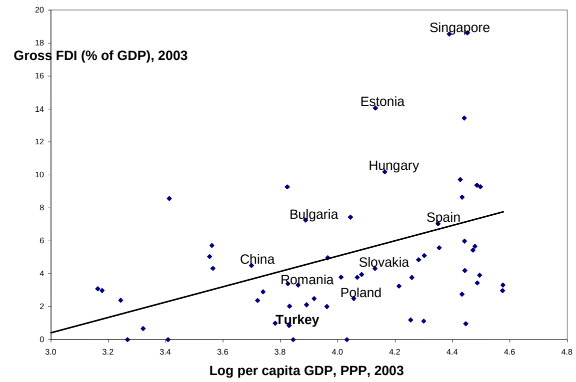
Figure 6.2: Foreign direct investment



Note: EMU — European Monetary Union countries.

Source: WDI, 2005.

Figure 6.3: Foreign direct investment: correlation with income

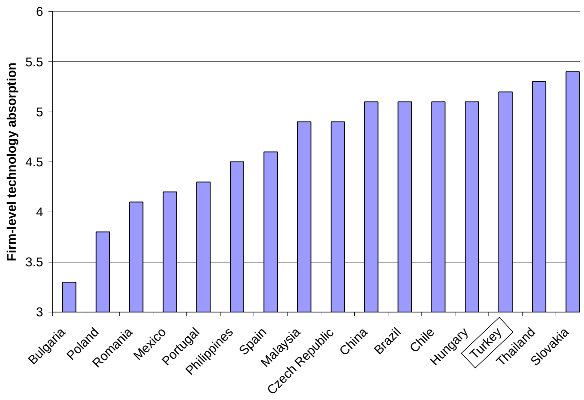


Source: WDI, 2005.

6.9 ***Interviews with leading Turkish business executives and entrepreneurs confirm that, while Turkish firms are eager to absorb technology, FDI is not yet a vehicle for acquiring it***. Among all comparator countries, Turkey has the widest disparity between firms' recognition of their readiness to absorb advanced technology and FDI contribution as a source of technological development — see Figures 6.4 and 6.5. This is probably due to the low current levels of FDI and concentration in sectors that are not technologically intensive (e.g., real estate, retail). On a more positive note, Turkey has experienced the positive effects of FDI in a few sectors, both in terms of growth and exports and in terms of spill-over effects on the local economy. In the automotive industry, for example, MNCs play a major role. They entered the Turkish market by merging with large local companies (e.g., Ford-Otosan, resulting from the merger of Ford and the local Koc group) and created strong links with several local small- and medium-size enterprises (SMEs), leading to an accumulation of know-how and the development of local technological capacities. [166]

[166] Interview with Ford-Otosan (February, 2005) and Sirin Elci, "Innovation and Technology Absorption in Turkey", 2005.

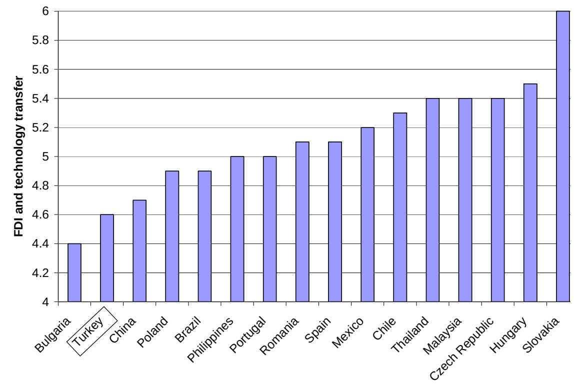
Figure 6.4: Interest of Turkish firms in absorbing new technologies



Note: Companies in your country are ...
... 1 = aggressively absorbing new technologies
... 7 = not interested in absorbing new technologies

Source: World Economic Forum (WEF), 2004-2005.

Figure 6.5: Acquisition of new technologies via FDI



Note: Foreign direct investment in your country ...
... 1 = brings little new technology
... 7 = is an important source of new technology

Source: WEF, 2004-2005.

6.10 ***The third avenue for absorbing foreign technology — licensing — is also somewhat weak in Turkey.*** Licensing involves the contractual transfer of technology between firms. It provides knowledge in a more accessible manner than FDI, and for this reason has been favored by several countries around the world, including Japan, Brazil, India and Mexico. Royalties and license fee payments in Turkey are about US$2 per capita — see Figure 6.6. This is broadly consistent with the country's level of development, although Turkey is below the regression line in Figure 6.7. However, other European comparator and Latin American countries are more aggressively tapping into the pool of global knowledge and over perform compared to their development level. As a comparison, per capita royalties and license fee payments in Poland, Slovakia and Chile are about ten times those of Turkey. Hungary is even more advanced, with per capita royalties and license fees of US$40. East Asian countries had Turkey's current levels of licensing in 1985 (US$2.7 per capita regional average). In 2002, the average per capita licensing for Korea, Thailand and Malaysia was US$42, with Korea reaching US$75. While aggregate values are low in Turkey, the country has had some success at licensing in manufacturing. Licensing agreements — particularly in automotive, automotive spare parts, and white goods sectors — have led to an accumulation of know-how and the development of local technological capacities.[167] Indeed, Turkish business executives and leading entrepreneurs consider licensing as a much more common means of acquiring technology than FDI — compare Figure 6.8 with Figure 6.5. Perceptions are far more optimistic than the real numbers indicate. At the same time, they do suggest that licensing is well known in Turkey and that it holds promise as a means to acquire technology in the future.

[167] Companies like Arcelik, Temsa and Tofas are good examples in this respect (interview with Arcelik, February, 2005). See also Sirin Elci, Op. Cit.

Figure 6.6: Royalty and license fee payments: trends

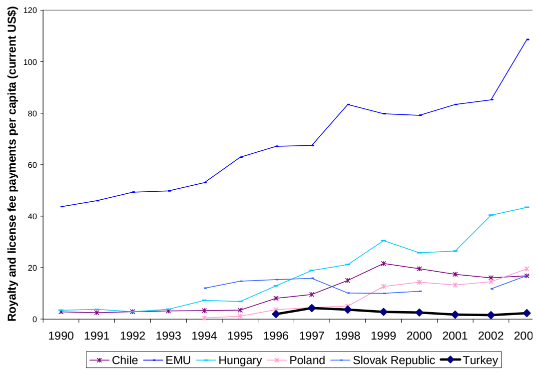
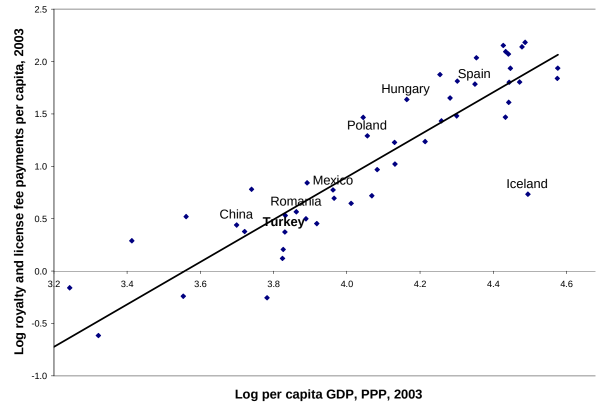
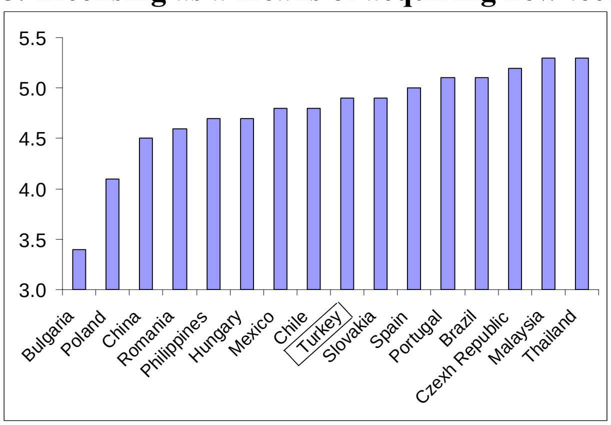


Figure 6.7: Royalty and license fee payments: level of development



Note: EMU — European Monetary Union countries.
Source: World Bank, WDI.

