DRIVERS OF INNOVATION

29% of exporters have introduced a new product or process, compared with 15% of non-exporters.

R&D increases the likelihood of introducing new products or processes by 26% for high-tech manufacturing firms.

Firms that use ICT are 9% more likely to introduce new products or processes.
Firms that innovate are more sensitive to the quality of their business environment. They tend, in particular, to complain about corruption, the limited skills of the workforce and burdensome customs and trade regulations. Reducing such business constraints can have a significant positive impact on firms’ ability and willingness to innovate. In countries where constraints are less binding, firms tend to innovate more as a result. However, not all firms in such countries are innovative: the age, size, ownership structure and export status of companies also have an impact.

Introduction

Innovation is an important driver of improvements in productivity. But what drives innovation itself? This chapter looks at the reasons for the significant variation seen in the rates of innovation of individual countries and sectors, as documented in Chapter 1.

Various factors influence firms’ incentives and ability to innovate, ranging from the prevalence of corruption to the availability of an adequately skilled workforce and access to finance. Some of these factors are internal, reflecting either characteristics of the firm (its size or age, for instance) or decisions made by the firm (such as the decision to compete in international markets or the decision to hire highly skilled personnel). Other factors are external and shape the general business environment in which firms operate (such as customs and trade regulations).

In some cases, the two are closely related: each firm makes personnel decisions that determine its ability to innovate, but these decisions are, in turn, strongly influenced by the prevailing skills mix and the availability of a sufficiently educated workforce in the region where the firm operates. Similarly, Chapter 4 shows that the local banking structure (an element of the external environment) has an impact on firms’ funding structures (an internal aspect), which then affects innovation. Even if firms share the same business environment, they will not necessarily make the same business decisions, and these decisions will influence their innovation activity.

This chapter examines internal and external drivers of innovation, looking at both firm-level and country-level evidence. The firm-level analysis builds on the first two stages of the model discussed in the previous chapter, which explained firms’ decisions to engage in research and development (R&D) and introduce new products or processes. This analysis uses a rich set of data looking at firms’ perceptions of the business environment. The data were collected as part of the EBRD and World Bank’s fifth Business Environment and Enterprise Performance Survey (BEEPS V) and the Middle East and North Africa Enterprise Surveys (MENA ES) conducted by the EBRD, the World Bank and the European Investment Bank. The country-level analysis uses a large sample of countries, including those from the transition region, to explain both innovation at the technological frontier (measured as the number of patents per employee) and the innovation intensity of exports (a broad measure of innovation and the adoption of technology that was introduced in Chapter 1).

The chapter starts by considering drivers of innovation within an individual firm, looking first at firm-level characteristics (such as a firm’s size and ownership structure), before turning to decisions made by firms (such as the decision to export or the decision to conduct R&D). The analysis then moves on to external factors, first comparing innovative firms’ perception of the business environment with the views of non-innovative firms. These views guide the discussion of the key external factors that affect innovation outcomes at country level.
Firm age
Firm size
Small
4
10
12
14
note:
source:
than 20 employees; young firms are less than five years old.
Medium/large
Firm age
Firm size
4
Old
14
10
Israel
2
8
0
6
Transition region
estimated using an asymptotic least squares estimator based on the model described in Box 2.1.
and * denote statistical significance at the 1, 5 and 10 per cent levels respectively. The regressions are
down by size and age
2
6
8
cHARt 3.1.

Determinants of R&D and innovation

<table>
<thead>
<tr>
<th></th>
<th>R&amp;D (1)</th>
<th>Technological Innovation (cleaned) (2)</th>
<th>Non-technological Innovation (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>0.2160***</td>
<td>0.1973***</td>
<td></td>
</tr>
<tr>
<td>(0.0076)</td>
<td>(0.00328)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm age (years)</td>
<td>0.0003</td>
<td>0.0010**</td>
<td>0.0004**</td>
</tr>
<tr>
<td>(0.0002)</td>
<td>(0.0004)</td>
<td>(0.0001)</td>
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<tr>
<td>5-19 employees (dummy)</td>
<td>-0.0927***</td>
<td>-0.0549***</td>
<td>-0.0873***</td>
</tr>
<tr>
<td>(0.0088)</td>
<td>(0.0126)</td>
<td>(0.0127)</td>
<td></td>
</tr>
<tr>
<td>20-99 employees (dummy)</td>
<td>-0.0480***</td>
<td>-0.0315**</td>
<td>-0.0605***</td>
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<tr>
<td>(0.0070)</td>
<td>(0.0119)</td>
<td>(0.0121)</td>
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</tr>
<tr>
<td>Majority foreign-owned (dummy)</td>
<td>0.0142</td>
<td>0.0235*</td>
<td>0.0428**</td>
</tr>
<tr>
<td>(0.0113)</td>
<td>(0.0130)</td>
<td>(0.0140)</td>
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</tr>
<tr>
<td>Majority state-owned (dummy)</td>
<td>0.0041</td>
<td>-0.0320**</td>
<td>-0.0075</td>
</tr>
<tr>
<td>(0.0307)</td>
<td>(0.0115)</td>
<td>(0.0130)</td>
<td></td>
</tr>
<tr>
<td>Direct exporter (dummy)</td>
<td>0.0635***</td>
<td>0.0317**</td>
<td>0.0339**</td>
</tr>
<tr>
<td>(0.0090)</td>
<td>(0.0132)</td>
<td>(0.0138)</td>
<td></td>
</tr>
<tr>
<td>Percentage of working capital financed by banks or non-bank financial institutions</td>
<td>0.0004***</td>
<td>0.0020**</td>
<td>0.0026**</td>
</tr>
<tr>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0002)</td>
<td></td>
</tr>
<tr>
<td>Percentage of fixed asset purchases financed by banks or non-bank financial institutions</td>
<td>0.0004***</td>
<td>0.0010**</td>
<td>0.0007**</td>
</tr>
<tr>
<td>(0.0001)</td>
<td>(0.0004)</td>
<td>(0.0002)</td>
<td></td>
</tr>
<tr>
<td>Percentage of employees with a university degree</td>
<td>0.0007***</td>
<td>0.0011**</td>
<td>0.0004**</td>
</tr>
<tr>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td></td>
</tr>
<tr>
<td>Main market: local (indicator)</td>
<td>-0.0461***</td>
<td>-0.0423***</td>
<td>-0.0461***</td>
</tr>
<tr>
<td>(0.0081)</td>
<td>(0.0085)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use email for communication with clients (indicator)</td>
<td>0.0908***</td>
<td>0.1430***</td>
<td>0.0104**</td>
</tr>
<tr>
<td>(0.0010)</td>
<td>(0.0014)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: BEEPS V, MENA ES and authors’ calculations.
Note: This table reports average marginal effects. Standard errors are indicated in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels respectively. The regressions are estimated using an asymptotic least squares estimator based on the model described in Box 2.1.
such as machinery or pharmaceuticals, as complex technologies are more difficult and costly to absorb and develop.

Similar estimates of the impact of a firm’s size and age emerge from the regression analysis, which controls for other firm-level characteristics. Indeed, this analysis suggests that small firms are 5 percentage points less likely to introduce new or improved products or processes than large firms (see Table 3.1, column 2). This is a substantial impact, given that 27 per cent of large firms have introduced new or improved products or processes in the last three years.

What may be surprising is the fact that young and small firms are also less likely to introduce marketing and organisational innovations. This probably reflects the fact that larger firms tend to have employees specialising in marketing (or even whole marketing departments), whose main task is to review existing marketing techniques and develop new approaches to marketing.

