OECD publishing

Please cite this paper as:

Kowalski, P., D. Rabaioli and S. Vallejo (2017-11-20), "International Technology Transfer measures in an interconnected world: Lessons and policy implications", *OECD Trade Policy Papers*, No. 206, OECD Publishing, Paris. http://dx.doi.org/10.1787/ada51ec0-en

OECD Trade Policy Papers No. 206

International Technology Transfer measures in an interconnected world

LESSONS AND POLICY IMPLICATIONS

Przemyslaw Kowalski,

Daniel Rabaioli,

Sebastian Vallejo

OECD

OECD TRADE POLICY PAPERS

This paper is published under the responsibility of the Secretary-General of the OECD. The opinions expressed and the arguments employed herein do not necessarily reflect the official views of OECD countries.

The publication of this document has been authorised by Ken Ash, Director of the Trade and Agriculture Directorate

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

This document has been declassified on the responsibility of the Working Party of the Trade Committee under the OECD reference number TAD/TC/WP(2017)1/FINAL.

Comments on the series are welcome and should be sent to tad.contact@oecd.org.

OECD TRADE POLICY PAPERS

are published on www.oecd.org/trade.

© OECD (2017)

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for commercial use and translation rights should be submitted to *rights@oecd.org*.

INTERNATIONAL TECHNOLOGY TRANSFER MEASURES IN AN INTERCONNECTED WORLD: LESSONS AND POLICY IMPLICATIONS

Przemyslaw Kowalski, Daniel Rabaioli and Sebastian Vallejo, OECD

The aim of this paper is to inform the ongoing debate on the policies being used to encourage international technology transfer (ITT) and, of these, which have the potential to distort trade or investment and which may effectively promote ITT. The paper develops a first-cut approach to cataloguing ITT-related measures across countries. Following the literature, technology transfer-related policies are grouped into six categories: 1) absorptive capacity policies; 2) measures related to intellectual property rights (IPR); 3) FDI promotion measures; 4) FDI restrictions and FDI screening; 5) performance requirements; and 6) investment incentives. A list of regulatory questions about measures in place is devised for the four categories 3 through 6 on which information is currently particularly scarce. Summary results are presented for twenty four developing and developed countries which are important actors in global FDI, technology and product markets. The findings of the literature addressing both the impact of these measures on technology transfer and on market competition are summarised for each of the four policy categories. The paper also explores the extent to which various ITT measures are covered by existing international agreements, with a view to helping inform future approaches. The concluding section elaborates on policy implications.

JEL codes: F1, F13, F15, F23, O3.

Key words: international trade, FDI, international technology transfer, competition, intellectual property, innovation.

Acknowledgements

The authors gratefully acknowledge helpful inputs and comments from Julia Nielson and Ken Ash and statistical assistance by Clarisse Legendre. The paper has benefitted from a literature review of the evidence on advantages and disadvantages of government efforts to promote technology transfer prepared for the purposes of this project by Lise Johnson, Perrine Toledano, Nicolas Maennling, and Brooke Skartvedt Guven of the Columbia Centre for Sustainable Investment, Columbia University. The authors would also like to acknowledge useful comments and suggestions from Koen de Backer, Véronique Bastien, Jane Korinek, Julia Nielson, Fernando Mistura, Piotr Stryszowski, Monika Sztajerowska and Stephen Thomsen. Finally, the authors thank Jacqueline Maher and Libby Bright for preparing this document for publication.

Table of Contents

POLICY MESSAGES 5

INTERNATIONAL TECHNOLOGY TRANSFER MEASURES IN AN INTERCONNECTED WORLD: LESSONS AND POLICY IMPLICATIONS 6

Executive summary 6
Key insights can be summarised as follows: 7
1. Introduction 9
2. Fundamentals of international technology transfer 10
2.1 Defining technology and technology transfer 10
2.2 Economics of international technology transfer 12
3. Policies to encourage international technology transfer in an interconnected world 13
3.1 An initial approach to comparing ITT policies in an international context 14
3.2 Absorptive capacity policies 20
3.3 Measures related to intellectual property rights protection 22
3.4 FDI promotion measures 31
3.5 FDI restrictions and FDI screening 38
3.6 Technology-related performance requirements 48
3.7 Technology-related investment incentives 57
3.8 Incidence of all measures documented according to the proposed methodology 67
4. Conclusions 67

REFERENCES 70

ANNEX 78

Tables

Table 1. Measures to encourage FDI 36
Table 2. FDI restrictions, FDI screening and concessions 44
Table 3. Performance requirements 54
Table 4. Investment incentives 64

Figures

Figure 1. A matrix of technology transfer effectiveness and impact on competition of ITT measures 15
Figure 2. World Bank's Doing Business rankings, 2016 34
Figure 3. WEF Competitiveness index and property rights index, rankings over 140 countries, period 2015-2016 34
Figure 4. Overall index of economic freedom and business and investment component, 2016 35
Figure 5. Summary chart: measures to encourage FDI 37
Figure 6. OECD FDI restrictiveness Index for selected developed and emerging countries 42
Figure 7. Summary chart: FDI restrictions, FDI screening and concessions 45
Figure 8. Summary chart: performance requirements 55
Figure 9. Direct government funding of business R&D and tax incentives for R&D, 2013 63
Figure 10. Summary chart: investment incentives 64
Figure 11. Summary chart: all ITT-related measures 67

Boxes

Box 1. Ensuring competitive conditions in international markets—the concept of "level playing field"17
Box A. Measures to encourage FDI....33
Box B. FDI restrictions and FDI screening....41
Box C. Performance requirements....49
Box 2. Local sourcing and related technology transfer measures in Nigeria....52
Box 3. Selected examples of investment-related fiscal incentives....59
Box D. Investment incentives....60
Box 4. Tax exemptions and deductions for technology transfer in China....62
Annex Box 1. Types of legal contracts for the transfer of technology....78
Annex Box 2. List of anti-competitive practices....79
Annex Box 3. List of prohibited clauses by country....80

POLICY MESSAGES

- **The aim of this paper is to inform the ongoing debate on the policies being used to encourage international technology transfer (ITT)** and, of these, which are potentially less trade or investment distorting and which may effectively promote ITT.

- **All countries studied maintain measures to encourage technology transfer, although these appear to be more frequent in developing countries.** There is considerable heterogeneity in emphasis on the different elements of technology transfer policies across countries and at different levels of development.

- While a broad evolution from ITT-related requirements to facilitating policies can be observed, **certain measures related to inward technology transfer continue to attract the attention** of business and regulators because of their distortionary trade and investment effects, with some stakeholders calling for greater international co-ordination.