Figure 6.8: Licensing as a means of acquiring new technologies



Note: Licensing in your country ...
... 1 = brings little new technology
... 7 = is an important source of new technology

Source: WEF, 2004-2005

A.2. Innovation

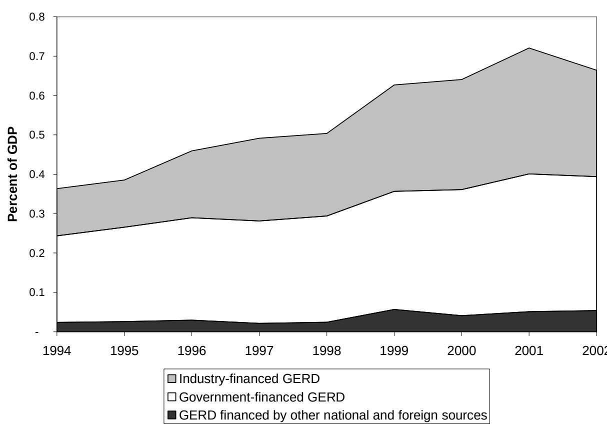
(a) Comparative Performance

6.11 ***Investment in R&D has improved in Turkey, and so has the share of R&D financed by the private sector, a key determinant of productivity.*** Without an adequate volume of R&D expenditures a country will most likely not ascend the technological ladder.[168] With gross expenditures in R&D (GERD) equaling 0.66 percent of GDP at the end of 2002, Turkey is in the middle of the GERD ranking compared to OECD countries taken as a reference (Figures 6.9 and 6.10). Turkey almost doubled its GERD during the

[168] World Bank, *Closing the Gap.*

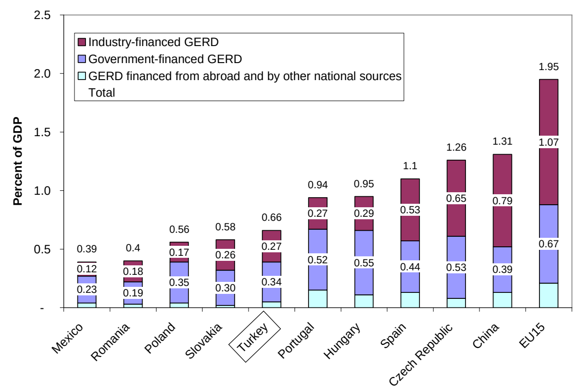
past decade, which (both public and private) is now slightly above that of countries with similar level of development (Figures 6.11 and 6.12). The latest budget allocation for R&D also confirms that the government is moving in the right direction — funds allocated from the 2005 (and 2006) budgets are much higher than in all previous years. However, and notwithstanding recent initiatives to increase institutional capacity – including the creation of the Turkish Research Area (TARAL) which has as one of its key objectives that of increasing institutional capacity for innovation and supporting public-private cooperation in this area—more effort are needed to ensure that Turkey has coherent programs and capacity to utilize these resources effectively. Despite a strong increase in private R&D during the past decade, firm-financed GERD in Turkey was still low at 41 percent of the total in 2002 (versus 52 percent in the Czech Republic and 60 percent in China, for example). R&D performed by enterprises affiliated with foreign companies is also very low — see Figure 6.13. Key objectives for the future will be increasing private R&D investment and ensuring productive use of public R&D by improving collaboration between the public and private sectors. Suggested measures to achieve these goals will be discussed in Section A.4.

Figure 6.9: Gross expenditures on R&D, trends and composition: Turkey.



Source: OECD, Main Science and Technology Indicators database, 2005.

Figure 6.10: Gross expenditures on R&D, total and composition: international comparison, 2001-2003, most recent data available*



Note: data are from 2003 for all countries but Mexico (2001) and Turkey and Portugal (2002).

Source: OECD, Main Science and Technology Indicators database, 2005.

Figure 6.11: Privately-financed R&D and level of development.

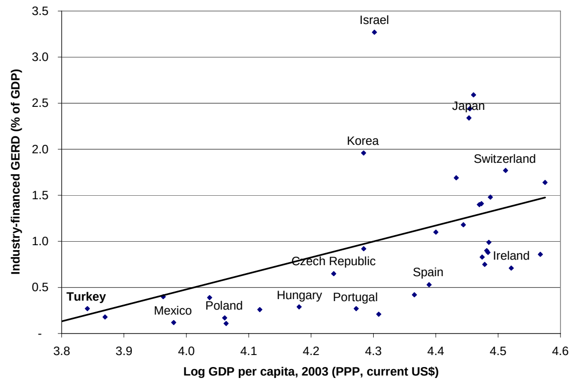
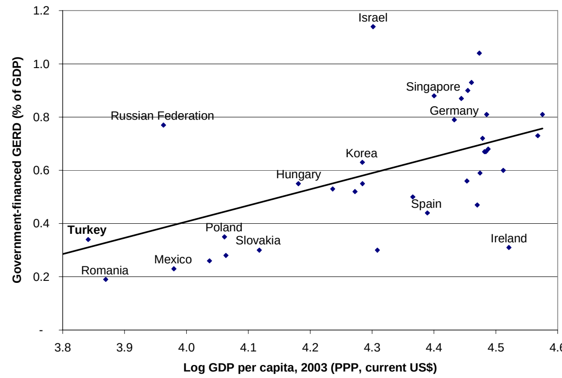
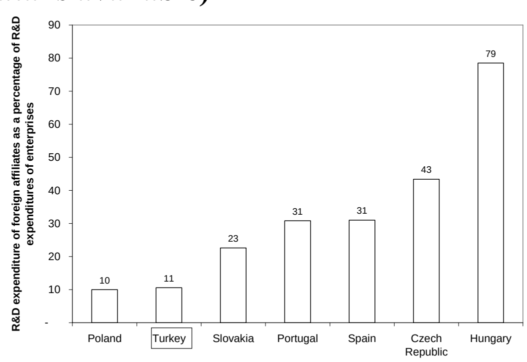


Figure 6.12: Government-financed R&D and level of development



Source: OECD, Main Science and Technology Indicators database, 2005.

Figure 6.13: R&D expenditure of foreign affiliates as percentage of total private R&D, 2000-2002 (most recent year for which data is available)



Note: 2002 data for Poland, Czech Republic and Slovakia, 2001 data for Portugal and Spain, 2000 data for Turkey and 1998 data for Hungary.

Source: OECD, Main Science and Technology Indicators, Volume 2005, Release 01.

6.12 ***The number of patents filed by Turkish innovators in the US is aligned with that of several comparators, but patents granted to Turkish inventors by the EU are limited and the number of patents registered locally is extremely low***. Patents are relevant for technological development because they protect inventions with industrial applicability.[169] While investment in R&D is an *input* to innovation, the number of patents registered by the residents of a country is a key *output* of the innovation process and can be considered as an indicator of the success of R&D expenditures. Table 6.1 includes the number of patents registered by residents of Turkey in the United States,

[169] Patent applications are for exclusive rights to an invention — a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection to the owner of the invention for a limited period, generally 20 years.

Europe and Turkey.[170] Turkey far underperforms all comparators (except Mexico) in filing patent applications at home. Turkish patent numbers are not growing and are low given the country's level of development (Figures 6.14 and 6.15). Turkish inventors also file few patents with the European Patent Office — fewer than all European countries except Romania.[171] The picture improves only when looking at patents granted by the United States to Turkish inventors — about as many as granted to inventors in Poland, although Bulgarians and Slovakians receive over twice that number — see Table 6.1.

Table 6.1: Patents granted per million population

	US utility patents granted per million population, 2003	European Patent Office applications, per million population, 2004	National patent applications, per million population, 2002
China	0.2	0.3	31.5
Philippines	0.3	0.0	NA
Romania	0.3	0.5	68.2
Poland	0.4	2.4	60.8
Thailand	0.4	0.1	NA
Turkey	**0.4**	**0.9**	**7.9**
Brazil	0.7	0.5	37.4
Chile	0.7	0.6	NA
Mexico	0.8	0.2	6.2
Bulgaria	1.1	2.0	38.9
Slovakia	1.1	2.2	51.3
Portugal	1.2	5.0	17.8
Malaysia	2	1.3	NA
Czech Republic	3.9	8.2	59.6
Hungary	7.3	9.3	94.7
Spain	7.5	20.6	105.8

Note: Population data used to calculate the EPO applications is for 2003 from the WDI

Source: US patents, USPTO; EP Patents, European Patent Office Annual Report 2004; National Patent, WDI, 2005.