Scarcity of innovative start-ups

Young, small firms may tend to innovate less, but start-ups still represent a very important class of innovators. They are the firms that are most likely to come up with innovations that are new to the global market. In some cases, the innovation is the sole reason for the firm’s creation.

In Israel, two-thirds of small firms introduced product innovations that were new to the international market, compared with 48 per cent for larger firms (see Chart 3.3). Moreover, all young firms (defined as companies that were established less than five years ago) introduced at least one new product that was new to the international market, hence the fact that Israel’s start-ups have a reputation as one of the key drivers of economic growth in that country.

In transition countries, by contrast, such start-ups remain rare. In fact, young and small firms in the transition region perform worse than their large and established counterparts when looking at the percentage of them that introduced product innovations new to the global market (see Chart 3.3). Younger firms are somewhat more likely than older firms to introduce world-class process innovations, but instances of such process innovation are very rare overall.

The scarcity of start-ups generating world-class innovation reflects the fact that transition economies are further removed from the technological frontier than advanced economies such as Israel. This may be due to a series of factors constraining the development of innovative start-ups. Among these factors are a lack of specialist financing (such as angel investors, seed financing and venture capital), skill shortages, high barriers to the entry of new firms and weak protection of intellectual property rights (all of which are discussed in more detail in Chapters 4 and 5), as well as the age of firms’ senior management.

Faced with these constraints, the most successful innovative entrepreneurs and small firms in the transition region often move to Silicon Valley, Boston, New York and other innovation hubs at the earliest opportunity; some keep their development centres somewhere in eastern Europe (see Box 3.1 for a further discussion and examples).

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1 Griffith et al. (2006) find that large firms are more likely to engage in R&D in four advanced European countries.
2 Acemoglu et al. (2014) show that younger managers are more open to new ideas, so they are more likely to instigate disruptive, risky innovations.
As transition economies develop and move closer to the technological frontier, young firms producing world-class innovation will become more prominent. The economic environment will need to adapt to this change and become more supportive of innovative start-ups (as discussed in more detail in Chapter 5, which looks at policies that can help start-ups to succeed).

Type of ownership

Another important characteristic affecting innovation is the type of firm ownership. In general, foreign ownership and the integration of local firms into global supply chains are expected to lead to increased innovation (see Box 3.2). On the other hand, concerns are sometimes raised that multinational companies may conduct all of their R&D activities in their home countries, outsourcing only lower-value-added activities to emerging markets, so foreign takeovers may actually result in reduced spending on R&D.6

Evidence from BEEPS V and MENA ES suggests that the first of these effects tends to dominate in the transition region and that foreign ownership is associated with an increased likelihood of innovation and higher levels of spending on in-house R&D. Foreign-owned firms are defined here as firms where foreign investors hold a stake of 25 per cent or more — that is to say, at least a blocking minority. The percentage of such firms that have introduced new products is significantly higher than the percentage of locally owned firms that have done so. The same is true of process innovations, as well as marketing and organisational innovations (see Chart 3.4).

Indeed, in the case of marketing and organisational innovation, the impact of foreign ownership is pronounced even when foreign investors own a small stake that falls short of a blocking minority (in other words, between 0 and 25 per cent), while foreign ownership does not have a clear impact on product and process innovations until that stake reaches the 25 per cent mark. This suggests that foreign owners may be an important source of information about new organisational arrangements and marketing methods. At the same time, sharing technological know-how requires stronger incentives and assurances, which come with a stake of a certain size in a company.

The results also suggest that increased innovation by foreign-owned firms is a result of a mixture of “make” and “buy” strategies when it comes to acquiring external knowledge. The percentage of foreign-owned firms that invest in R&D (thereby pursuing a “make” strategy) tends to be higher than the percentage of domestic firms that follow this strategy (see Chart 3.5). This is the case in virtually every country in the transition region. Foreign-owned firms also tend to spend more on R&D (see Case study 3.1 for details of a joint venture in the Turkish automotive sector with an active domestic R&D programme). Overall, these findings run counter to the view that foreign takeovers undermine domestic R&D.

Not only do foreign firms “make” more knowledge, they are also more likely to engage in the acquisition of external knowledge (through the purchasing or licensing of patents and non-patented inventions and know-how) than locally owned firms (see Chart 3.5). This is the case in virtually every country in the transition region. Foreign-owned firms also tend to spend more on R&D (see Chart 3.6).

The formal regression results in Table 3.1 confirm that the relationship between foreign ownership and innovation holds when other firm-level characteristics are also taken into account. Everything else being equal, a majority foreign-owned firm is, on average, 2.3 percentage points more likely to introduce new products or processes (see column 2) and 4.3 percentage points more likely to introduce organisational or marketing innovations (see column 3).7 This is a sizeable difference, given that the average probability of a majority domestic-owned firm introducing new or improved products or processes is 17.5 per cent, while the probability of it introducing organisational or marketing innovations is almost 27 per cent.

In contrast, majority state-owned firms are significantly less likely to introduce new products or processes than locally owned private firms or foreign firms, and this effect is even larger in the case of new processes. This may reflect the fact that managers of state-owned firms have weaker incentives to achieve efficiency savings and improve productivity. Their remuneration, for example, is not necessarily linked to their firm’s performance, and these firms can typically rely on the state to bail them out in the event of poor performance.

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6 See, for example, Sample (2014).

7 Crespi and Zuñiga (2012) find mixed results for South America, with foreign ownership having a significant positive impact on R&D in Argentina, Panama and Uruguay, but not in Chile, Colombia or Costa Rica.
Competition in international markets

In addition to firm-level characteristics such as a firm’s age, size and ownership structure, various decisions made by firms are related to their incentives and ability to innovate. One such decision is whether to compete in international markets.

Firms that export their goods are able to spread the fixed costs of innovation over a larger customer base, so exports can support innovation. By the same token, firms in larger economies with larger domestic markets may find it easier to innovate on account of higher levels of domestic demand for new products.

Exporting can also expose domestic producers to stronger competition from foreign products, thereby providing an incentive to innovate (see Box 3.3 for a discussion of the complex relationship between competition and innovation). Furthermore, firms’ participation in global value chains, which involves the exporting of either intermediate or final goods, facilitates the adoption of foreign technologies, particularly in emerging markets (see Box 3.2).

BEEPS V and MENA ES data confirm the importance of export markets for innovation. Firms that export their products directly appear to be more likely to engage in R&D and introduce new products, processes, marketing methods and organisational innovations than firms that only serve their domestic markets (see Chart 3.6).

Similar differences can be observed in firm-level regressions. The estimates in Table 3.1 suggest that once various other firm-level characteristics are taken into account, exporters are around 3 percentage points more likely to innovate than non-exporters. This is a sizeable impact, as the probability of a non-exporter is 15 per cent more likely to engage in R&D and introduce new products than firms that only serve their domestic markets (see Chart 3.6).

The differences between exporters and non-exporters are particularly large when it comes to in-house R&D and process innovation. Regression results indicate that exporters are 6 percentage points more likely to engage in R&D. This may be explained by the fact that exporting and entering new markets can help firms to improve their knowledge of production processes, while R&D can help firms improve their ability to absorb new technologies.

Of the firms that do not export, those that primarily sell in the national market are more likely to introduce new products, processes and marketing methods than firms that operate primarily in the local market. Similar forces may be at play here: a national market provides a broader customer base, making it easier to justify the fixed costs of developing new products and processes, while the higher levels of competition in the national market provide stronger incentives to seek productivity gains.