- **Effectiveness in terms of technology transfer and distortionary competition effects are two relevant sets of criteria** which are likely to determine the incentives for further international co-ordination regarding ITT measures.

- **IPR protection plays a key role in creating the necessary market conditions for ITT** and is already covered extensively in the WTO TRIPS Agreement, other international agreements dealing with IPR protection, newer preferential trade agreements (PTAs) and some bilateral investment treaties (BITs).

- **Most countries have investment promotion policies which target technology-related investment**, although the evidence is limited regarding their impacts on technology transfer and on international competition. A few studies suggest that such measures can be effective in attracting additional FDI but the potential distortions to competition have not been extensively researched.

- **Policies directly setting limits to FDI are rare** and often determined by other considerations such as antitrust and national security. Overall, joint-venture requirements have proven highly ineffective in many cases in terms of ITT; evidence on competition effects of these measures is also scarce.

- **ITT-related performance requirements (PR) are rare in developed countries, but they are still common in developing countries.** Policy makers appear to have taken into account the deterrent effect PRs can have on FDI inflows, especially in countries where the size of local markets, natural resource endowments or cost advantages are insufficient to compensate for the unattractiveness of these measures.

- **Some PRs have been disciplined by WTO Agreements and a myriad of BITs and PTAs** and the trend appears to be in the direction of expanding the list of prohibited measures. However, inclusion of such disciplines in international agreements remains uneven, particularly as far as agreements involving developing countries are concerned.

- **Policy is increasingly focused on encouraging technology transfer through investment facilitation and incentives for investment in R&D and technology-intensive industries**. These measures face less strict disciplines at the international level and are used more equally across all the studied countries. While in many cases their effectiveness has been limited, in a few cases they may have generated positive effects. These measures may also be highly distortive, given that they offer financial benefits and often target specific firms, sectors or technologies. Overall, empirical evidence in this area is scarce.

- **There is arguably a case for developing additional international rules regarding technology transfer measures**. If there is a widespread interest in doing so, a fundamental challenge highlighted in this paper would need to be overcome: there is at present little empirical research and data to enable development of objective criteria for distinguishing between measures that have pronounced distortionary effects on international competition and those that do not.

INTERNATIONAL TECHNOLOGY TRANSFER MEASURES IN AN INTERCONNECTED WORLD: LESSONS AND POLICY IMPLICATIONS

Executive summary

In a global economy characterised by increasing competition and geographically fragmented and mobile production activities, knowledge and innovation are becoming a key source of sustainable competitive advantage and are a central focus of economic policy. Although much technology is developed, held and managed by private actors, policies can influence firms' choices and thus shape the global distribution of technology-related economic gains. International trade and foreign direct investment (FDI) have always been seen as important channels of international technology transfer (ITT) whereby national economic agents access foreign knowledge and successfully learn and absorb it into their production functions (Maskus, 2004) and various trade and FDI-related measures have long been key elements of national technology and innovation strategies. However, the nature of technology and the economic context have evolved considerably in recent decades and so has the debate about the role of policy in ITT.

Given their potentially distortionary commercial effects, some ITT-related measures are attracting attention and some stakeholders are calling for their greater international co-ordination.[1] Such action, however, appears to be constrained as measures which can have more or less impact on international competition and can at the same time effectively enable technology upgrading have not been clearly identified. Certain trade-related investment measures (TRIMS), subsidies or certain measures related to intellectual property rights (IPR), are already covered by WTO disciplines. Others, such as technology transfer-related performance requirements, have been disciplined in some preferential trade agreements (PTAs) and bilateral investment treaties (BITs). Yet others are not currently covered by international agreements.

The aim of this paper is to inform the ongoing debate on the policies being used to encourage ITT and, of these, which have the potential to distort trade or investment and which may effectively promote ITT. The paper develops a first-cut approach to cataloguing ITT-related measures across countries. Following the literature, technology transfer-related policies are grouped into six categories: 1) absorptive capacity policies; 2) measures related to intellectual property rights (IPR); 3) FDI promotion measures; 4) FDI restrictions and FDI screening; 5) performance requirements; and 6) investment incentives. A list of "yes/no" questions about regulations and measures in place is devised for the four categories 3 through 6 on which information seems currently particularly scarce. Summary results are presented for twenty four developing and developed countries which are important actors in global FDI, technology and product markets.[2] In addition, the findings of the literature addressing both the impact of these measures on technology transfer and on market competition are summarised for each of the four policy categories. The paper also explores the extent to which various ITT measures are covered by existing international

1. See, for example, ITIF (2012). Also, the majority of existing PTAs and BITs do not prohibit technology-related performance requirements but a prohibition has been appearing in a growing number of these agreements for a decade (Nikièma, 2014).

2. These include twelve OECD countries (Australia, Chile, Germany, France, Japan, Korea, Mexico, the Netherlands, Norway, Poland, the United Kingdom and the United States) and twelve developing countries (Brazil, China (People's Republic of), India, Indonesia, Malaysia, Nigeria, Russian Federation, Saudi Arabia, Singapore, Thailand, South Africa and Viet Nam).

agreements, with a view to helping inform future approaches. The concluding section elaborates on policy implications.

Key insights can be summarised as follows:

- All countries studied maintain measures to encourage technology transfer, although these are more frequent in developing countries. There is considerable heterogeneity in emphasis on the different elements of technology transfer policies across countries and across countries at different levels of development.

- Effectiveness in terms of technology transfer and the extent of distortionary competition effects are two relevant sets of criteria which are likely to determine the incentives for further international co-ordination of ITT measures.

Absorptive capacity

- While important for ITT, absorptive capacity policies are usually horizontal domestic policies related to education and workforce training, educational and scientific institutions and their links with business, the business climate and access to finance. They do not usually discriminate between different types of technology or technology holders or economic sectors and are thereby arguably associated with limited distortionary international effects. They are therefore less likely to be co-ordinated in an international context.

IPR

- Particularly for foreign participants, IPR protection, including through relevant provisions on patent and licensing agreements, trade secrets, test data and IPR-related provisions in competition law, plays a significant role in creating the necessary market conditions for technology transfer and for the operations of technology markets. It is thus a prerequisite for ITT.

- IPR are already granted a minimum level of protection under the WTO TRIPS Agreement. Some new generation PTAs contain higher levels of IPR protection, through inclusion of new areas of IPR, implementation of more extensive levels or standards of IPR protection than the minimums required by TRIPS, or removal of some flexibility available under TRIPS.