6.13 ***Progress has been made to improve protection of Intellectual Property Rights in Turkey, but further effort is needed to ensure compliance with the Acquis.*** Intellectual property rights give the inventors or innovating firm the right to temporarily exclude others from using the new ideas commercially, improving innovation and (in turn) technology adoption. IPR protection requires clear rules to ensure that inventors can

[170] The advantage of measuring patents registered in the US is that it is of similar "quality" (within a given technology field) across countries. The shortcoming of this measure is that it reflects, in part, the expected likelihood that inventors of a given country will sell their product in the U.S., and may therefore be contaminated by trade and other flows across countries. Moreover, the relatively high cost may further discourage inventors from lower income countries from registering a patent in the U.S.

[171] Countries outside the European area are not ideal comparators in this case, as they are less likely to file patent applications with the European Patent Office.

appropriate the benefits of their research, together with implementation agencies that are able to ensure enforcement of the IPR rules. Weak enforcement of IPRs and regulatory gaps with respect to international standards (see below) seem to be at the origin of the underperformance regarding especially national patent applications. During the past few years, several legislative changes to improve IPR protection have been introduced in Turkey, including changes to the law on trademark protection to ensure compliance with other Turkish laws and EU requirements, as well as the introduction of decrees related to protection of pharmaceutical and medical processes and products and biotechnological inventions. The Turkish Patent Institute (TPE) has also strengthened its capacity and modernized processes in order to improve its services, including process automation, various IPR promotion campaigns and training programs, and the creation of an Industrial Property Campus building in Ankara, hosting specialized IPR courts. Despite recent progress, more effort is needed to ensure full compliance with *Acquis* requirements and the creation of a comprehensive legal and implementation IPR framework, which is in turn an important condition to foster productive innovation in Turkey. Specific suggestions are included in section A.4.

Figure 6.14: Patent applications (national patent office).

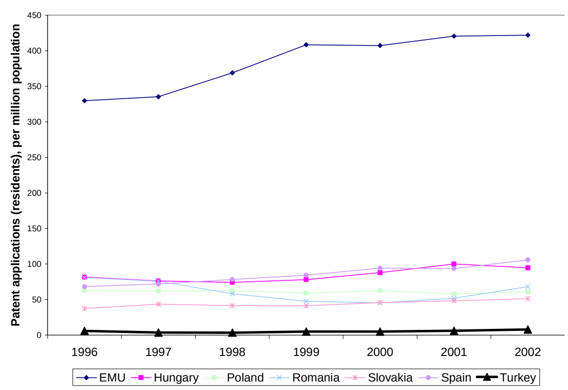
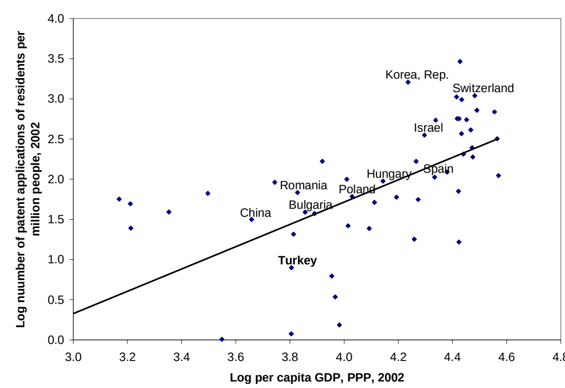


Figure 6.15: Patent applications (national patent office) and level of development.



Source: World Bank, World Development Indicators; U.S. Patent and Trademark Office.

(b) Finance For Innovation

6.14 ***Several tax incentive schemes aim to encourage investment in R&D in Turkey. However, their impact on innovation and their fiscal implications are unclear.*** Turkey has four fiscal schemes to promote R&D:

- Decree on Tax Postponement to Support R&D (1986)
- Support for R&D Investment (1986)
- Law of Technology Development Zones (2001)
- R&D Tax Exemption (2005)

Turkish firms do not find tax postponement or support for R&D investment incentives beneficial and therefore do not use these schemes. The incentives provided by the Technology Development Zone and R&D Tax Exemption Laws are very generous. They include deduction of 40 percent of R&D expenditures from taxable corporate income, in addition to the ordinary Investment Tax Allowance (deduction of 40 percent of investment expenditures) for all firms and exemption from CIT for software development and R&D activities, as well as PIT-exemption for salaries of R&D personnel until the end of 2013 for firms located in Technology Development Zones. The incentives provided under the Technology Development Law have fuelled high start up rates for technoparks in the past few years. However, the recently approved Tax Exemption legislation provides even more appealing incentives, which are likely to reduce future requests to locate in technoparks. These four schemes should be evaluated to assess their impact on innovation, fiscal impact and consistency with the *Acquis*.

6.15 ***Public and public-private matching grants and soft loans schemes also aim at promoting private R&D and innovation.*** Matching grants to promote private R&D are offered by TUBITAK-TIDEB under the "State Support for R&D Program" financed by the Treasury. TUBITAK-TIDEB provides up to 60 percent of the firm's total project budget to finance R&D-related expenses for personnel, materials, equipment, travel, consultancy and patenting. Reimbursable (soft) loans are provided by the Technology Development Foundation of Turkey (TTGV) with resources from the Undersecretary of Foreign Trade (also under the "State Support for R&D Program") and the World Bank (under the Industrial Technology Project). Finally, the Small and Medium-Size Industry Development Organization (KOSGEB) provides a mix of grants and soft loans for R&D projects by SMEs located in TEKMERs (under the "Technology Research and Development Support" program). As further explained below, existing matching grants and loans programs should also be assessed systematically in tandem with fiscal incentives.

6.16 ***Venture capital and other private means to finance start up are almost non existent in Turkey.*** There are only four VC funds in Turkey[172] and the total percentage of VC investment over GDP is close to nil. To help develop the VC industry, the Turkish Capital Market Board (SPK) modified the venture capital legislation in 2004.[173] The new law introduced two types of Venture Capital Investment Trusts (VCITs): (1) those only entitled to sell their shares to accredited investors such as banks, intermediary institutions, insurance companies and long-term pension funds, and (2) those that can sell their shares to the public without limitations. In addition, the minimum capital requirement for both types of funds was decreased and other unfavorable conditions, such as requirements for a Turkish majority among VCIT board members, were abandoned. Despite the recent legislative improvements, both supply and demand factors still limit the VC industry in Turkey. As explained in Chapter 5, these factors are, indeed, more generic as they impede the development of private capital markets more broadly.

- Key factors hindering VC development on the *supply* side include: the instability of the macro environment until very recently, low FDI levels until 2005, immature

[172] Vakif Girisim (a subsidiary of Vakif Bank), Is Girisim (owned by Is Bank, TSKB and TTGV), TurkVan Ventures (Advent, IFC, TTGV and others) and KOBI Girisim (owned by TOBB, Halk Bank and KOSGEB). An additional fund is currently being established by FIBA Holding. Sirin Elci, 2005, Op. Cit.

[173] See Communiqué Serial: VI, N. 16 "Amending the Communiqué Regarding the Principles about Venture Capital Investment Trusts".

pension funds and insurance markets that make fundraising difficult, the small size and limited liquidity of the capital market (the market capitalization of Turkey's stock exchange is US$68 billion, versus US$14.2 trillion in the United States and US$726 billion in Spain, for example[174]), insufficient exit mechanisms that make IPOs rare in Turkey, and lack of limited rights for, and protection of, minority shareholders.

- Key factors hindering VC development on the *demand* side are the cultural and managerial practices of Turkish firms and entrepreneurs, which negatively affect the quality and quantity of deals. These include traditional family ownership and management, weak corporate structures, confidentiality concerns of entrepreneurs who are reluctant to share ideas, ownership and control, and firms' accounting practices (e.g., different accounting books kept for different purposes like taxation, banking and management), which make company valuation difficult. The impact of these factors is exacerbated by the low levels of awareness of venture capital investments and the limited capabilities of firms and entrepreneurs to transform their ideas into business plans.