R&D inputs and innovation outputs

Another important decision that a firm faces is whether to spend on R&D to support the development of new products. As discussed in Chapter 1, R&D is not a prerequisite for the introduction of new products or processes, as firms may decide to acquire existing knowledge from elsewhere.

At the same time, R&D significantly increases the likelihood of successful innovation. Firms that invest in R&D are an average 10 percentage points more likely to invest in new products, processes and marketing methods than firms that only serve their domestic markets (see Chart 3.6).

Unweighted averages across transition countries. The acquisition of external knowledge includes the outsourcing of R&D and the purchasing or licensing of patents and non-patented inventions or know-how. "Foreign-owned firms" are those where the foreign stake totals 25 per cent or more. "Domestic firms" include locally owned firms and firms with foreign ownership totalling less than 25 per cent.

Note: BEEPS V, MENA ES and authors’ calculations.

References:

8 See also Aghion et al. (2005) and Bilson et al. (2011).
9 See, for instance, Coe et al. (2009) and Baldwin and Gu (2004).
10 These estimates are consistent with the results of studies looking at other regions. For instance, Crespi and Zuñiga (2012) estimate that exporters in Colombia and Argentina are, respectively, 7 and 15 percentage points more likely to invest in the development of new products (including R&D). Meanwhile, Baldwin and Gu (2004) find that exporters in Canada are 10 percentage points more likely to invest in R&D.
11 Damijan et al. (2010) find evidence that, in Slovenia, exporting increases the probability of becoming a process innovator for medium-sized and large firms.
CHART 3.7. The impact of R&D on product and process innovation, broken down by sector

Source: BEEPS V, MENA ES and authors’ calculations.
Note: This chart reports the average marginal effect of R&D on product and process innovation. Sectors are based on ISIC Rev. 3.1. High-tech and medium-high-tech manufacturing sectors include chemicals (24), machinery and equipment (29), electrical and optical equipment (30-33) and transport equipment (34-35), excluding 35.1. Low-tech manufacturing sectors include food products, beverages and tobacco (15-16), textiles (17-18), leather (19), wood (20), paper, printing and publishing (31-32) and other manufacturing (36-37). Knowledge-intensive services include water and air transport (61-62), telecommunications (64) and real estate, renting and business activities (70-74).

CHART 3.8. The impact of ICT on innovation, broken down by sector

Source: BEEPS V, MENA ES and authors’ calculations.
Note: This chart reports the average marginal effect of the use of ICT on product and process innovation. The use of ICT is estimated using the question about the use of email to communicate with clients or suppliers. See the note accompanying Chart 3.7 for the list of industries in each sector.

of 22 percentage points more likely to introduce new products or processes.\(^{12}\) They are also an average of 20 percentage points more likely to introduce marketing or organisational innovations (perhaps because these types of innovation often go hand in hand with technological innovation).

Investing in R&D has the largest impact on the probability of introducing a new product in high-tech manufacturing sectors such as electrical equipment or pharmaceuticals (see Chart 3.7). In these sectors R&D increases the probability of product innovation on average by 26 percentage points, while in less knowledge-intensive service sectors (such as catering or sales) R&D has virtually no impact on the probability of introducing a new product.

While R&D is closely linked to product innovation in high-tech manufacturing sectors, R&D in low-tech manufacturing has a large impact on process innovation, which involves the optimisation of the production of existing products (for instance, a clothing manufacturer that replaces the manual cutting of fabric with an automatic fabric-cutting machine). Conducting R&D in these sectors increases the probability of introducing a new process by an average of 20 percentage points (compared with an average of 11 percentage points in high-tech manufacturing sectors).

Human capital

A suitably skilled workforce (including strong management skills) is one of the key prerequisites for successful innovation — both innovation at the technological frontier and the adoption of existing technology — as workers are required to develop and learn new production techniques.\(^{13}\)

The results in Table 3.1 suggest that while the percentage of employees with a university degree affects the probability of introducing a new product or process and the likelihood of investing in R&D, this impact is fairly small relative to the effect of other firm-level characteristics discussed above. The regression analysis already accounts for the differences between the skill intensities of the various industries, so this finding suggests that differences in human capital across firms within a particular industry do not explain much of the remaining differences in innovation activity.

While a firm’s human capital reflects its recruitment decisions, it is also, to a large extent, shaped by the availability of skills in the market. There is further cross-country analysis of this issue later in the chapter.

Information and communication technology

Firms that use email to communicate with their clients or suppliers are, on average, 9 percentage points more likely to introduce new products or processes and 14 percentage points more likely to introduce organisational or marketing innovations (see Table 3.1, column 3). This attests to the importance of both modern organisational practices and supporting information and communication technology (ICT) infrastructure in facilitating innovation.

ICT’s largest impact is on the probability of introducing product

\(^{12}\) These estimates are comparable to those obtained by Crespi and Zuñiga (2012) for South American countries.

\(^{13}\) See, for instance, Nelson and Phelps (1966).
and process innovations in high-tech and medium-high-tech manufacturing sectors (see Chart 3.8). At the same time, in low-tech manufacturing sectors (such as textiles or food and beverages) and less knowledge-intensive services (such as catering or sales), use of ICT has a large impact on the probability of implementing marketing and organisational innovations.

When it comes to innovation, firms may also benefit from the expert advice of external consultants (see Box 3.4). Lastly, the availability of finance also plays an important role, as firms may abandon the development of new products if the requisite funding cannot be obtained. Chapter 4 discusses these issues in more detail.

The business environment as a driver of innovation

Firms’ ability to innovate also depends on external factors. As Chapter 2 notes, a poor business environment – widespread corruption, weak rule of law, burdensome red tape, and so on – can substantially increase the cost of introducing new products and make returns to investment in new products and technologies more uncertain. These factors can undermine firms’ incentives and ability to innovate.

The results of BEEPS V and MENA ES confirm this. As part of these surveys, each firm was asked whether various factors, such as access to land or labour regulations, were obstacles to doing business. Firms responded using a scale of 0 to 4, where 0 meant “no obstacle” and 4 signified a “very severe obstacle”.

On the basis of these answers, firms that have introduced a new product in the last three years regard all aspects of their business environment as a greater constraint on their operations than firms that have not engaged in product innovation.

This can be seen from the fact that all business environment constraints lie above the 45-degree line in Chart 3.9. The differences between the views of innovative and non-innovative firms are especially large when it comes to skills, corruption and customs and trade regulations (with these dots lying furthest away from the 45-degree line). Inadequate skills and corruption, in particular, are perceived to be among the main constraints for all firms, and they are even greater constraints for innovative firms. (These are located towards the top right of the chart and are marked in red.) In contrast, customs and trade regulations (in the bottom left of the chart, marked in orange) are not major concerns at the level of the economy as a whole, partly because only a relatively small number of firms import production inputs or export their products directly. However, customs and trade regulations specifically affect innovative firms, as the introduction of new products and technologies is often dependent on imported inputs and the ability to tap export markets.  

Innovative firms are also significantly affected by a number of other aspects of the business environment (located to the right of the chart, but close to the 45-degree line, and marked in yellow). However, these tend to constrain innovative and non-innovative firms alike, with only a slightly larger impact on innovative firms. These include access to finance, the practices of competitors in the informal sector, tax administration and, to a lesser degree, electricity.