FDI promotion measures

- Most countries have investment promotion policies which target technology-related investment in specific sectors but few countries have sector or technology-specific administrative simplifications. Sectoral approaches to aftercare services or promotion of business linkages with domestic suppliers are absent in most of the countries under analysis. More than one half of the countries analysed have, however, put in place policies that facilitate investor access to human capital in technology-intensive areas.

- Although the evidence is limited, the few existing studies suggest that targeting investment promotion at technology intensive-sectors can be effective in terms of attracting additional FDI in these sectors. Research and empirical evidence on the potential distortions it might cause are even scarcer.

FDI restrictions and FDI screening

- Policies directly setting limits to FDI are rare and often determined by other considerations such as, for example, those related to antitrust and national security. A small number of countries do,

however, have joint-venture requirements in technology-intensive sectors and these sometimes mandate transfer of technology to local partners.

- The literature suggests that joint-venture requirements are often highly ineffective, because of reluctance to transfer the latest technology, a high risk of failure of such ventures, and possibility of exits. There are some case studies that find positive technology transfer effects but these do not address associated economy-wide or international competition impacts.

Performance Requirements

- Technology transfer-related performance requirements are not pervasive in developed countries, although they still seem rather common in developing countries, especially regarding sectoral local content requirements in government procurement, local employee quotas, and provisions setting training requirements and requiring substitution of foreign with national employees.

- The literature on impact of performance requirements is mixed, and sectoral specificities arise (notably in the natural resource sectors). Some measures such as local employment quotas, for example, may be ineffective unless accompanied by efforts to build skills and absorptive capacity of the local workforce. Likewise, mandatory R&D requirements may have a limited positive impact in the absence of local expertise to absorb and develop the available know-how. There is considerable evidence that such requirements may have significant competition impacts because they affect conditions under which firms from different sectors, or equipped with different technologies, compete in markets. These measures may be particularly detrimental to effective participation in GVCs.

- The less frequent use of performance requirements in developed countries suggests that policy makers have largely taken into account the deterrent effect restrictions and performance requirements can have on FDI inflows and ITT. Such instruments are, however, still being used in selected developing countries where the prevailing view seems to be that the size of local markets or natural resource endowments are sufficient to compensate for the deterrent effect these measures can have on investment and on trade.

- Some performance requirements have been disciplined in some international agreements such as the WTO TRIMS and a myriad of related provisions in BITs and PTAs. The trend appears to be in the direction of expanding the list of prohibited measures. However, inclusion of such disciplines across existing BITs and PTAs remains uneven, particularly as far as agreements involving developing countries are concerned. Future agreements might therefore attempt to set additional limits to the misuses of such measures. There is, however, also room for further international cooperation at the multilateral level in order to establish more widely-accepted standards regarding ITT-related performance requirements.

Investment incentives

- The FDI-deterring effect of performance requirements and restrictive regulation explain also the relative popularity of investment incentives which face even less strict disciplines at the international level and are used more equally across the studied developing and developed countries. For example, the majority of the countries have investment incentives which depend on R&D spending or technological characteristics of investments.

- While the actual impact of these incentives depends on the context and the literature shows that in many cases their effectiveness is limited, in a few cases they may generate positive externalities and thus support ITT. However, providing selective investment incentives to

industries or firms with certain technological characteristics may distort resource allocation, favour uneven development of some industries at the expense of others, and create unfair competitive advantages over non-subsidised companies. Such incentives also require leveraging public resources and their use by some governments may incite similar or more generous measures by others.

- Developing effective disciplines in future international agreements, assuming there is interest in doing so, would require identifying measures that encourage FDI and ITT but do not (or only 'minimally') create distortions or undermine international competition. Some inspiration in this respect can perhaps be drawn from existing approaches such as the WTO ASCM and the EU rules on state aid.

1. Introduction

Technology and innovation are some of the key determinants of long-term per capita productivity and income growth. In a global economy characterised by increasing competition and geographically fragmented and mobile production activities, knowledge and innovation are also becoming an even more important source of sustainable competitive advantage (Nolan and Pilat, 2016). Technology and innovation policies are thus a central focus of economic policy.

International technology transfer (ITT) whereby a party from one country gains access to a foreign party's information and successfully learns and absorbs it into her or his production function (Maskus, 2004) is an important element of technological upgrading and diffusion. The traditional view of ITT is based on the observed technological divide between developed country firms who are owners of the most advanced technologies and developing country actors seeking access to those technologies (e.g. WTO, 2002; Fu and Zhang, 2011). This thus sees ITT as one of the key ways of increasing productivity and as an important complement to domestic sources of productivity growth in the developing world (Grossman and Helpman 1994; Romer 1994; Eaton and Kortum 1995; Maskus, 2004). That said, diffusion and absorption of efficient technologies, which ITT can facilitate, is an important policy goal for countries at all levels of development.

International trade and foreign direct investment (FDI) are two important channels of ITT and trade and FDI-related policies have long been key elements of national technology and innovation strategies. However, the nature of technology, the means of its storage and transfer, as well as the economic context and policies that shape the incentives and conditions of its application in foreign markets, have evolved considerably in recent decades. The unbundling of tasks and business functions in global value chains (GVCs), in particular, has created new opportunities for the application and transfer of technology, particularly in developing countries. GVCs have also sharpened the interdependencies between trade, FDI and technology, and influenced the debate about the role of openness in technology and innovation strategies.

Prior to the emergence of GVCs, when production of advanced products tended to be geographically concentrated, countries aiming to maximise technology transfer tended to rely on specifying conditions on FDI under which this could occur (e.g. requirement for FDI registration, documentation or approval; regulation of licenses and technology contracts) or restricting foreign equity participation in order to encourage transfer of technology to domestic firms through licensing of technology to local producers instead. This gradually shifted to an emphasis on accessing technology through increasing inward FDI, with countries developing strategies to attract investment, removing FDI restrictions, improving the business climate, enhancing protection of intellectual property rights (IPR) and policies aimed at ensuring effective absorption of technology in the domestic economy. Nevertheless, some countries still maintain various technology-related performance requirements. More recently, and concurring with proliferation of GVCs, ITT policies have been turning increasingly towards investment facilitation and investment

incentives, combined with innovation, training and other performance requirements in order to maximise FDI spillovers to the local economy.

While a broad evolution from restricting to facilitating policies for ITT can be observed, some measures related to technology transfer are seen as having distortionary competition effects and have attracted criticism in international contexts. Concerns about such measures, which have been referred to in the literature as "mandatory technology transfer measures" (MTTMs thereafter; ITIF, 2012; Hufbauer et al., 2013; OECD, 2015b), refer to measures that can be broadly categorised as: certain *measures related to IPR*; *FDI* and *technology licensing* regulations; various *trade-related investment measures* (TRIMs) such as, for example, *local content requirements* (LCRs); technology, research and development (R&D) and training-related *performance requirements*; and technology transfer-related *subsidies and investment incentives*.