A.3. Links Between Firms And Research Institutions

6.17 ***Creating links between firms, universities and research centers is essential to focus research on productive purposes and stimulate technology adoption and innovation at the firm level.*** University / research center / industry collaboration comes in many forms, including mobility of researchers and students, joint or contract research projects, licensing, consulting, training, formal and informal networks, and spin-offs.[175] According to the WEF survey, university / industry research collaboration is low in Turkey compared to most EU and East Asian countries, although it is higher than in Romania, Bulgaria and Hungary. Leading Turkish executives and entrepreneurs also consider scientific institutions to be of low quality, below those of all other comparators — see Figure 6.16. While these data are based on qualitative surveys and should therefore be taken with caution, they do point to the need to conduct an in-depth assessment of the quality of Turkish research institutions and the constraints that limit collaboration between firms and the scientific world. Indeed, Figure 6.16 shows a high level of collaboration between firms and universities and a low gap between collaboration and quality of scientific institutions in all East Asian countries and in the comparator European countries that have made deliberate efforts to become more technologically advanced (e.g., Spain, Slovakia). The perceptions of Turkish executives and entrepreneurs are also confirmed by other surveys. Reports evaluating the results of the World Bank Industrial Technology Project (ITP)[176] confirmed that "most of the firms in

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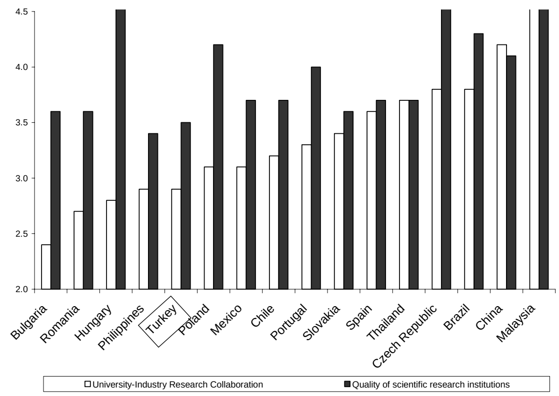
[174] World Bank, *Doing Business in 2005*, based on Standard & Poor's (2004).

[175] Sirin Elci, "Innovation and Technology Absorption in Turkey", 2005, Op. Cit.

[176] The WB ITP Project (1999-2006) was designed to assist in the harmonization of Turkish technology infrastructure with European Customs Union standards and assist firms in upgrading their technological capabilities in order to improve the competitiveness of the Turkish real sector, in both domestic and foreign markets. For a description of the project and its results, see the project documents at: http://www.worldbank.org.tr/external/default/main?pagePK=64027221&piPK=64027220&theSitePK=361712&menuPK=361744&Projectid=P009073

Turkish manufacturing industries do not collaborate with any research center or university in Turkey or abroad to acquire knowledge or develop new technologies."[177]

Figure 6.16: University-industry research collaboration



Source: WEF, 2004-2005.

6.18 ***Several factors hinder collaboration between firms and research institutions in Turkey.*** First, communication between research institutions and firms is limited. One of the main reasons for this is the limited availability of intermediaries (such as technology transfer offices, technology parks, and university-industry technology centers) to facilitate exchanges between the industry and research communities. Second, universities do not have the right incentives to collaborate with firms. Academicians who provide services to firms outside of Technology Development Zones must transfer to universities 70 percent of their income and are not allowed to start their own businesses.[178] Third, firms perceive the quality of Turkish scientific institutions as quite low, which limits their interest in collaborating with local researchers. Finally, cultural differences are an issue. Traditional business culture is reflected in Turkish firms' claim that mature technologies are sufficient for their needs.[179] Firms' overemphasis on confidentiality, academicians' missing deadlines, and differences between the priorities of both sides are also stumbling blocks in Turkey.

6.19 ***Recent measures to increase the number of intermediaries include the Law on Technology Development Zones and the establishment of government-funded university/industry research centers. Despite these efforts, the gaps between the scientific and industry communities are still large.*** Besides providing fiscal incentives for companies located in specific areas, the 2001 "Law on Technology Development Zones" stimulates collaboration between private firms and research centers or universities by supporting the creation of technoparks. The law includes incentives for firms located in technoparks to hire university researchers (who do not have to transfer to their universities any income generated by working for firms in the technoparks) as well as

[177] E. Taymaz "Monitoring and Evaluation of the Industrial Technology Project, Second Report" (2003) and S. Lall and E. Taymaz "Monitoring and Evaluation of the World Bank Turkey Industrial Technology Project, Third Report" (2004).

[178] Sirin Elci, "Innovation and Technology Absorption in Turkey", 2005, Op. Cit.

[179] S. Lall and E. Taymaz, 2003, Op Cit.

giving researchers the opportunity to start companies in the parks. Since the Technology Development Law passed, several universities and research centers have established technoparks. Private firms have also been responsive, mainly due to tax incentives offered in the parks. As a result, there are 17 technoparks in Turkey, more than half of which are under construction. Other programs aimed at improving collaboration between firms and universities or research centers include TUBITAK-TIDEB's University-Industry Joint Research Centers (USAMs) and KOSGEB's Technology Development Centers (TEKMERs), which specifically target SMEs. There are 6 USAMs and 14 TEKMERs throughout Turkey. In 2005, TUBITAK also initiated a National Public Research Program aimed at encouraging public agencies to establish partnerships with industry and academia, as well as an Industry Liaison Office in cooperation with the Chamber of Commerce (TOBB), aimed at training some of TOBB's staff to act as intermediaries between industry and TUBITAK.[180] Despite the recent increase in technoparks, USAMs and TEKMERs and more recent initiatives, the Turkish innovation infrastructure is not sufficient to jumpstart university-firm collaboration throughout the country. Before scaling up, it is important that the outcomes of existing and new programs be evaluated by external experts on the basis of international best practices.

A.4. Policy Recommendations

6.20 ***This section includes key policy recommendations to improve innovation at the firm level.*** It does not include specific suggestions to improve technology adoption through increased imports of capital goods, FDI and licensing. Measures to improve technology adoption (which require general improvements to the country's overall investment climate) are addressed in other chapters of this report (Chapter 1 regarding a macroeconomic environment conducive to stability and growth, and Chapter 3 on Product Market Regulations). Recommendations to improve innovation at the firm level are grouped below under three items: (a) improving the overall policy framework and infrastructure for innovation, (b) increasing access to finance for innovation and (c) improving the institutional effectiveness of the Turkish National Innovation System (NIS).

(a) Improving The Policy Framework And The Infrastructure For Innovation

6.21 ***Policy and legal changes are needed to improve the environment for firm-level innovation and strengthen collaboration between researchers and firms, including extending to all universities incentives currently granted only to technoparks.*** University researchers, excluding students, can benefit from their own research in Turkey.[181] That is, the academician who invents something is the owner of the related IPR and has the right to commercial revenues from patents that his/her research generates. While this policy is satisfactory, additional measures are needed to: (a) extend the benefits currently provided to researchers working in technoparks to all universities, that is, eliminate the rule requiring academicians working for firms outside of

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[180] *TUBITAK's observations and contributions to the CEM, October 2005.*

[181] Decree-Law No. 551, Article 41, April 1995.

technoparks to transfer 70 percent of the income they receive to their universities; (b) provide students with the same patenting rights as researchers, because they may contribute to increasing productive innovation and patent levels in Turkey; and (c) create patent cost sharing schemes between inventors, universities and government, and introduce clear rules about IPR ownership among researchers, research institutions and private firms.

6.22 ***The IPR legislation should be reviewed and IPR enforcement strengthened.*** As mentioned in section II.B, Turkey has improved its IPR regime. However, as also indicated by the EU evaluation of alignment with the *Acquis* Chapter Six on Company Law, the country needs to make further progress both on IPR *legislation* and on IPR *enforcement*.

- *IPR Legislation.* Changes in the final legislation should be revised in collaboration with international experts and relevant stakeholders to ensure that the law meets EU and international rules and requirements.
- *IPR Enforcement*. Suggested measures to improve IPR enforcement include:
  - Increasing the independence of the Turkish Patent Institute (TPE) and improving its staff's capacity and experience on IPR-related issues, on both registration and protection. In the past few years, the TPE has been supported by the World Bank's ITP Project, which has financed several initiatives to improve its effectiveness.[182] Additional staff has also been hired following changes to TPE's law in 2003. The ITP project evaluation shows that TPE's capacity, costs, paperwork and time needed to provide services have improved significantly since program inception.[183] TPE has particularly improved the average registration periods in trademarks, patents and industrial designs. More effort in this direction is needed to further improve TPE's effectiveness. Establishing an independent board dealing with appeals to the decisions taken by the TPE on registration of industrial property rights would also be important. The board should be composed of neutral experts and have a role in between the current board of re-evaluation and examination and the courts.
  - Increasing the number of IPR courts and training programs for judges and prosecutors to ensure that they are able to address the high number of IPR infringement cases. Development of standard manuals, implementation guidelines and training to improve IPR understanding and specialization among prosecutors, judges, and police and customs officers is also needed.