The extent to which the various features of the business environment affect all firms and innovative firms differs from region to region (see Chart 3.10). In central Europe and the Baltic states (CEB), for instance, the differences between the responses of innovative and non-innovative firms are relatively small (in other words, all dots lie close to the 45-degree line). This suggests that the business environment in the CEB region is less hostile towards innovation. However, a number of aspects of the business environment remain significant obstacles to the growth of innovative and non-innovative firms alike, including access to finance, tax administration and inadequate skills.

In south-eastern Europe (SEE) corruption stands out as an issue, constraining the growth of all firms, but particularly affecting those that innovate. Inadequate skills also particularly affect innovative firms, while both innovative and non-innovative firms frequently complain about the actions of competitors in the informal sector, access to finance and electricity.

The differences between the views of innovative and non-innovative firms are larger in eastern Europe and the Caucasus (EEC), Central Asia and Russia. While corruption and inadequate skills strongly affect all firms, this negative impact is felt most strongly by firms that innovate. In addition, innovative firms feel constrained by a number of aspects of the business environment that other firms regard as being less binding. These include customs and trade regulations, telecommunications and business licensing and permits, all of which are likely to be important inputs in the innovation process. 

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14 See Lileeva and Trefler (2010).
The BEEPS V and MENA ES results suggest that improvements in the provision of infrastructure, further deregulation in the area of licences and permits and improvements in the quality of government services can specifically help innovative firms. Table 3.2 summarises innovative firms’ perception of the business environment in the various regions.

### Cross-country analysis

#### Economic institutions

The previous section shows that innovative firms tend to have a much more negative view of certain aspects of their business environment when compared with non-innovative firms. This raises the question of whether such perceived constraints negatively affect innovation outcomes. Do they inhibit innovation in practice? To answer this question, the impact of various aspects of the business environment is examined in more detail using cross-country regressions.

The business environment is, to a large extent, shaped by a country’s deeper economic institutions, such as the rule of law, control of corruption, the effectiveness of the government and regulatory quality. This can be captured by the average of the relevant Worldwide Governance Indicators, as discussed in Chapter 2. Together with other country-level characteristics, such as income per capita, R&D inputs, financial development and the quality of human capital, the quality of institutions is used in this section to explain the number of patents granted per worker and the innovation intensity of exports in various countries. The results of these cross-country regressions are presented in Table 3.3.

These results indicate that better institutions are associated with increases in patenting and more innovation-intensive exports. The effect of improving institutions is stronger and has greater statistical significance in countries where institutions are relatively weak. This can be seen where the average of the

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**TABLE 3.2. Main obstacles to firms’ operations**

<table>
<thead>
<tr>
<th>Region</th>
<th>All firms, including innovators</th>
<th>Top constraints, affecting...</th>
<th>Specifically innovators</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEB</td>
<td></td>
<td>Tax administration</td>
<td>Informal sector</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to Finance</td>
<td>Corruption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skills</td>
<td>Electricity</td>
</tr>
<tr>
<td>SEE</td>
<td></td>
<td>Access to informal sector</td>
<td>Corruption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skills</td>
<td>Taxes administration</td>
</tr>
<tr>
<td>EEC, Russia and Central Asia</td>
<td>Access to finance, informal sector</td>
<td>Corruption</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skills</td>
<td>Telecommunications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customs and trade regulations</td>
<td>Licences and permits</td>
</tr>
</tbody>
</table>

Source: BEEPS V and authors’ calculations.

Note: excludes tax rates and political instability.
Worldwide Governance Indicators is interacted with (i) a dummy variable that takes the value of one when that average is above the mean for the sample (indicating strong economic institutions); or (ii) a dummy variable that takes the value of one when that average is below the mean for the sample (indicating weak economic institutions; see columns 3 to 8).

An improvement of around half a standard deviation in the quality of economic institutions in a country with below-average economic institutions (say, from the level of Ukraine to that of Albania) is associated with a 60 per cent increase in the innovation intensity of exports. An improvement of this magnitude is also associated with a 40 to 50 per cent increase in patent output. These effects are sizeable, considering that they only capture the direct impact of the quality of institutions, beyond the indirect effect that it may have through a higher level of income and of human capital in the country.

### TABLE 3.3. Determinants of patent output and the innovation intensity of exports

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Log of GDP per capita</td>
<td>-0.117***</td>
<td>1.260***</td>
<td>-0.006</td>
<td>1.062***</td>
<td>-0.078</td>
<td>1.115**</td>
<td>-0.229</td>
<td>0.878**</td>
</tr>
<tr>
<td></td>
<td>(0.169)</td>
<td>(0.185)</td>
<td>(0.166)</td>
<td>(0.335)</td>
<td>(0.168)</td>
<td>(0.430)</td>
<td>(0.202)</td>
<td>(0.642)</td>
</tr>
<tr>
<td>Log of population</td>
<td>0.236***</td>
<td>-0.012</td>
<td>0.181**</td>
<td>-0.152</td>
<td>0.195**</td>
<td>-0.149</td>
<td>0.177***</td>
<td>-0.096</td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td>(0.108)</td>
<td>(0.069)</td>
<td>(0.109)</td>
<td>(0.064)</td>
<td>(0.111)</td>
<td>(0.067)</td>
<td>(0.126)</td>
</tr>
<tr>
<td>Institutions (WGIs)</td>
<td>0.733***</td>
<td>0.851*</td>
<td>0.333</td>
<td>0.763*</td>
<td>0.225</td>
<td>0.450</td>
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<tr>
<td></td>
<td>(0.230)</td>
<td>(0.459)</td>
<td>(0.225)</td>
<td>(0.450)</td>
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<tr>
<td>WGIs * high WGI dummy</td>
<td>-0.165</td>
<td>0.795*</td>
<td>-0.16</td>
<td>0.871*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.246)</td>
<td>(0.465)</td>
<td>(0.262)</td>
<td>(0.487)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>WGIs * low WGI dummy</td>
<td>1.081**</td>
<td>0.535</td>
<td>1.309***</td>
<td>0.951</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.508)</td>
<td>(0.980)</td>
<td>(0.491)</td>
<td>(0.952)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average years of tertiary education</td>
<td>-0.132</td>
<td>1.311**</td>
<td>-0.288</td>
<td>0.662</td>
<td>-0.002</td>
<td>0.614</td>
<td>0.144</td>
<td>0.757</td>
</tr>
<tr>
<td></td>
<td>(0.372)</td>
<td>(0.528)</td>
<td>(0.420)</td>
<td>(0.467)</td>
<td>(0.426)</td>
<td>(0.546)</td>
<td>(0.418)</td>
<td>(0.524)</td>
</tr>
<tr>
<td>Ratio of external trade to GDP</td>
<td>0.002</td>
<td>-0.001</td>
<td>0.003*</td>
<td>-0.001</td>
<td>0.004**</td>
<td>-0.001</td>
<td>0.005**</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Financial openness</td>
<td>-0.001</td>
<td>-0.086</td>
<td>0.054</td>
<td>-0.164</td>
<td>0.010</td>
<td>-0.156</td>
<td>0.033</td>
<td>-0.146</td>
</tr>
<tr>
<td></td>
<td>(0.071)</td>
<td>(0.133)</td>
<td>(0.071)</td>
<td>(0.115)</td>
<td>(0.070)</td>
<td>(0.117)</td>
<td>(0.071)</td>
<td>(0.132)</td>
</tr>
<tr>
<td>Private credit</td>
<td>0.002</td>
<td>0.009**</td>
<td>0.003</td>
<td>0.001***</td>
<td>0.003</td>
<td>0.011***</td>
<td>0.004*</td>
<td>0.011***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Natural resource rents</td>
<td>-0.029**</td>
<td>-0.005</td>
<td>-0.032**</td>
<td>0.009</td>
<td>-0.028*</td>
<td>0.008</td>
<td>-0.014</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.020)</td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.013)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Ratio of business R&amp;D spending to GDP</td>
<td>0.338</td>
<td>0.834**</td>
<td>0.360**</td>
<td>0.026***</td>
<td>0.382**</td>
<td>0.839***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.208)</td>
<td>(0.315)</td>
<td>(0.168)</td>
<td>(0.309)</td>
<td>(0.187)</td>
<td>(0.261)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio of government R&amp;D spending to GDP</td>
<td>-0.63</td>
<td>4.845***</td>
<td>-0.35</td>
<td>4.765**</td>
<td>-0.321</td>
<td>5.053***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.989)</td>
<td>(1.763)</td>
<td>(0.944)</td>
<td>(1.915)</td>
<td>(0.907)</td>
<td>(1.657)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio of university R&amp;D spending to GDP</td>
<td>-0.191</td>
<td>-1.901</td>
<td>0.416</td>
<td>-1.949</td>
<td>0.550</td>
<td>-1.767</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.637)</td>
<td>(1.272)</td>
<td>(0.881)</td>
<td>(1.304)</td>
<td>(0.704)</td>
<td>(1.280)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EBRD dummy</td>
<td>0.604***</td>
<td>1.325***</td>
<td>0.522**</td>
<td>0.798*</td>
<td>0.172</td>
<td>0.828*</td>
<td>0.188</td>
<td>0.882**</td>
</tr>
<tr>
<td></td>
<td>(0.202)</td>
<td>(0.372)</td>
<td>(0.244)</td>
<td>(0.403)</td>
<td>(0.291)</td>
<td>(0.481)</td>
<td>(0.292)</td>
<td>(0.423)</td>
</tr>
<tr>
<td>No. of observations</td>
<td>113</td>
<td>68</td>
<td>100</td>
<td>68</td>
<td>100</td>
<td>68</td>
<td>97</td>
<td>65</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations using data from WIPO, World Bank, UNESCO, Penn World Table 8.0, Chinn and Ito (2006) and Barro and Lee (2013).