Given their potential distortionary commercial effects, the question has arisen whether there is a need for greater international co-ordination on these measures. However, these measures have national technology upgrading as their main policy objective and those measures which can have a more significant impact on international competition have not been clearly identified. Certain trade-related investment measures (TRIMS), subsidies or certain measures related to intellectual property rights (IPR), are already covered by WTO disciplines. Others, such as technology transfer-related performance requirements, have been disciplined in some preferential trade agreements (PTAs) and bilateral investment treaties (BITs). Yet others are not currently covered by international agreements.

The aim of this paper is to inform the ongoing debate on the policies being used to encourage ITT and, of these, which have the greatest potential to distort trade or investment and which may promote ITT in a more effective manner. First, definitions and economic mechanisms that underlie ITT and the rationale for policy intervention are discussed. Next, a first-cut approach to cataloguing ITT-related measures is presented. Following the literature, technology transfer-related policies are grouped into six categories: 1) absorptive capacity policies; 2) measures related to intellectual property rights (IPR); 3) FDI promotion measures; 4) FDI restrictions and FDI screening; 5) performance requirements; and 6) investment incentives. To provide some information on the prevalence of measures, a list of "yes/no" questions about measures in place is devised for categories 3 through 6 and results are presented for twenty-four developing and developed countries which are important actors in world FDI, technology and product markets.[3] The findings from the literature addressing both the impact of these measures on technology transfer and on market competition are summarised for each of these four policy categories. The paper also explores the extent to which these measures are covered by existing international agreements—including, for example, in PTAs and BITs, mega regional and multilateral agreements—with a view to helping inform future approaches. The concluding section elaborates on policy implications.

2. Fundamentals of international technology transfer

2.1 Defining technology and technology transfer

Technology can be defined as "the information necessary to achieve a certain production outcome from a particular means of combining or processing selected inputs" (Maskus, 2004). Different technologies may clearly generate different outcomes in terms of quality of products, although they may

3. These are twelve OECD countries (Australia, Chile, Germany, France, Japan, Korea, Mexico, the Netherlands, Norway, Poland, the United Kingdom and the United States) and twelve developing economies (Brazil, China (People's Republic of), India, Indonesia, Malaysia, Nigeria, Russian Federation, Saudi Arabia, Singapore, Thailand, South Africa and Viet Nam). The choice of countries has been made so as to cover important actors in world FDI, technology and product markets, as well as a diverse sample of technology exporters and importers in all major regions.

also generate the same outcomes at different costs. Innovation in this context can be defined as development of new technologies that can create additional economic value. Productivity, technology and innovation are thus closely related.

Technology can be categorised along several dimensions. Some types of technology, for example, can be translated into formulas, blueprints, patents or software (codified technology), while others are uncodified and entail implicit know-how of production and managerial techniques (non-codified technology) (Maskus, 2004). Additionally, some technologies – such as those related for example to chemical formulas or simpler machinery – may be classified as "embodied" in particular products and therefore possible to reverse-engineer. Other technologies, such as those used to produce complex machinery or deliver business services, are "disembodied" and less easy to copy or reverse-engineer (Maskus, 2004).

Technology transfer can in turn be broadly defined as "any process by which one party gains access to a second party's information and successfully learns and absorbs it into his [sic] production function" (Maskus, 2004). WIPO (2010) provides a fuller definition as a series of processes for sharing ideas, knowledge, technology and skills with another individual or institution leading to the acquisition by the other of such ideas, knowledge, technologies and skills. That said, for the purposes of considering policy measures aimed at influencing ITT, it might be more helpful to think of technology transfer in terms of the actions technology holders themselves consciously take to share or apply their technology for some kind of compensation in a new context or environment.[4]

When interpreted narrowly, this last definition of technology transfer could be read to exclude an application of technology in a foreign country when the technology remains within the boundaries of the foreign firm (e.g. application of technology in a new location through a foreign subsidiary). Nevertheless, this form of technology application can under certain circumstances result in similar productivity gains and spillovers in the host economy and is in fact often included among the objectives of policies targeting international technology transfer (e.g. investment incentives targeting technologically-intensive FDI).[5] For this reason, the analytical approach of this paper is to consider the broader definition of technology transfer which includes its application in the territory of another country through local presence of a foreign company as well as transfer of technology to local firms. For both these cases, it also includes the potentially resulting spillovers and innovation effects.

ITT can occur through various channels: trade in products; international movement of people; FDI; trade in technology markets (e.g. through licensing) (Hoekman et al., 2005). Many of the underlying modes of technology transfer can be influenced by the holders and take the form of market transactions: for example, trade in goods and services, FDI, technology licensing, joint ventures, and planned assignment of personnel. Other mechanisms, such as reverse engineering, research based on freely available or paid information (e.g. published patent applications, published research, conferences) or personal movement of key individuals may, however, be beyond the control of technology holders and not subject to market transactions (Maskus, 2004). Finally, informal technology transfer channels include hiring of new university graduates, exchanges of staff, joint research projects or specific projects related to FDI. In the case of the latter, technology transfer is often only one component of a larger project, rather than a stand-alone objective.

4. In this context, is important to distinguish technology transfer from spillovers – the difference being that the latter are information learned and absorbed by others (including competitors) in such a way that the benefits do not fully, or at all, accrue to the technology owner. Technology spillovers are a source of market externalities whereby the value of technology to technology developers can be much lower than to a society (Maskus, 2004).

5. Indeed, schematically, licensing a patent or know-how for a royalty payment could be seen as an alternative to technology application through FDI where the equivalent of the royalty payment are expected returns.

Technology development is a costly investment but its ownership can generate benefits (and hence brings an incentive to innovate). To maximise these benefits, technology holders assess the interest and scope for application of their technology in new contexts, including abroad, and weigh the pros and cons of different channels of, and partners for, technology transfer (Maskus, 2013). The mode of transfer depends on whether the technology is proprietary (under patent or trade secret protection) or non-proprietary (e.g. public or off-patented); the stage in a life cycle of technology (e.g. frontier technology, more mature standard technology or a not yet fully developed technology requiring additional R&D investments); as well as available alternatives (other available technologies and their costs). Additionally, the transfer mechanism may depend on the type of actors involved (e.g. between private parties or between private and public parties, WIPO, 2010).