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[182] The World Bank ITP program supports activities necessary to bring the Turkish IPR system into conformance with the European Customs Union requirements. Specific initiatives financed under this project include: (a) technical assistance and training of TPE staff, (b) reorganization of the TPE's staff workflow, (c) construction of a new building for expansion and upgrading of current activities, (d) IPR awareness campaigns for consumers, industry, R&D managers and technical staff and academicians, (d) dedicated information centers easily accessible to customers, and (e) training of judicial officials on IPR.

[183] It is important to note that, in 2004, TUBITAK also established an IPR department that provides help desk services for patent and trademark applications, and also organizes training for TUBITAK researchers, affiliate institutions and firms receiving TUBITAK's financial assistance.

- Limiting piracy and counterfeiting by applying sanctions and improving border controls following the EC Directive on enforcement of intellectual property rights. This, in turn, requires strengthening the administrative capacity of all agencies involved with piracy control, as well as improving coordination and cooperation among enforcement and administrative bodies such as customs, the police, the judiciary, TPE and the Ministry of Culture and Tourism.

6.23 ***Increasing the number and quality of intermediaries to improve communication and collaboration among firms, universities and research centers in Turkey.*** Existing innovation intermediaries (i.e., technoparks, USAMs, TEKMERs and more recent initiatives such as the Industry Liaison Officers) should be systematically evaluated so that only successful approaches will be replicated on a broader scale.[184] TUBITAK has recently started promoting public-private collaboration by requiring public agencies to establish consortia with universities and private firms in order to be eligible for funding, and by providing technical assistance and seed funds to young entrepreneurs. Successful international programs stimulating public-private collaboration that could serve as a useful benchmark include the MAGNET program in Israel, TEKES in Finland and ATP in the US. The Spanish model of private-public Technology Innovation Centers (*Centros de Innovacione Tecnologicas, or CITEs*) may prove particularly beneficial for promoting technology adoption among Turkish SMEs.

(b) Increasing Access to Finance for Innovation

6.24 ***The results of existing financing programs to promote private R&D and business start up (i.e., fiscal incentives, matching grants and reimbursable loans) should be evaluated using best-practice international criteria.*** The results of the four fiscal incentives schemes described previously should be evaluated, to assess their effectiveness, fiscal impact and consistency with the *Acquis*. It is also important to emphasize that fiscal incentives do not benefit SMEs, which do not have sufficient profits to use the tax benefits and usually do not record R&D expenses separately on their financial statements, making them ineligible for these incentives. Thus, alternatives to fiscal incentives should be preferred for stimulating private R&D and innovation, particularly for SMEs. In addition, all existing matching grant and loan programs should periodically be assessed against criteria based on international best practice (e.g., the SPREAD program in India and, for matching grants, the experiences of Israel and Finland). The experiences of Finland, Israel, Malaysia, Hong Kong and (more recently) Mexico and Chile[185], show that well-designed participatory matching grants for R&D projects and consortia of academics and firms, if properly designed, can be beneficial in enhancing R&D investment by firms and promoting the commercialization of

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[184] The Ministry of Industry and Trade is developing a monitoring and evaluation (M&E) system to assess the results of existing technoparks. The M&E system should be designed on the basis of international best practices.

[185] These include the TEKES Program in Finland, the Magnet Program in ISRAEL, the Small Entrepreneur Research Assistance Program (SERAP) in Hong Kong, the Industrial Technical Assistance Fund (ITAF) in Malaysia, and programs supported by the World Bank through Science and Technology Projects in Chile and Mexico. See Philips (2000) and Batra and Mahmood (2003) for an overall evaluation of the benefits and shortcomings of matching grant programs supporting technology and innovation.

innovations generated in academic centers. (Box 6.1). Both TUBITAK and KOSGEB have started evaluating the results of their matching grants programs. External reviews could add value to the internal assessments by providing inputs based on lessons learned from international best practices. Finally, an overall support framework should be designed so as to: (a) assess and reduce as needed overlap among providers; (b) replicate schemes with the highest impact on innovation; (c) increase the level of collaboration between some of these institutions and the funding Ministries — both TTGV and KOSGEB have recently experienced funding problems due to some issues with the Undersecretariat of Foreign Trade and the Ministry of Finance; and (d) reduce administrative hurdles in all financing programs, which beneficiary firms say are a major drawback — citing especially implementing agencies' burdensome bureaucratic procedures, delays in payments caused both by late transfers of funds from the Government and inefficient processes at the implementing agencies, and the risk averse fund allocation approach taken by all institutions. TUBITAK has recently introduced simplified procedures in its TIDEB program, including advanced payment options in R&D financing schemes[186]. It also plans to introduce accelerated application and appraisal processes to facilitate access to R&D grants. The results of TUBITAK's and other agencies' recent efforts to streamline processes should be evaluated and complemented by similar initiatives aimed at streamlining administrative hurdles throughout the financial process.

Box 6.1. Designing matching programs for private R&D investments

Since matching grants programs work by encouraging risk-sharing between the public sector and firms, they orient the selection process toward R&D programs that are most likely to generate innovations that can be commercialized. There are three critical aspects of a matching grant program. First, firms are required to invest a dollar of their own funds against every dollar that they receive as a grant (*matching*). Proof of the private expenditure of a dollar is required before the government reimburses the entrepreneur for the dollar it invested. The importance of matching stems from the fact that it precludes the dollar-for-dollar crowding out of private by public money. Second, matching grant schemes favor *marketable projects*. Successful projects (i.e., those leading to sales) will be required to repay the grant as a royalty from revenue, up to the dollar-linked amount of the grant. Finally, matching grants schemes are *neutral*. Neutrality means that the government does not decide *ex ante* which technological areas, firms or projects to support, but rather responds to the demands of the market. The program should not try to steer the grants (or any other such instrument) in any predetermined direction, but rather to deploy them so as to maximize spillovers or social returns. The success of R&D support programs in both Finland and Israel is in large measure attributable to the fact that, in both cases, the policies were neutral in this sense. In contrast to matching grants, instruments with mandatory repayments (like commercial loans or even loans with interest rate subsidies) do not provide the crucial risk-reducing instrument. In case of technological or commercial failure, the entrepreneur loses his or her own investment and has to repay the loan amount in full. As a result, an adverse selection occurs: only non-innovative entrepreneurs apply, since they are sure that they can repay.

Source: Goldberg, I., World Bank 2005.

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[186] Starting in 2006, under the Industrial R&D Grant Program, TUBITAK and the Under Secretary of Foreign Trade will grant up to 10% down payment to SMEs or large firms requesting funds for projects belonging to national priority areas.

6.25 ***Increasing access to finance for innovative start up will also require policies to support development of the venture capital (VC) industry.*** Development of the venture capital industry requires further reforms to improve the business environment (see Chapters 1 and 3) and promote innovation (e.g., improving IPR protection). These measures should be coupled with further revisions to the VC legislation and capital market reforms to increase the liquidity of the stock market (see Chapter 5).

(c) Improving the Effectiveness of the Turkish National Innovation System

6.26 ***Improving the effectiveness of the Turkish National Innovation System is important for aligning with EU policies and promoting innovation and technology absorption.*** A National Innovation System is a network of public and private institutions interacting in a concerted way to create and adopt technologies, together with the policies and strategies that regulate and influence technology adoption and generation. While Turkey's NIS comprises several institutions covering all relevant aspects of science, technology and innovation policies (see Annex 6.2) some key measures are needed to improve its effectiveness, in turn increasing technology adoption, innovation and productivity. These include:

(a) Reviewing the institutional structure and capacity of the Scientific and Technological Research Council of Turkey (TUBITAK) to ensure alignment with international best practices. A new law addressing these issues by introducing changes in TUBITAK's mission and organizational structure based on lessons learned from other countries has been drafted. An external review of the law is needed to ensure that the proposed actions are aligned with international best practices, and lead to improve effectiveness of both TUBITAK and the Turkish NIS. Clarifying TUBITAK's role in Turkey's NIS is also important. Currently, TUBITAK is both secretary of the Supreme Council of Science and Technology (BTYK), and monitoring and implementing agency for science, technology and innovation support programs. International best practice suggests separating these functions. Finally, it is important to complement ongoing internal assessments of TUBITAK's programs and affiliate institutions (e.g., TUBITAK-TIDEM, and UME), which have been recently upgraded and are in the process of further expansion, with external evaluations. The evaluations should focus on outputs and outcomes (e.g., increased innovation, technology adoption and productivity at the firm level) rather than inputs (e.g., number of projects financed, amounts disbursed).