Note: The dependent variables are the log of total patents granted per 1,000 workers (“patent intensity”) and the log of the innovation intensity of exports (IIE), both of which are averages over the period 2010-13. “WGIs” denotes the average of four Worldwide Governance Indicators (rule of law, control of corruption, effectiveness of government and regulatory quality). See tre.ebrd.com for details about other explanatory variables. Robust standard errors are indicated in parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels respectively. Columns 1 to 6 are estimates using ordinary least squares; columns 7 and 8 are estimates using two-stage least squares, with lagged values for income per capita, openness to trade, and dependence on natural resources used as instruments for contemporaneous values.
Economic openness

The analysis above shows that innovative firms feel far more constrained by customs and trade regulations than non-innovative firms. At the same time, firms that sell their products in export markets are more likely to innovate. The results of cross-country analysis confirm that both the size of the market (measured by population and GDP per capita) and economic openness (measured by the ratio of exports and imports to GDP) are important for the innovation intensity of exports. An increase in openness to trade totalling 30 percentage points of GDP (say, from the level of Ukraine to that of Latvia) is associated with a 9 to 15 per cent increase in the innovation intensity of exports. At the same time, no strong links are found between patent output and economic openness or the size of the economy.

In addition, there is also a positive (albeit weaker) relationship between the innovation intensity of exports and the financial openness of the economy (as measured by the Chinn-Ito index, where higher values correspond to free cross-border movement of capital and lower values correspond to more restrictive regimes). All in all, these results suggest that a country’s ability to commercialise innovations and adopt technologies benefits from openness to trade and a large market.

These results should be viewed as indicating a general correlation between innovation and country-level characteristics, rather than a causal relationship. For instance, the causality may also run from innovation to openness to trade. Indeed, innovation can support exports, as it can help firms to become more productive and improve their competitive positions in international markets, thereby increasing the ratio of exports to GDP. In order to take some account of such reverse causality, similar regressions have been estimated using values for income per capita, openness to trade and dependence on natural resources with a lag of ten years as proxies for their contemporaneous values. The results remain broadly unchanged (see columns 7 and 8).

Dependence on natural resources

Interestingly, an abundance of natural resources – measured by calculating natural resource rents (that is to say, revenues net of extraction costs) as a percentage of GDP – has the opposite effect to economic openness. Reliance on commodities does not appear to have an impact on the patent output of an economy, but the exports of countries that are dependent on natural resources tend to be significantly less innovation-intensive than those of other countries (see Table 3.3).

This is, of course, partially a reflection of the fact that commodity sectors inevitably account for a larger share of such countries’ exports. However, this negative relationship may also arise because the economy’s dependence on natural resources reduces the average firm’s economic incentives to innovate, as a large percentage of the value added in the economy is derived from activities that are less reliant on continuous innovation.

For instance, while constant innovation and the adoption of cutting-edge technologies is a prerequisite for maintaining a competitive position in the automotive sector, a firm’s competitive edge in terms of natural resource exports is dependent primarily on natural resource endowments. At the same time, the availability of natural resource rents may enable governments (as well as universities and firms) to finance research, which offsets any negative impact that natural resources may have on patent output, but does not necessarily strengthen incentives to commercialise innovations.

Skills of the workforce

The third aspect of the business environment that constrains innovative firms particularly strongly is the availability of the right skills. In country-level regressions (such as those reported in Table 3.3) measures of human capital – including the percentage of the population that has completed secondary or tertiary education, the average number of years of schooling and the average number of years of tertiary education – are not consistently found to be significant determinants of innovation. However, a higher average number of years of university education is generally associated with a higher patent output. This weaker correlation may be due to the fact that enrolment ratio-type measures predominantly capture the quantity – rather than the quality – of education.

A more nuanced measure of the quality of education and basic skills is available for a sample of 65 OECD and non-OECD economies, based on the Programme for International Student Assessment (PISA) conducted by the OECD. PISA is a standardised international assessment of 15-year-old students’ abilities in the areas of reading, mathematics and science. It has been conducted every three years since 2000, with a sample of schools chosen at random in each country. Higher average scores across all students in all three subjects generally correspond to a higher quality of education in a given country.

For the sub-sample of countries participating in PISA, the average scores achieved by these 15-year-old students are positively and significantly correlated with innovation, in terms of both patent output and the innovation intensity of exports (see Chart 3.11). This relationship is particularly strong for patent output (with the correlation coefficient standing at around two-thirds), highlighting the role that the quality of education plays in facilitating innovation at the technological frontier.

The effect that R&D has on innovation outcomes, which was examined earlier at the level of individual firms, can also be observed in cross-country data (see Table 3.3). Furthermore, the results of cross-country analysis reveal that the distribution of R&D spending across firms, academic institutions and government also plays an important role. Both business R&D spending and government R&D spending are associated with increases in patent output, with the impact of an additional US$ 1 of R&D spending estimated to be higher for government R&D than for business R&D. However, only business R&D appears to have a positive impact on the innovation intensity of exports. This could be because of the poor links between science and industry in transition countries (see Box 5.3).

This discussion of the links between innovation and R&D in the various sectors also highlights the complexity of the innovation
process, which requires a variety of general and specialist inputs. For this reason, countries that are at a more advanced stage in their development (measured, for instance, by GDP per capita at purchasing power parity) may be better placed to innovate. The cross-country results presented in Table 3.3 confirm that rich countries do tend to patent more.