The analysis in this paper focuses on FDI and technology licensing, as, broadly speaking, the two major options for technology holders to apply technology in foreign countries. To simplify, a technology holder can choose between licensing its technology to a foreign entity at arm's-length or it can acquire an equity stake in a foreign entity or establish itself abroad to control technology transfer more directly. An advantage of licensing is minimisation of the risks and costs associated with foreign establishment, production and marketing. However, it gives rise to other risks related to more limited control of the technology, including the possibility of illegal or inadequate use of the technology, or inadequate protection from unauthorised leakage. Equity-based transfers may allow for better control and supervision, especially in cases of transfers of complex technology which require multiple interactions. Equity control can also help minimise the risk of leakages of know-how and trade secrets. In practice, however, there are many different types of technology licenses (see Annex Box 1) and foreign ownership, and they can be combined in multiple ways.

2.2 Economics of international technology transfer

At the firm level, the creation or absorption of new technology is a *sine qua non* of remaining competitive.[6] At the economy level, technology and innovation are some of the key determinants of long-term per capita productivity and income growth.[7]

The technological divide between developed countries, which own most of the advanced technology (e.g. WTO, 2002; Fu and Zhang, 2011) and developing countries suggests that acquisition and diffusion of advanced foreign technologies can allow the latter to catch up rapidly (Grossman and Helpman, 1994; Romer, 1994; Eaton and Kortum, 1995; Maskus, 2004). Foreign technology adoption can also play a pivotal role in shifting resources from less to more productive uses, and facilitating the structural or economic transformation identified as an important contributor to economic growth in developing countries (McMillan et al., 2013). The question is then how such transfers occur and the role of governments in influencing them.

6. Firms operating in markets characterised by price competition alone (e.g. in raw materials or more traditional segments of manufacturing) rely on new technologies to improve efficiency of their operations and they may be able to rely more on adopted or imported technology. Competition in markets characterised by constant evolution of functions and designs of products may have to rely more on own innovation.

7. For example, in the standard Solow model of economic growth (Solow, 1957), the only sustainable source of long-term income growth is growth in productivity or the ability to combine the different production factors in the productive process so as to achieve more with given resources (i.e. total or multi-factor productivity). This model posits that accumulation of factors of production such as physical capital or labour can in the long term only lead to changes in income levels but not growth rates. Recent evidence shows that in some developing regions, heavy investment in production factors has not led to commensurate increases in per capita incomes, in contrast to productivity developments (Izquiredo et al., 2016). Technology, productivity and per capita income are thus closely related.

In market economies, much technology is developed, held and managed by private actors. Technology is often traded in markets with a view to making a profit – although this can be a costly process. These costs are central to how – and between which partners – information and technology is traded (Maskus, 2013). Some of the costs relate to the actual ability to transfer certain kinds of knowledge (e.g. tacit knowledge and intangible assets) and some relate to the market failures to which information and technology are seen as particularly prone (Maskus, 2004).

Market imperfections related to technology transfer and the need to support technology diffusion, in particular to the poorest countries, are argued to be important enough to constitute a justification for public intervention.[8] However, the interests in shaping such intervention differ between the developers and importers of technology (Maskus, 2004). Developers are typically interested in reducing the costs of uncertainty around technology transfers and in protecting their rights to profit from such transfers, while technology acquirers are interested in minimising the cost and maximising spillovers to the local economy, including beyond those which would occur automatically. This can mean: for holders, securing exclusive rights to exploit technology (Maskus, 2004) and, for the acquirers, encouraging or "mandating" transfer of technology at prices lower, or quantities higher, than those that would be set by markets, or through specifying requirements such as mandatory investment in R&D or training of workers or local firms in exchange for FDI market access or various types of incentives.

3. Policies to encourage international technology transfer in an interconnected world

There are thus both convincing economic arguments for policy intervention in the area of ITT as well as potential pitfalls related to the possibility of distorting—or even blocking—processes which might be better left to markets. In addition, different ITT measures can have both different benefits as well as costs in terms of technology transfer and competition impacts, with implications for their applicability in different contexts. In general terms, the key factors that matter for technology transfer and diffusion comprise: access to the real know how from source companies (e.g. through inward FDI); availability of suitably skilled staff; sufficiently developed scientific infrastructure as well as favourable market conditions. It is in this context that many countries have adopted a range of technology transfer policies and innovation strategies with the objective of enhancing the development benefits of entry of foreign firms or technology licensing. There is considerable heterogeneity in emphasis on the different elements of technology transfer policies across countries, although certain tendencies reflecting evolving views on ITT and appropriate policy responses can be observed. Traditionally, technologically-advanced developed countries, which were also net foreign direct investors, tended to focus on trade and investment openness and protection of IPR as key elements for the protection of existing intellectual property and investments in research and development, and as contributing to orderly diffusion and transfer of technology. Less technologically advanced developing countries have tended to lean towards policies focusing more specifically on inducing technology transfer and diffusion (Gehl, Sampath and Roffe, 2012).

The policy landscape has evolved considerably in recent decades. Among other factors, this is due to strong economic growth and capital and knowledge accumulation in many developing countries; changing national and international institutional and regulatory contexts; changing nature of technology; and implications of evolving models of international competition and production, most notably the increasing role of knowledge-based capital and the internationalisation of production in GVCs. Many emerging and developing economies have improved their IPR protection systems either in the context of implementation

8. Literature on ITT is filled with examples of market failure (see, for example, Maskus, 2004 or Hoekman et al., 2005). The particular situation of the poorest countries was recognised by negotiators at the WTO, resulting in the TRIPS article 66.2 stating that "developed country members [of the WTO] shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least developed country members in order to enable them to create a sound and viable technological base".

of TRIPS, agreeing to additional IPR-related provisions in their PTAs and BITs or unilateral reforms of IPR systems. As a result, a global convergence towards higher IPR protection has been observed (Maskus, 2015). Increased emphasis on IPR protection has been accompanied by more open perspectives on trade and FDI (Sauvant and Hamdani, 2015), less emphasis on interventionist approaches to ITT such as licensing and technology transfer requirements (Lippoldt and Schultz, 2015), or local content and performance-requirements, and more attention to technology-focused investment facilitation, promotion and incentives as well as technology absorption policies.