(b) Broadening coverage of the Turkish NIS. Given the size of the country and the economic, social and geographical diversity of its regions, a fully centralized NIS is a significant barrier to addressing local challenges. Local strategies and institutions should be established to ensure that all regions are reached.

(c) Adopting an innovation strategy that places productive innovation at the heart of all economic, and social development (including science and technology) policies, by strengthening the role of the business sector in the innovation process and by broadening the definition of innovation to include non-technological improvements (e.g., organizational and process changes). While Turkey has developed several strategic plans to support innovation, they have mainly been centered on R&D and science policies. The main science and technology objectives adopted by BTYK in September 2004 are: (a) increasing the demand for R&D, (b) increasing the number and quality of scientists and vocational and technical staff, and (c) raising gross expenditures in research and development (GERD) as a percentage of GDP.[187] While these objectives are relevant, the strategy would benefit from a clearer focus on productive innovation and technology adoption at the firm level and from a stronger emphasis on output (rather than input) measures. Some measures in the Vision 2023 document and BTYK's strategic documents point in this direction, for example: developing skills and technologies to improve productivity in specific industries, supporting the creation of science- and technology-based innovative firms, and improving venture capital legislation and revolving fund regulation (see Box 1). Further emphasis on these objectives and a clear focus on implementation are essential to comply with EU suggestions and ensure that the resources the government has allocated to science, technology and innovation are used effectively and result in increased productivity in the Turkish economy.

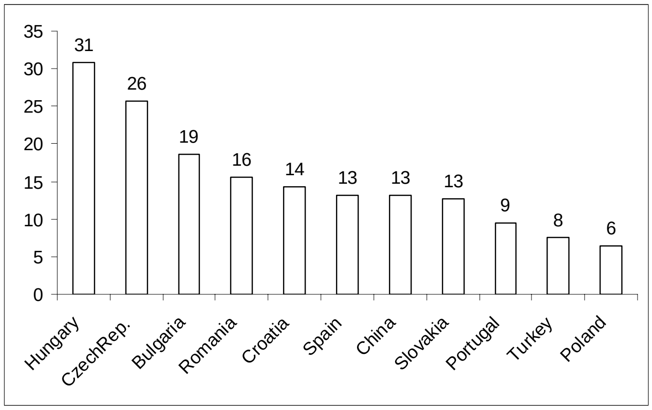
B. QUALITY STANDARDS

6.27 ***Improving use of quality certification is important to increase Turkish firms' exports and facilitate integration between local and foreign firms.*** By complying with international quality standards, Turkish firms can be recognized as reliable partners for foreign firms. The Turkish firms could then more easily sell their products abroad, either as inputs to local or foreign firms' production processes or directly to final customers. The use of quality standards also lays the foundation to promote technology adoption and innovation at the firm level. While the use of quality standards has increased in Turkey during recent years, quality certification is still less common among Turkish firms than among firms in most comparator countries — see Figure 6.17. Romania and Bulgaria, for example, have twice as many ISO-certified firms by industry value added as in Turkey.[188] Increasing the use of quality certification at the firm level requires that several conditions be in place, including: a well functioning National Quality Certification System (NQCS), comprehensive quality legislation and regulations, and a sufficient number of accreditation and certification institutions.

[187] The specific targets to be reached by 2010 to approach the EU objectives set in Barcelona are: increasing the share of GERD/GDP to 2 percent (from 0.66 percent in 2002) and the number of full-time equivalent R&D personnel to 40,000 (from 28,964 in 2002) while increasing the number of vocational and technical staff proportionally. The centrality of these objectives is confirmed by BTYK's *Science and Technology Strategies Implementation Plan* for the period 2005-2010, approved in March 2005.

[188] Although figures on Turkish firms' use of industry- and product' specific quality standards (which are often more relevant than ISO certifications, particularly for supply chain development) are not available, we can assume that ISO certifications are a good proxy for the use of quality standards and the importance that firms attribute to certification.

Figure 6.17: ISO certifications per US$100 million of industry value added, 2003.



Sources: ISO, 2005 (for ISO certifications) and WDI, 2005 (for industry value added).

6.28 ***Turkey has gone a long way towards establishing a modern, market-based quality standards regime compatible with relevant sections of the Acquis.***[189] Turkey has already replaced almost all national technical standards with EU and international standards. It has also significantly reduced (by 60 percent) the number of mandatory standards applied to imports, from about 650 to 261. This reduction brings Turkey close to have an EU-compatible control mechanism (EU Regulation 339/93) on imports from third countries.190 Turkey has a well functioning NQCS in place, comprising the Turkish Standard Institute (TSE), an accreditation agency (TÜRKAK) and a National Metrology Institute (UME). TÜRKAK is a full member of the European Cooperation for Accreditation. While TÜRKAK has not yet been internationally recognized, it is expected that it will soon meet all requirements for signing multilateral agreements with the European Cooperation for Accreditation (EA), which will in turn ensure that its accreditations of Turkish conformity assessment bodies (89[191] in 2005) and their conduct conformity assessments will be recognized by EU countries. The National Metrology Institute already offers reliable measurement traceability, which is needed for the proper functioning of the Turkish quality infrastructure. The transposition of harmonized European legislation into Turkish national legislation, as the first necessary step on the way towards full implementation of the legislation, is now nearing its completion. Public authorities are now at the stage of implementation of the transposed legislation. This requires, among other things, the establishment of a sound functioning market surveillance system with improved administrative and technical infrastructure.

6.29 ***Notwithstanding recent progress, policy and institutional changes are still needed to further improve Turkey's National Quality System and foster adoption of quality standards at the firm level.*** First, it is in Turkey's interest to recognize tests and standards for products originating in countries with which the EU has signed mutual

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[189] B. Kaminski, 2005, *Technical Standards Regime and Trade*, Background Note.
[190] The list of those mandatory standards was revised and published as an Annex of the Communique on Standardization of Foreign Trade (Official Gazette 26040 of December 2005).
[191] http://www.turtak.org.tr/eng/acredited.htm

recognition agreements (MRAs),[192] It is also in Turkey's interest to obtain similar recognition for its products from the same countries. This would reduce the cost of imports by increasing competitive pressures on preferential (i.e., free trade agreement) exporters to Turkey and Turkey's quality standards. Second, it is important to complete the process leading to TÜRKAK's international recognition. Third, some sector specific legislation should be aligned with the Acquis requirements (including legislation for pharmaceuticals, cosmetics and chemicals), and food safety and foodstuff legislation should be adopted. Fourth, TSE's responsibilities and functions should be compared with those of similar institutions operating in other countries. International best practice indicates that private sector institutions are often best placed to provide certification and testing services. TSE's standard development, certification and testing functions are now clearly separated both administratively and financially, to avoid conflicts of interest. It would be useful to assess whether the separation of these three functions within TSE is effective or whether it would be preferable to outsource certification and testing services to the private sector. Fifth, the government should encourage creation of private secondary metrology facilities to ensure national coverage. Finally, it is essential to increase Turkish labs' and firms' requests for accreditation and certification. Matching grants have proven successful at raising awareness of encouraging adoption of quality standards in several countries.

C. LABOR SKILLS

6.30 ***Advanced labor skills are essential complements of technology and innovation and fundamental determinants of productivity and income gaps across countries.*** Productivity gaps can be thought of as having two components, skills gaps and technology gaps, which must be closed simultaneously in order to maximize TFP.[193] Countries and firms that are more innovative and open to technology adoption require a more educated and skilled labor force. Likewise, a more educated and skilled labor force is essential for innovation and technology adoption. An educated and skilled labor force includes university graduates, able technical workers and, more broadly, flexible workers who are able and willing to learn and apply their skills productively. What workers need most in today's rapidly changing world, rather than knowledge of specific techniques that can quickly become obsolete, are the abilities to solve problems and to continue to learn. This section provides an overview of the main challenges to enhance the skills of the labor force in Turkey. It starts with a description of educational attainment in the Turkish adult population and then provides an assessment of the *flow* of skilled workers, together with an overview of the quality of the skills obtained at various levels of education.