However, there does not appear to be any correlation between income per capita and the innovation intensity of output. This may be due to the fact that firms in less developed countries have become increasingly successful at adopting existing technology over the last few decades.

Overall, the various factors discussed above explain between 60 and 90 per cent of variation in innovation outcomes across countries. The analysis also suggests that, given their income per capita, economic openness, human capital, economic institutions, R&D spending and other characteristics, transition economies innovate at around or slightly above the level that would be expected of them, in terms of both patent output and the innovation intensity of their exports.19

**THE AVERAGE PERFORMANCES OF 15-YEAR-OLD STUDENTS IN THE PISA ASSESSMENT ARE POSITIVELY CORRELATED WITH THE INNOVATION INTENSITY OF EXPORTS**

**CASE STUDY 3.1. Ford Otosan**

The Turkish automotive sector has gradually evolved over the years. It used to focus purely on assembly, but it now conducts more higher-value-added activities, including local R&D. So far, however, R&D has focused mainly on the design and development of simple products (such as plastic and metal vehicle parts) and the optimisation of manufacturing techniques. Thus, significant challenges remain if its focus is to shift towards high-tech components (such as engine parts), which would require an accommodating innovation ecosystem with strong links between manufacturers, academia and local suppliers.

Ford Otosan has played a leading role in developing local R&D capabilities and establishing and nurturing links with local suppliers and academia, thereby helping the Turkish automotive industry to move towards higher-value-added activities.

The company is a joint venture bringing together a global automotive giant (the Ford Motor Company) and a local industrial conglomerate (Koç Holding). The firm was set up in 1959 to assemble Ford’s commercial vehicles. Ford’s stake in the company has gradually increased, reaching 41 per cent in 1997. Koç Holding also owns 41 per cent, and the remaining 18 per cent is publicly traded. In 2007 the company opened the Gebze Engineering Centre, which develops new products and technology. The firm now has the largest private R&D centre in Turkey, employing around 1,300 engineers.

Ford Otosan is currently in the process of further increasing its local R&D activity and strengthening its links with local suppliers and academia. Specifically, the company has launched a project to develop a new heavy truck engine that will meet European standards and be an industry leader in terms of its energy performance, service life and maintenance costs. As part of the project, high-tech engine components are being designed and developed locally by Ford Otosan engineers, in cooperation with local universities and suppliers. Importantly, the project boasts more than a dozen specialist partnerships with local universities, using these institutions to verify new technologies and create an appropriate testing environment.

19 The coefficient for the regional dummy variable is positive, but in most cases it is not significantly different from zero.
Conclusion

Successful innovation relies on a supportive business environment. A poor business environment can substantially increase the cost of developing new products and make returns to innovation much more uncertain, undermining firms’ incentives to innovate. In some cases it may prompt start-ups and other innovative firms to move their activities elsewhere, resulting in an “innovation drain”.

Strikingly, firms that have recently introduced a new product tend to regard all aspects of the business environment as a greater constraint on their operations and growth than firms that do not innovate. These differences between the views of innovative and non-innovative firms are particularly large when it comes to corruption, the skills of the workforce and customs and trade regulations.

From a geographical perspective, they tend to be larger in Central Asia, the EEC region and Russia. In the CEB region, by contrast, these differences are less pronounced, suggesting that the overall environment there may be more supportive of innovation.

Firm-level and cross-country analysis has identified a number of factors that play an important role in shaping firms’ incentives and ability to innovate, as well as innovation outcomes at country level. In the case of the latter, the factors that determine a country’s patent output are not necessarily the same as those that determine the innovation intensity of a country’s exports. For example, countries that are rich in natural resources tend to have less innovation-intensive exports, despite patenting levels that are comparable to those of other countries.

Overall, the analysis in this chapter supports the view that R&D activities increase the likelihood of successful innovation, but are by no means a prerequisite for innovation. The impact that R&D activities have on the likelihood of a new product being introduced is particularly large in high-tech manufacturing sectors. Meanwhile, R&D in low-tech sectors can help to optimise production processes. Lastly, while both business R&D and government R&D increase a country’s patent output, only business R&D has a significant positive impact on the innovation intensity of a country’s exports.

This analysis also reveals the relative scarcity of innovative start-ups in the transition region. While larger firms that have been around for a longer period of time tend to innovate more — particularly in high-tech manufacturing sectors, where innovation is more dependent on R&D — smaller and younger firms are often the ones developing products that are new to the global market.

In Israel, young, small firms are more likely to introduce world-class innovations than larger, established firms, but in the transition region this is not the case. On the contrary, innovations introduced by young, small firms in the EBRD region are less likely to target the global technological frontier than those of larger firms.

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BOX 3.1. Innovation drain

The transition region’s most successful innovative entrepreneurs and small firms often move to London, Berlin, Silicon Valley, Boston, New York and other innovation hubs at the earliest available opportunity in order to take advantage of the resources available there. The investors, mentors, advisers and clients located in these places help them to develop products faster and more efficiently (thanks to the benefits of agglomeration and clustering), while at the same time increasing the value of their businesses. The legacy of socialism means that entrepreneurship does not have a long tradition in the transition region, so marketing and business development still lag behind advanced economies.

Since a country’s development prospects are partly dependent on its capacity for innovation – which, in turn, depends on human capital – such “innovation drain” may be damaging. Indeed, research suggests that the emigration of highly skilled individuals weakens local knowledge networks.

However, a highly skilled diaspora can contribute to economic development through a variety of channels (such as remittances, trade, foreign direct investment and knowledge transfers), helping innovators back home to access knowledge accumulated abroad. Most successful start-ups from the transition region are now developing their businesses in the United States or the United Kingdom, but have development centres somewhere in eastern Europe.

The net effect ultimately depends on the country’s economic development, the degree of transparency within government and public administration, the business environment, and employers’ business practices in terms of recruitment and selection. It also depends on how good the country is at establishing links with its citizens abroad. One option here would be to use expats in contact with one another through social media and networking events and help them to return home if they so wish.

There are numerous examples of companies from the transition region that have moved abroad at an early stage.

Tosli Inc., the creator of a personal financial assistant app, was established in Slovenia in 2012, but moved its headquarters to Silicon Valley after joining the 500 Startups accelerator programme later that year. Another example is Double Recall, which helps publishers to increase the profitability and efficiency of paywalls by monetising social media, search and email traffic using simple advertisements that connect and engage with users. The company was established in Slovenia in 2010, but then graduated from Y Combinator (an American seed accelerator) in 2011 and now has its headquarters in New York.

Likewise, Croatian-Slovenian start-up Bellabeat (previously BabyWatch), the creator of pregnancy tracking system Bellabeat, participated at Startupbootcamp Berlin and raised funds via angel investors and an Indiegogo campaign in 2013. It graduated from the Y Combinator accelerator in March 2014 and launched its product in the US market after successfully completing the seed round. Its headquarters are in Silicon Valley.

Croatian start-up Repsys, a field management software company that was founded in 2010, moved its headquarters to Boston in 2014 after securing funding from Launchpad Venture Group, First Beverage Group and K5 Ventures.

GrabCAD, a company established in 2009 that has created a collaborative product development tool that helps engineering teams to manage, view and share CAD files in the cloud, moved its headquarters from Tallinn to Boston in 2011 in order to benefit from the start-up scene there.