3.1 An initial approach to comparing ITT policies in an international context

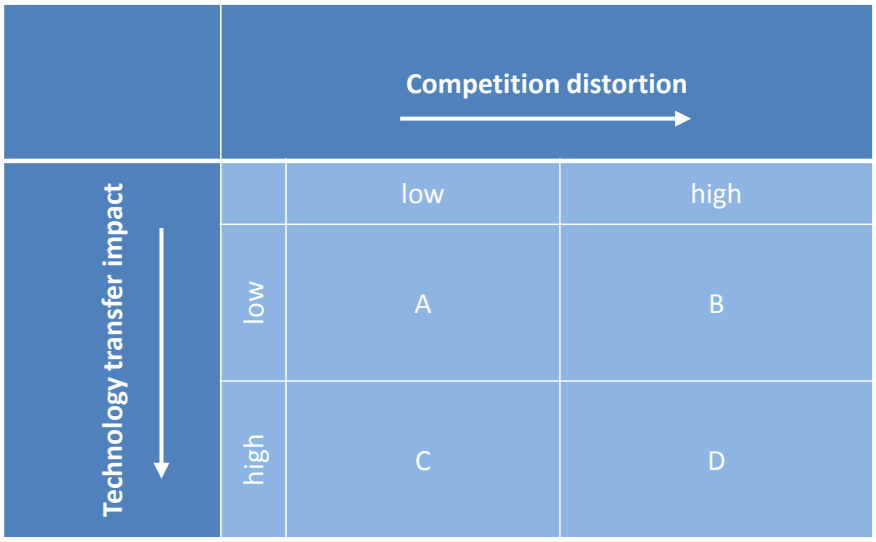
Setting the stage: effectiveness in terms of technology transfer and distortionary competition effects

While a broad evolution from restricting to facilitating policies for ITT can be observed in the last decades, some measures related to technology transfer continue to be seen as counterproductive and as having significant distortionary effects on international competition (e.g. Nikièma, 2014). ITT measures have national technology upgrading as their main policy objective and these kinds of objectives are not normally the subject of international agreements unless they have significant international spillovers. Certain trade-related investment measures (TRIMS), subsidies or certain measures related to intellectual property rights (IPR), are already regulated by WTO disciplines. Others, such as technology transfer-related performance requirements, have been disciplined in some preferential trade agreements (PTAs) and bilateral investment treaties (BITs). Yet others are not currently covered by international agreements.

Effectiveness in terms of technology transfer and distortionary competition effects are two relevant sets of criteria which will determine the incentives for further international co-ordination. Namely, of the wide spectrum of policy measures which can be used to promote ITT, some will arguably be more effective in terms of achieving technology transfer and absorption, and some will also have less distortionary impacts on market competition (Figure 1). For example, policies which improve absorptive capacity in economies hosting FDI which are covered in Section 3.2 below might be relatively effective in terms of ITT and, due to their horizontal nature, they may also have negligible impact on competition (quadrant C in Figure 1). Likewise, certain policies which are correcting market failures, such as those that curb anti-competitive practices in technology transfer agreements (covered in Section 3.3), may facilitate both competition and technology transfer. In other instances, policies may be less effective in terms of ITT but have considerable negative impacts on competition, making a stronger case for their co-ordinated elimination (quadrant B in Figure 1). But in some cases technology transfer policies may mean deliberately providing regulatory or financial incentives to a select group of economic actors, for example foreign investors transferring attractive technologies. While the actual impact of these incentives depends on the context and the literature shows that in many cases their effectiveness is limited (See Section 3.7), in a few cases this may still generate positive externalities[9] and thus support ITT policy objectives—but at the price of significantly undermining competition (quadrant D in Figure 1).

9. A classical argument for governments intervention in the case of positive externalities is that government's valuation of returns from investments in some technologies may be higher from valuations by private investors themselves because the latter may not take into account the positive spillovers of these investments to the rest of the economy.

Figure 1. A matrix of technology transfer effectiveness and impact on competition of ITT measures



Source: Own elaboration.

This potential tension between technology and competition objectives of policy takes on a particular importance in an international context. In a domestic context, objectives of technology policy, types of instruments and impacts on competition and the associated trade-offs can be in principle considered by the public and the government as part of national policy making processes within national governance institutions.[10] In an international context, different countries can have diverging views on the rationale for technology policy intervention and on the associated impacts in terms of competition. Some countries may also deliberately use ITT policies to pursue strategic economic and political objectives to the detriment of their foreign competitors. However, at the international level there can also be more incentives to co-ordinate; impacts on competition, for example, may be more pronounced as compared to the domestic context in so far as beggar thy neighbour policies of one country may lead to retaliation by others. Countries may then decide to co-ordinate such ITT policies either in softer ways through development of guidelines or through binding international accords. Incentives to co-ordinate ITT policies in the international context will in principle be highest when the competition distortions are high and when policies have limited impact on ITT (quadrant B in Figure 1). At the same time, even though calls may be strong for action on measures in quadrant D, the willingness for countries to engage in co-ordination may be more challenging when impact on technology transfer is high.

A further complicating factor is that neither the "effectiveness" nor "distortionary effects" of ITT measures are necessarily clear issues. For example, a measure may grant investment incentives in order to catalyse FDI (that can in turn result in technology transfer and knowledge spillovers). Even if it could be shown that the incentive did in fact influence investment decisions, it might not necessarily be clear whether that increased FDI actually resulted in technology transfer, or whether the benefits derived by the spillovers justified the costs spent on the incentives. Similarly, a measure requiring joint ventures or local content may result in transfers of technology, but the technology transferred could be old and outdated (see Sections 3.5 and 3.6 below), again raising the question of whether the policy achieved its desired objective. In any case, the counterfactual–what ITT may have taken place in the absence of the incentive–can be hard to establish.

10. That said, there are also strong arguments for greater transparency about these measures at the domestic level.

Similarly, "distortionary effects" are not easy to define and measure. One example could be a definition that includes all those cases when the measure caused an outcome that otherwise would not have occurred. But this is inherent to any incentive, or arguably any policy: they are by definition designed to influence outcomes. A more practical definition could aim at capturing "inequality of opportunities" in terms of how policies are designed and implemented. The latter concept is related closely to the notion of a level playing field which is often used to describe a market in which all participants compete under the same conditions from regulatory and fiscal points of view. A distortion in this context could arise if certain specific firms or types of firms (or other economic actors) receive advantages or face disadvantages depending on their attributes (e.g. sector of operation, technology they invest in, behaviour or ownership), i.e. when there is no level playing field. Note, however, the term "level playing field" has not been precisely defined and it can mean different things in different contexts (see Box 1). In particular, in the context of ITT the definition of distortions or "unlevel playing field" would also be relevant to the question of effectiveness, in that it could refer to transfers of technology that would target certain activities and would not have happened but for the market intervention.