6.31 ***The stock of educational attainment among the Turkish population is low.*** Turkey has made substantial gains in educational level of its population, having increased the enrollment of 7-14 year-olds from 80 percent to 90 percent in just eight years and

[192] These countries include Australia, Canada, Israel, Japan, New Zealand, Switzerland and the United States.
[193] World Bank, *Closing the Gap*.

introduced programs to improve quality and reduce the disparities in school attainment. Nonetheless, the country faces some significant challenges. Adults in Turkey average only 5.3 years of schooling, less than in all comparator countries (except Brazil) and below the expected value given Turkey's level of development — see Figures 6.18 and 6.19.[194] On average, Turkish adults have 4 fewer years of education than their Polish, Hungarian or Slovakian counterparts, while educational attainment is similar to that of Finland's in 1960. Increasing the average stock of education is essential to ensure that Turkey can absorb and adapt global knowledge and technologies. While current educational attainment is the result of past investments in education, enrollment rates reflect current investments and indicate how the stock of education will evolve. To better assess these trends, the sections below analyze enrollment rates at the primary, secondary and tertiary levels, as well as the quality of the education provided. Overall, as noted in Chapter 2, current expenditures (both public and private) are high in international comparison, but considerable room for improvement in efficiency seems to exist as educational outcomes remain below comparator countries.[195]

Figure 6.18: Average years of schooling of adults (aged 15 and over), 2000.

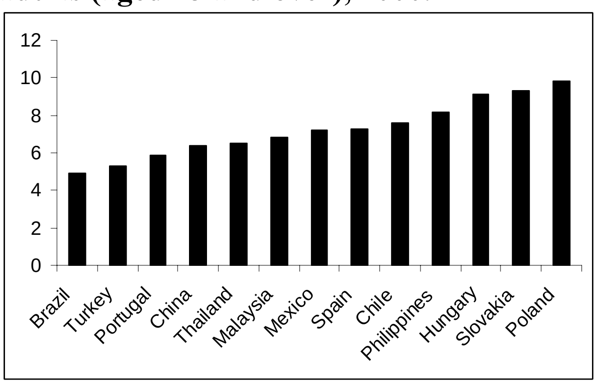
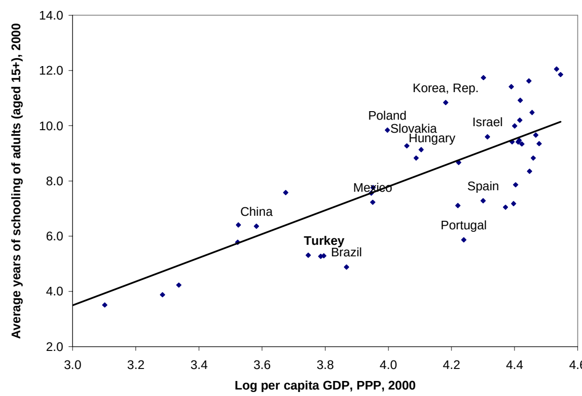


Figure 6.19: Average years of schooling and level of development, 2000.



Source: World Bank EdStats database based on the Barro and Lee Data Set.

While enrollment rates in primary education have significantly improved, Turkish pupils are not acquiring the advanced problem solving, reading and understanding skills that would allow them to learn more and be more productive in future years. Following the adoption of the Basic Education Law in August 1997,[196] which mandated eight years of compulsory education, Turkey dramatically increased its educational coverage. As a result, net enrollment in grades 1 through 8 rose from 81 percent in 1997

[194] Mean years of educational attainment in Turkey is likely to be somewhat higher in 2005 as a consequence of the enactment in 1997 of the eight-year compulsory education law.
[195] The World Bank Education Sector Study (2005) reports that Turkey spends approximately 7 percent of its GDP (combining private and public sources) on education, which is well above most EU and comparator countries.

[196] Law No. 4306

to 90 percent in 2003. However, international assessments of primary school students[197] show that Turkish pupils are learning substantially less than children in EU member states in the core areas of mathematics, science, and reading literacy. On the TIMSS study of mathematics, Turkish students performed almost one standard deviation below EU children — sees Figure 6.20. In the TIMSS primary school science assessment, the average Turkish student's performance is at the lower quartile benchmark, while the mean achievement of EU children is at the top quartile. On the PIRLS assessment of reading literacy, Turkish students also performed, on average, one standard deviation below EU students. Critical learning shortcomings of Turkish children include the ability to apply mathematical understanding to relatively complex situations, to recognize and state relationships between events that they have read in a story, and to solve problems by making inferences based on a variety of information provided by texts, tables, maps, diagrams and images. These capacities are essential foundations to develop knowledgeable and flexible workers able to apply problem solving skills to different contexts and learn continuously. The Government hopes to address these quality constraints by means of a comprehensive program of curriculum modernization that it launched in 2004 to improve teaching and learning across all of the core subject areas.

Figure 6.20: Acquisition of skills in mathematics and science.

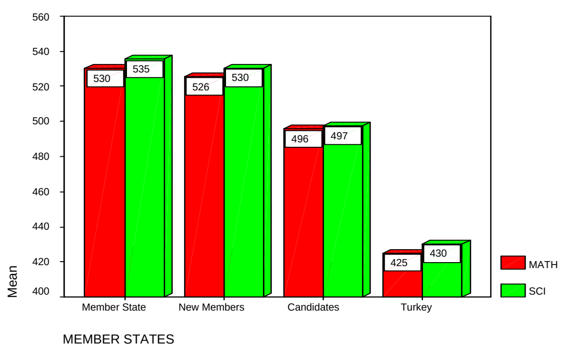
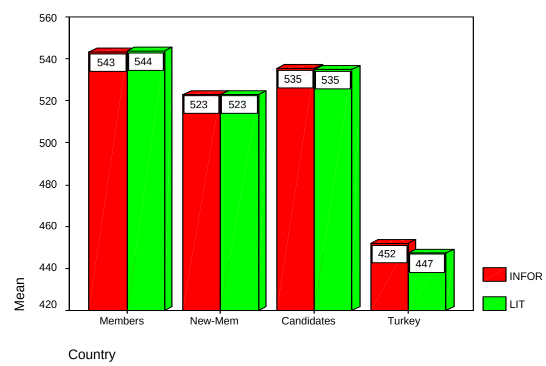


Figure 6.21: Acquisition of skills in reading literacy.



Source: World Bank, Education Sector Study, 2005[198].

6.32 ***Expanding enrollments and improving quality of secondary education are Turkey's critical challenges.*** Less than 50 percent of the 20-24 year old young adults have a secondary education diploma in Turkey, which is well below the EU target of 85 percent. Turkey's success in implementing its eight year compulsory education program has contributed substantially to increasing enrollment in secondary education, but the challenge of closing the gap remains quite substantial. Results from the 2003 OECD Program for International Student Assessment (PISA) show that Turkish students

[197] The Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) are carried out by the International Education Association in partnership with participating countries, including Turkey. They measure cognitive development and skill acquisition among fourth and eighth grade students (respectively half-way through and at the completion of primary schooling).

[198] Forthcoming, following final review by Government for dissemination.

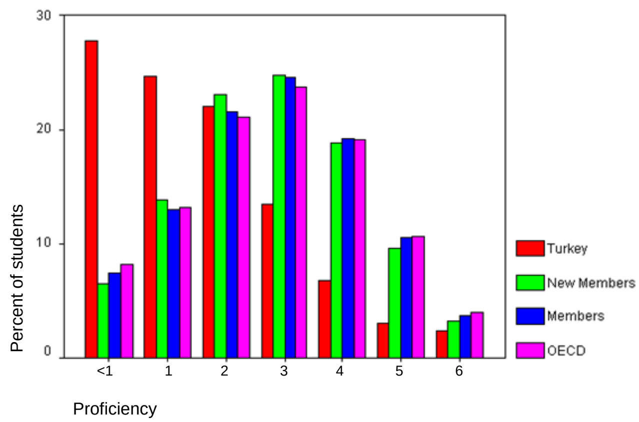
perform well below their OECD counterparts (although a small percentage perform at world-class standards). PISA uses a six-level scale of mathematics-quantitative proficiency, where "1" represents the absolute minimal level of proficiency and "6" represents high-level, complex problem-solving and mathematical reasoning ability. More than half of Turkey's 15-year-old students (55 percent) were unable to perform above level "1," whereas the average proportion in OECD countries (including Turkey) was less than 21 percent —– see Figure 6.22. Similar results were found in all mathematics skill areas, from geometry and algebra to statistics and computation, as well as in reading and science.