Codility, which produces software used for testing candidates for developer positions and was founded in London by a group of Poles in 2009 after winning the Seedcamp competition, is an example of movement in the opposite direction. Most of the team is now based in Warsaw, where they have an R&D centre, although they still have an office in London.

RealtimeBoard, which has developed a cloud-based whiteboard that facilitates collaboration, was founded in Perm, in Russia, in 2011, but it now has its headquarters in Las Vegas. Similarly, Jelastic, a cloud computing service that provides networks, servers and storage solutions to software development clients, enterprise businesses, original equipment manufacturers and web hosting providers, was founded in Zhitomir, in Ukraine, in 2010. It received funding from several Russian venture funds, but moved its headquarters to Silicon Valley in 2012.

It is interesting to note that several of these start-ups were given an initial (financial) push by seed financing or boot camp accelerator programmes in Berlin or London, but nevertheless moved across the Atlantic to the United States. The pull of the US innovation hubs and the large US market remains too strong for Europe to compete with, particularly as there are still many barriers to the free movement of online services and entertainment across national borders in the EU.

BOX 3.2. Global value chains: drivers of innovation?

Over the past two decades, the increased prominence of global value chains (GVCs) has transformed the world economy. The declining cost of communication and international shipping has caused production processes to be broken down into ever smaller parts and spread across vast geographical areas. As a result, international commerce is now dominated by trade in intermediate – rather than final – goods and services. This box looks at how GVCs stimulate innovation among manufacturing firms in the transition region.

There are several reasons why participation in GVCs can help firms in emerging economies to learn and innovate. First, being part of a GVC means that a firm has to satisfy the chain’s requirements in terms of the quality of products and the efficiency of processes. To do so, managers may need to adapt their production methods or acquire technology via licensing arrangements. Second, serving foreign clients may require improved logistical solutions or delivery methods, as delivery at the appropriate time is essential for a smooth supply chain. Third, importing intermediate goods can itself be a channel for the diffusion of technology where firms import state-of-the-art technology that has not previously been available in the domestic market. Importing new technologies can also enhance the technical skills of the firm.

23 See Kremikov (2013).
24 See Kremikov (2013).
25 See Forrester (2013) for more details.
26 See Fransen (2014) for more details.
27 See Pietrobelli and Raballotti (2011).
workforce if this necessitates further training. These increases in human capital may, in turn, enable companies to introduce innovative products of their own.

However, in certain circumstances GVCs can also hamper innovation within participating firms. This is most likely to occur where firms in developing countries are involved solely in the assembly of foreign intermediate goods. As this is the least skill-intensive stage of the value chain, the potential for technological spillovers is minimal and it is unlikely that participation in the GVC will encourage these firms to introduce new products of their own.

Chart 3.2.1 shows the percentage of innovative BEEPS V firms that are part of a GVC. GVC firms are defined as those that both import at least 10 per cent of their intermediate goods and export at least 10 per cent of their output.28

We can see that GVC firms tend to be more innovative than other firms across all five measures of innovation. In particular, 44 per cent of GVC firms responding to BEEPS V have introduced a new product in the last three years, compared with only 31 per cent of firms that do not participate in an international supply network. Equally striking is the fact that there is a 15 percentage point difference between the two when it comes to the percentage of firms that spend money on R&D or use technology via a licensing arrangement.

In order to check that these substantial differences are not driven by other factors, such as firms’ ownership structures or their access to finance, Table 3.2.1 presents the results of a multivariate regression analysis. It shows that these differences in R&D, the licensing of technology, product innovation and process innovation continue to be observed when other firm-level characteristics are controlled for. This analysis also determines the precise source of the positive impact that GVCs have on innovation. All measures of innovation – with the exception of the acquisition of external knowledge – are positively and significantly correlated with the importing of at least 10 per cent of total intermediate goods. However, only product innovation is positively and significantly associated with the exporting of at least 10 per cent of total output.

These results suggest that GVCs help firms to expand their product ranges and upgrade technology primarily by giving them access to better quality inputs, rather than by expanding the size of their markets.

The detailed innovation module in BEEPS V can help to shed more light on the mechanisms that are at work here. Firms that reported the introduction of a product or process innovation or the acquisition of external knowledge were asked whether they were able to do so as a result of working with domestic or foreign partners (such as clients or suppliers). Chart 3.2.2 shows that 22 per cent of GVC firms reported working with foreign partners on innovation, compared with only 10 per cent of non-GVC firms. This suggests that the higher levels of innovative activity among GVC firms can indeed be attributed to their easier access to foreign technology and knowledge. An important policy implication is that firms in emerging markets cannot hope to become more innovative simply by importing physical inputs. Instead, they need to invest in longer-term relationships with foreign suppliers and clients in order to allow a continuous flow of knowledge and know-how.

Chart 3.2.3 shows the impact that participation in GVCs has on the probability of firms innovating. Here, firms are grouped together on the basis of the relative skill endowments of the countries where they operate (measured as the percentage of the workforce that has completed secondary education). This chart suggests that the marginal probability of innovating on account of participation in a GVC increases with the quality of the workforce that is at the firm’s disposal. Firms in countries with higher skill levels are given – via GVCs – more skill-intensive tasks with greater scope and need for technological spillovers.

However, caution is warranted when it comes to the type of involvement that firms have in GVCs. As mentioned above, participation in GVCs may hinder innovative activity and prevent positive spillovers if it only involves the assembly of components.

All in all, the analysis in this box shows that where participation in GVCs goes beyond simple assembly, it may allow firms to reap substantial productivity benefits through international spillovers of technology and know-how. A good example of this is the automotive industry in central and eastern Europe.29 In CEB countries where this sector has seen high levels of foreign direct investment and local car producers are well integrated into GVCs – such as Hungary and the Slovak Republic – labour productivity in the automotive sector is substantially higher than the average for the manufacturing industry as a whole. By contrast, in countries where foreign investors play no meaningful role in the car industry (such as Bulgaria), the opposite is true.

The challenge, then, remains unchanged: not only replicating, but also improving on this paradigm across a variety of industries in the region, in order to help countries move up the value chain.


29 Early methods of measuring GVCs focused on vertical specialisation and the flow of intermediate goods across borders (see, for instance, Hummels et al., 2001), while more recent methodologies focus on the value-added content of final goods. Identifying two-way trade at the firm level is important in order to correctly determine whether firms are likely to be part of a GVC.

Source: BEEPS V and authors’ calculations.
Note: GVC firms are those participating in global value chains.
Chapter 3
Drivers of Innovation

Chart 3.2.2. Sources of Innovation

Chart 3.2.3. The marginal impact that participation in a GVC has on the probability of innovating, broken down on the basis of countries’ skill endowment levels

Table 3.2.1. Global value chains and innovation

Source: BEEPS V and authors’ calculations.

Note: GVC firms are those participating in global value chains.

Source: BEEPS V and authors’ calculations.

Note: Standard errors are reported in parentheses below the coefficients. ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels respectively.
CHAPTER 3
EBRD | TRANSITION REPORT 2014

BOX 3.3. Competition and innovation: a complex relationship

Does stronger competition in product markets boost or hamper technological advances? The relationship between competition and innovation is complex, as multiple countervailing forces are at work.

On the one hand, concentrated markets with less competition may be more conducive to innovation. Large firms with substantial market power may be more willing to carry out innovation-oriented R&D activities because the scarcity of competitors will allow them to reap higher rents from newly introduced products if those innovations turn out to be successful. Market power may also help firms to finance R&D activities using retained earnings.