Definition of those distortions of most concern can nevertheless also be guided by existing approaches used in national and international contexts to detect anti-competitive practices of firms and governments. A number of concepts developed at the WTO seem a particularly relevant starting point. The WTO Agreement on Trade-Related Investment Measures (TRIMS) for example, defines TRIMS as investment measures which can restrict or distort trade of goods and gives further precisions of what is meant by such distortions (see Section 3.6). Likewise, prohibited subsidies, defined in the WTO Agreement on Subsidies and Countervailing Measures (ASCM), are those subsidies contingent on export performance or use of domestic over imported goods. In addition, actionable subsidies are those other subsidies that are specific to an enterprise or industry or a geographical region and can be demonstrated to have negative impact on domestic industry, interests or benefits of another Member State (see Section 3.7).

Box 1. Ensuring competitive conditions in international markets—the concept of "level playing field"

Even though "level playing field" is a term that is often mentioned in international contexts in reports, policy statements and international agreements, it has not been precisely defined and it can mean different things in different contexts. It can be broadly characterised as an expression for a market or industry in which participants compete under the same conditions from regulatory and fiscal points of view.[11]

For example, the term has been used recently in the context of competition between state and private enterprises (e.g. OECD, 2014b), and with regard to competitive conditions in international aviation (Tretheway and Andriuliatis, 2015), or in export credit markets. Most recently, the G7 Leaders communique from the 2017 Taormina summit stated: "We push for the removal of all trade-distorting practices – including dumping, discriminatory non-tariff barriers, forced technology transfers, subsidies and other support by governments and related institutions that distort markets – so as to foster a truly level playing field" (G7, 2017).

While difficult to precisely define, the concept of a level playing field is crucial for economic performance. Although there are many legitimate economic and non-economic reasons which may justify tilting competitive conditions towards certain economic actors (e.g. policies undertaken with a view to correcting of market failures through provision of "due" advantages), there is an interest in minimising the "undue" advantages granted to economic actors so that goods and services can be produced by those who can do produce them most efficiently, not those that receive the greatest advantage.

What is "due" and what is "undue"—and thus what is and what is not an issue for a level playing field—is not straightforward and is often context-specific. Tretheway and Andriuliatis (2015), for example, argue that "outside the classroom construct of *perfect competition* it is an anomaly to find a perfectly level playing field." They argue that economic efficiency is a relevant yardstick, implying that market power or monopoly rents (which are inconsistent with economic efficiency) are a legitimate concern for regulatory authorities, while resource rents or rents that accrue to a firm due to the nature of the assets held should not be a concern because they do not distort behaviour of the firm (in the latter case, the firm does not have the ability to satisfy the entire market and does not set the price). These authors see innovation rents as benign because, even though such rents do lead a firm to reduce output below, and raise prices above, the optimal situation, this is the price we pay to achieve innovation.

These complications apply to both domestic and international contexts but for the purposes of this paper, the focus is on the international context. For example, according to the theory of comparative advantage, trade and investment allow countries to boost productivity and expand consumption through a better allocation of productive resources across the economy. A key implication is, however, that for gains from trade to materialise, policies must not play too large a role in subsidising or otherwise influencing a trade pattern that contradicts comparative advantage (e.g. OECD 2011). When the international playing field is not level, the benefits from more open policies related to international trade and investment may be undermined. That said, identification of "due" and "undue" advantages may be challenging in an international context.

Overall, it can be argued that future deliberations on international co-ordination of ITT policies will have to consider effects on ITT and international competition across different measures and in different specific contexts. Ideally, these considerations will be underpinned by clearer definitions of effectiveness and distortions and more rigorous empirical assessments of their effects. For this to be possible, data on ITT policies is needed. The following subsection discusses a first-past methodological approach to collect such data across a number of broad ITT policy categories for which comparative information is currently unavailable.

Comparing ITT-related policies across countries

Following the literature on ITT, the remainder of this section groups technology transfer-related policies into six categories: 1) absorptive capacity policies; 2) measures related to intellectual property rights (IPR); 3) FDI promotion measures; 4) FDI restrictions and FDI screening; 5) performance requirements; and 6) investment incentives.

11. See, for example, Financial Times Lexicon: http://lexicon.ft.com/Term?term=level-playing-field

Categories 1 (absorptive capacity policies) and 2 (measures related to IPR) are discussed in general terms without elaborating on specific practices in our sample of countries. While important for wider technology absorption, including in the context of ITT, absorptive capacity policies are usually horizontal domestic policies which do not explicitly discriminate between different types of technology or technology holders, or do so only to a small degree. They are thus arguably associated with limited distortionary international effects and are therefore less likely to be co-ordinated in an international context. Measures related to IPR, on the other hand, are already covered extensively in the WTO TRIPS Agreement. The IPR section thus provides a general discussion of implications of TRIPS without assessing countries' compliance with their TRIPS obligations or documenting measures that go beyond TRIPS obligations.

For the remaining categories (categories 3 through 6: FDI promotion measures; FDI restrictions and FDI screening; performance requirements; and investment incentives) existing sources of comparative regulatory data are drawn upon to identify the prevalence of measures and in areas where there is less readily-available, codified information, or available information is insufficiently detailed, regulatory questions which can be used to collect data on additional measures are proposed. Answers to these questions have been researched and documented by the authors. The new data collected in this way draws on publicly-available information, mostly laws and regulations, policy papers and web pages of national authorities responsible for setting and implementing the different policies.[12]

The information collected reflects therefore regulations or official policies in place rather than the extent of their implementation or enforcement. This distinction is important because in some policy areas enforcement may matter as much as, or more than, laws. For example, a number of recent OECD Market Openness Reviews suggested that while in terms of legal standards, regimes with respect to IPR may be similar to those considered to be best practice, enforcement of these standards determines the actual conditions for doing business (e.g. OECD, 2015d). Similar arguments can be put forward in the case of FDI restrictions, performance requirements and investment incentives. Ideally, the objective would be to develop a quantitative index and measure the degree of enforcement or implementation.[13] However, collection of data which would enable this more advanced assessment goes beyond the resources that can be devoted to the current exercise. It should also be noted that, for similar reasons, the exercise focuses largely on policies in place at the central or federal level of government.[14]

The regulatory information consists of "yes" and "no" answers to specific regulatory questions, which are formulated so that the "yes" responses denote a country's attempt at encouraging ITT. Thus, in principle, a higher number of "yes" responses for a country would indicate that it has more regulations or policies aiming at encouraging ITT. However, as discussed above and in the remainder of this paper, policies that can be used to influence ITT differ along several dimensions and can be interpreted in a variety of ways. For example, while the approach aims to capture the most competition-distorting measures through a focus on those measures which are technology, sector or product specific (i.e. the measures target sectors with specific technology characteristics or specific technologies) in some cases information collected encompasses broad or sector or technology-neutral measures (e.g. inclusion of technology-related provisions in a country's trade and investment agreements). Some of these measures take the form of restrictions or requirements, while others are facilitating measures or financial incentives. Therefore, they can have different impacts in terms of both technology transfer and international competition.