6.33 ***Turkey's secondary vocational schools — which have very low enrollment rates despite the government efforts to increase them — also do not provide Turkish youth with skills that can be readily applied in the labor market.*** Evidence from PISA indicates that vocational graduates in Turkey are not prepared for employment. World Bank research also shows that vocational graduates are not significantly more likely to be employed after high school than general secondary graduates who do not continue to tertiary education.[199] Vocational school graduates, the vast majority of whom are unable to qualify for university entrance, have the opportunity to enroll directly in post-secondary vocational institutions (MYOs) without an examination. Nonetheless, many of these institutions are of inadequate quality and do not provide adequate value in terms of skill development and preparation for employment (see paragraph 6.35, below). In addition, fewer than half of employed vocational high school graduates report having jobs that use the vocational skills they actually learned in school.[200] This is because many of the secondary vocational/technical school programs are out of step with the needs of the modernizing economy. Some of the vocational programs are still directed to girls with instruction in traditional homemaking skills such as embroidery, knitting, food preparation, and childcare. Even as computer science is being introduced into girls' vocational education programs, it is difficult to see how they can prepare young women for a real profession in a modern labor market, or help them become catalysts of technological change and innovation within firms.

[199] World Bank, Education Sector Study, 2005. The finding is derived from an analysis of Household Labor Force Surveys (HLFS) of the State Institute of Statistics for 2003.

[200] World Bank, Education Sector Study, 2005. The finding is derived from the 1997 household survey, the only survey that included a module on the acquisition of workforce skills.

Figure 6.22: Distribution of students by PISA proficiency level in Turkey and EU, 2003



Source: Education Sector Study, The World Bank, 2005

6.34 ***The skills of university graduates also do not meet the needs of the private sector.*** Tertiary education in Turkey encompasses all post-secondary programs of at least two years. Improving academic qualifications among the teaching staff, especially in newly established higher education institutions, and expanding access to tertiary education have been two of the government's main objectives during the past decade. Tertiary education enrollment rates in Turkey have increased during recent years (from 13 percent in 1990-91 to 25 percent in 2002-03) but are still below those of most comparator countries — see Table 6.2. While the enrollment ratio in science and engineering schools is high in Turkey (above comparator countries according to the latest statistics available),[201] Turkish business executives and entrepreneurs consider the quality of science and engineering schools rather low — see Figure 6.23. Admission to higher education in Turkey is managed centrally through a very competitive process, centered on a highly regarded, broadly trusted university entrance examination. Because this examination serves as the main "entry ticket" to the substantial economic and social benefits associated with university education in Turkey, it drives what most young people study and learn. As such, Turkish experts should review and modernize the content, structure, and methodology of the examination (while maintaining its integrity and transparency) to make sure that it drives the kinds of learning efforts and outcomes for students that Turkey needs to have a highly competent and competitive labor force. Other critical issues for the Turkish tertiary education system include the need to address the uniformity of mission and organization of public universities, the administrative and financial rigidity of the public university system, excessively academic curricula, inadequate communication between universities and the private sector, lack of

[201] WDI (2002).

specialized technical or professionally oriented undergraduate degrees (such as universities of applied science in Germany or the former polytechnics in the UK), and lack of an adequate system of regional colleges that can provide good capillary education. Employers in Turkey, like their international peers, are increasingly concerned about problem solving, creativity, confidence and communication skills than about specific technical skills. However, academics seem reluctant to accept input from firms in determining what and how they teach (with the important exception of a handful of institutions, including private (foundation) institutions, which are beginning to take account of labor market needs). Partially as a result of these issues, there is a relatively high level of unemployment among new university graduates.[202]

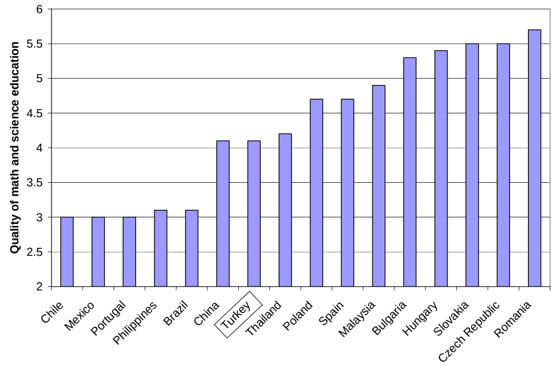
Table 6.2: Tertiary Education Indicators: Stock and Flow

	Tertiary education (% of 25-64 year olds)	Tertiary school enrollment (% gross) 2002-2003
Brazil		18
Turkey	**8.9**	**25**
Portugal	9.4	53
China		13
Thailand		37
Malaysia		27
Mexico		21
Spain	24.4	59
Chile		42
Philippines		31
Hungary	14.1	44
Slovakia	10.8	32
Poland	12.2	60
Bulgaria	21.1	38
Romania	10.0	30

Source: Population with Tertiary Education—EUROSTAT Labor Force Survey, as reported in the TrendChart Innovation Policy in Europe, Innovation Scoreboard 2003.

[202] The level of unemployment is higher among young university graduates than for recent secondary school graduates..

Figure 6.23: Quality of math and science education.



Note: Math and science education in your country's schools:
... 1=lags far behind most other countries
... 7=is among the best in the world).
Source: WEF, 2004-2005

6.35 ***Post-secondary vocational education is also of poor quality and out of sync with the needs of the private sector.*** Employers in Turkey face even greater shortages of mid-tier, technician level workers than of university graduates. Well-prepared technician level workers are essential to facilitate technology absorption and adaptation, as well as (to a lesser extent) innovation. Thus, qualified post-secondary vocational institutions (MYOs), or technically oriented programs in undergraduate schools, are much needed in Turkey. Unfortunately, Turkish MYOs suffer from historic underinvestment, neglect and a poor image. Many students and employers consider most MYOs as undesirable, and many of the universities that are responsible for them neglect them.[203] These circumstances have led to a downward quality spiral, with low staff morale, less prepared students, and a tarnished image among employers. The fact that the MYOs are associated with universities, but are relegated to a second-class status in the system, also prevents them from evolving into strong alternatives to universities, restricts their ability to innovate, and diminishes them in the eyes of students and the public.

6.36 ***Improving the skills of the labor force and ensuring that they match the needs of the private sector will require rethinking the education system at all levels.*** First, it is essential to improve the quality of education both at the primary and secondary levels, to ensure that students acquire the foundations that are needed to continue learning at later stages and key problem solving skills that will allow them to be conduits of change at all stages of their careers. Second, reforms are needed to encourage higher education institutions to develop differential missions and strategies, with a different balance of effort across the functions of teaching, research and service provision. Third, the curricula of universities should be revised to reduce their academic thrust and ensure that they better match the needs of the private sector. Improvement of university-firm communication is essential to reach this aim. Fourth, the Turkish education system should be reformed to avoid systematically assigning students into a specific education track from a very early age. The existing tracking system reduces learning opportunities through a series of selection examinations that tend to separate students by achievement

[203] An indicator of the quality challenge for MYOs is that, according to Government figures, 25 percent of their places remain unfilled, despite the opportunity of open enrollment for vocational education graduates.

and place them into schools that then exacerbate their learning differences and career outcomes. Currently, each step of the education selection process in Turkey leaves fewer and fewer students to benefit from high-quality education. Fifth, there is a need to consolidate and refocus post-secondary technical institutions with their own budgets and missions, while maintaining the academic link to universities. Turkey should also consider ways of using its funding of postsecondary education to upgrade MYOs into technical colleges or polytechnic institutions that can grant two- to four-year degrees in a broad variety of areas so as to more flexibly provide high end technical skills to graduates in line with labor market demands. Finally, more emphasis should be given to cultivating lifelong learning systems for continuously upgrading human capital and to promoting continuing vocational training. This can be accomplished by providing incentives to firms, both to hire technical personnel and to provide relevant training.

D. CONCLUSIONS

6.37 ***This chapter has emphasized that improving Turkey's performance on the knowledge factors — technology, innovation, quality and skills — is a critical part of increasing total factor productivity and ultimately achieving Turkey's goal of sustainable, long-term economic growth.*** Despite some recent improvements and successes, Turkey lags behind comparator countries on many indicators in these areas, including importing capital goods, FDI and licensing (for technology absorption), R&D, patents, access to finance and university/firm collaboration (for innovation), use of quality standards by firms, and the stock of educational attainment and flow of skilled workers (for labor skills). Table 6.3 includes a summary of short- and medium-term recommendations to improve Turkey's performance in the knowledge areas. A firm commitment by both the Turkish Government and the Turkish private sector to make progress on access to and use of the *knowledge factors* will not only allow Turkey to meet the requirements of the *Acquis* and other EU recommendations, but also ensure that the country develops the capability to generate and manage technological change and innovation, as well as create a better alignment between workers' skills and the needs of the private sector, in turn reaping the social benefits of increased productivity and consistent economic growth.