On the other hand, a lack of competition, while enabling firms to enjoy higher rents from new products, may also lead to complacency. In other words, firms may have more incentives to innovate in a competitive environment, in order to get ahead of their rivals and increase their market share.

The combination of these two effects may lead to a non-linear relationship between competition and innovation (such as an inverted U-shape). This shape may reflect the existence of two broad types of industry: “neck-and-neck” industries, in which companies operate with similar levels of technology, and “unlevelled” industries, in which a technological leader competes with a group of followers.

In neck-and-neck industries, competition encourages firms to innovate, because it allows them to move ahead of their competitors and increase their market share. In contrast, tougher competition discourages laggard firms in unlevelled industries from innovating, as the laggard’s reward for catching up with the technological leader declines. An inverted U-shape may emerge where neck-and-neck industries are more prevalent at low levels of competition, but then, as competition intensifies, more industries become unlevelled and further competition starts to put a break on innovation.

BEEPS V and MENA ES data broadly confirm the existence of an inverted U-shape in transition economies (see Chart 3.3.1). This chart plots innovative output in the SEE and CEB regions against the distribution of the number of competitors, showing that the average percentage of firms introducing a new or improved product or process initially increases with the number of competitors, before then declining in the third and fourth quartiles of the distribution. The chart also shows that the inverted U-shaped relationship between competition and innovation translates into a similar relationship between competition and firms’ growth.

Empirical evidence suggests that the positive impact that competition has on innovation is stronger for older firms. This is consistent with the view that older firms are inherently less likely to innovate unless they are spurred on by competition. Overall, the literature seems to conclude that some degree of market power appears necessary for stimulating innovation activity, coupled with competitive pressure (especially pressure from foreign competitors).

**Competition policy**

There is a broad consensus that well-designed and properly enforced competition policies can be broadly divided into two groups. First, product market deregulation aims to remove barriers to entry, trade and economic activity, as well as limiting the state’s direct interference in economic activity. Second, competition laws provide a legal framework for the prosecution of anti-competitive conduct, cartels and the abuse of dominant positions, as well as reducing the anti-competitive effect of mergers.

Product market deregulation has consistently been found to increase the adoption of state-of-the-art production techniques, as well as the introduction of new technologies. As a result, deregulation may ultimately translate into stronger total factor productivity growth.

Conversely, restrictive product market regulations limit the productivity of the industries concerned. This is particularly true of industries that are a long way from the technological frontier. In these industries, restrictive regulations tend to halt the catching-up process.

Recent analysis also shows that anti-competitive product market regulations in upstream sectors curb productivity growth even in very competitive downstream sectors. In other words, a lack of competition in upstream sectors can generate barriers to entry that curb competition in downstream sectors as well, reducing pressures to improve efficiency in those sectors. For example, tight licensing requirements in retail or transport sectors can restrict access to distribution channels, while overly restrictive regulation in banking and financial sectors can reduce sources of financing, affecting all firms in the economy.

When it comes to the enforcement of competition law, the existence of a complex relationship between competition and innovation has sometimes been interpreted as meaning that more lenient standards should be adopted when it comes to innovative industries. The complicated relationship between competition and innovation does call for a more comprehensive assessment of the impact that specific actions have on market participants’ ability to innovate and the incentives they have. However, it does not justify the blanket dismissal of all concerns about anti-competitive behaviour in industries that are deemed to be innovative.

A proper assessment of innovative industries requires well-designed competition laws and competent competition authorities. The enforcement of competition law can play an important role in supporting innovation by allowing actions that promote innovation (such as mergers) and prohibiting actions that hamper it. Recent evidence from OECD countries points in this direction, showing that sound competition policies lead to stronger total factor productivity growth (which may be seen as a proxy for innovation).

Data for the transition region show the positive effect that competition-enhancing policies have on innovation. Chart 3.3.2 shows that there is a positive relationship between the quality of competition-enhancing policies (as measured by the EBRD’s competition indicator, which assesses the quality of competition law, the institutional environment and enforcement activities) and innovation. While the chart does no more than indicate a correlation between the two, this nevertheless points to a link between the quality of competition policy and the strength of innovation.

All in all, while the relationship between competition and innovation is a complex one, well-designed competition policies can help to provide the right business environment, allowing companies to fulfil their competitive potential and having a positive impact on innovation.

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30 See Aghion et al. (2005).
31 See Arrow (1962) for an early discussion of this effect.
33 In addition, if there is market power in upstream sectors and firms in downstream industries have to negotiate the terms and conditions of their contracts with suppliers, some of the rents that are expected downstream as a result of the adoption of state-of-the-art technology will be taken by providers of intermediate inputs. This, in turn, will reduce incentives to improve efficiency and curb productivity in downstream sectors, even if competition in these sectors is strong.
34 See Nicoletti and Scarpetta (2005) and Conway et al. (2006).
35 See Annex 5.1 of this Transition Report for a description of the EBRD’s competition indicator.
BOX 3.4. Consultants as conduits for firm-level innovation

Consultancy firms can play a vital role in facilitating innovation by acting as conduits for external know-how and providing information about customers’ preferences. They can help a firm adapt its organisational structure and management practices to changing industry needs, help it refine its design and packaging in order to appeal more effectively to its target groups, or provide market research underpinning the development of new products that better satisfy customers’ needs. For instance, consultants have helped a Swedish bank to introduce internet banking.

Consultants can also help firms’ managers to analyse the pros and cons of developing new products and processes. They can help a firm adapt its organisational structure and management practices to changing industry needs, help it refine its design and packaging in order to appeal more effectively to its target groups, or provide market research underpinning the development of new products that better satisfy customers’ needs. For instance, consultants have helped a Swedish bank to introduce internet banking.

While the percentage of firms using consultants varies greatly across the countries of the transition region – ranging from just 4 per cent in Azerbaijan to 54 per cent in Ukraine – consultants are more likely to be used by innovative firms in almost all countries (see Chart 3.4.1). Across the region as a whole, 61 per cent of firms that have introduced a new product in the last three years also hired a consultant during that period, compared with 20 per cent of firms that did not innovate. Consultants also assisted 63 per cent of firms that introduced new or improved organisational management practices.

These relationships do not appear to be driven by particular industries or specific types of firm. Even when firm-level characteristics are taken into account, there remains a positive and highly significant correlation between the use of consultants and all types of innovation – product, process, organisational and marketing innovations. This is consistent with evidence that external consultants can help small and medium-sized firms improve their productivity.

Despite these apparent advantages, many firms choose not to use consultants when developing new products or processes. One reason for this is that every consultancy contract involves transaction costs, which may take resources away from the innovation itself. Firms may also be concerned about leaking information regarding new products and processes, particularly in countries where intellectual property rights are poorly enforced.

However, the main reason why firms in the transition region do not hire consultants is that they simply see no need for them. Interestingly, exposure to consultancy services seems to change this belief: once firms have employed consultants once, they typically do so again. Indeed, BEEPS firms that use external consultants have done so an average of four times in the last three years. Moreover, where clients of the EBRD’s Small Business Support team have never worked with a local consultant before, nearly half of these clients then undertake a second consultancy project independently within a year. Since firms that hire consultants also tend to be more innovative, their exposure to external know-how seems to be an important channel in the fulfilment of their innovation potential.

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38 See Back et al. (2014).
39 See Back et al. (2014).
40 See Bruhn et al. (2012) for evidence from Mexico.
42 See Bruhn et al. (2012) for evidence from Mexico.
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