12. The OECD Services Trade Restrictiveness Index, which identifies measures restricting trade in the services sectors, has also been used to access information on, for example, FDI screening, joint venture obligations, performance requirements and nationality requirements for enterprise directors.

13. This is for example the case for the Ginarte-Park index of patent protection (Ginarte and Park, 1997; Park and Wagh, 2002; Park, 2008) and the Lippoldt-Schultz index of trade secret protection (Lippoldt and Schulz, 2014).

14. Single project incentives can also be a feature of the ITT landscape but for similar reasons are also not captured here.

The aim of this initial methodology is therefore neither to rigorously compare the relative importance of the different elements of ITT policy nor to draw conclusions about which measures are more effective in encouraging technology transfer or which are potentially more distortive in terms of competition. The intention is rather to present an initial approach that consistently maps the policies being used in different countries with a view to providing an empirical foundation for discussion of their effects as well as for more advanced empirical work by researchers in this area in the future.

To inform an initial assessment of these measures, each section addressing policy categories 3 through to 6 ends with a short summary of key findings from the relevant economic literature on their technology transfer effectiveness as well as their competition-distorting effects.

These summaries and observations are far from being conclusive and some important caveats should be noted. These reviews take a broad view of effectiveness, looking simply at whether the relevant measures have been argued in the literature to be capable of influencing transfer of technology to consumers, employers, suppliers, or others. They do not focus on whether the costs of the measure outweighed their benefits in terms of technology transfer (such literature is very limited); nor whether the technologies transferred were optimal, modern, or the same technologies that would have been used absent the transfer requirement.[15]

Similarly, to identify potential distortions of competition that may occur through incentives and mandates, this paper follows the broad concepts of equality of opportunity and a level playing field (see Box 1) and focuses on examining whether, and to what extent, measures are specific – applying to particular firms or industries – and impose a cost on or provide a benefit to the firm or industry that is targeted. This paper does not take a definitive position on whether or not the distortions are good policy to address any potential market failures or to achieve other purposes; doing so is highly issue- and context-specific, involves complex and sometimes competing values, and assessment is thus beyond the scope of this paper. Sector- or technology-specific performance requirements are seen as having the potential of having similar effects in terms of competition to sector- or technology-specific investment incentives. This is because even though the former are implicitly conditional on access to a given market and the latter provide a financial incentive, they can, as argued above, have similar effect on conditions under which firms from different sectors, or equipped with different technologies, compete in markets.

In its design, the proposed taxonomy also does not differentiate between the measures that are applied to all investors and those applied only to foreign investors. Many international trade and investment regimes already include the principle of non-discrimination[16] and examining these differences is beyond the scope of this exercise.

15. It should also be kept in mind that while a particular policy may not be effective in spurring technology transfer from FDI, it may have other effects sought by policy makers or other stakeholders, such as increasing local employment (e.g., in the case of local content requirements).

16. For example, the TRIMS Agreement provides that no contracting party shall apply any trade-related investment measure inconsistent with the national treatment obligation and the prohibition of quantitative restrictions in the case of trade in goods. PTAs with investment chapters and BITs, include a non-discrimination obligation between foreign and national investors. After a foreign investor has established in the territory of the host country, the latter has the obligation to accord to investors of another Party, treatment no less favourable than that it accords, in like circumstances, to its own investors with respect to the establishment, acquisition, expansion, management, conduct, operation, and sale or other disposition of its investment. The national treatment obligation covers not only de jure treatment, that is, treatment of foreign investors provided for in national laws and regulations, but also de facto treatment, as where a measure in fact works against national treatment. In services, WTO Members may maintain restrictions on national treatment, provided these are scheduled under the relevant GATS commitments.

Finally, each of the policy sections also explores the extent to which the identified ITT measures are covered by existing international agreements, with a view to helping inform future international regulatory approaches.

3.2 Absorptive capacity policies

Absorptive capacity can be defined as availability of human capital and presence of technological capability and other factors, such as access to finance and infrastructure, which helps assimilate and replicate knowledge gained from external sources (e.g. Cohen and Levinthal, 1990; Criscuolo and Narula, 2002). Absorptive capacity is key for diffusion of any knowledge, originating domestically or abroad, and thus for determining how technology can contribute to economic transformation and "catching-up" of a country. It can also influence technology holders' incentives to promote transfer and diffusion of knowledge.[17] Policies aimed at improving absorptive capacity can help to remove some of the key bottlenecks to technology transfer, particularly in developing and least developed countries (LDCs). They are thus briefly discussed below.

Aimed at increasing the ability to absorb, internalise and utilise new knowledge, absorptive capacity policies encompass a wide range of measures addressing workforce, organisational and adjustment deficiencies. Increasing the pool of trained workforce able to understand and assimilate technology, improving the quality of higher educational institutions and scientific infrastructure as well as of networks between these educational and research institutions and enterprises, and better access to finance and efficient institutions, can all have significant impact on technology absorption.

Early studies show that in order to be able to assimilate new knowledge, firms need prior related knowledge i.e. the initial development of related knowledge and capacities. A survey of FDI and growth in developing countries revealed, for example, that the larger the technological gap between the host and the home country of FDI, the smaller is the impact of FDI on economic growth (De Mello, 1997). Kokko et al. (1996) found that in the presence of a very high technology gap, recipient Uruguayan firms did not enjoy positive spillovers in terms of productivity. Technological capability has also been found to be a determinant of whether or not firms benefit from horizontal spillovers in a study of horizontal spillovers from FDI by UK firms (Girma and Gorg, 2007).

A related crucial element is own R&D, which enhances firms' ability to assimilate and exploit external knowledge (Cohen and Levinthal, 1990). The importance of R&D in facilitating technology transfer from multinationals to SMEs has been highlighted for example by Kinoshita (2000) who found positive evidence in the Czech Republic. Similarly, Jefferson and Jinchang (2005) found that investment in R&D facilitated technology transfer in a panel of Chinese firms in the manufacturing sector. Interestingly, Kneller (2005) found that the effect of R&D on absorption capacity is weaker for big OECD economies, most probably due to the orientation of R&D activities towards creation of new technology—and not absorption—in advanced economies.

Other important determinants of absorptive capacity identified in the literature are human capital and education, and training at both country and firm level. In order to internalise technology efficiently, domestic firms need appropriately qualified and trained employees (e.g. Nelson and Phelps, 1966; Blomstromm and Kokko, 2003; Traore and Rose, 2003). This can depend on the quality of the education system in the country, but in-house training by firms can also have positive effects; for example, local firms that provided training for their employees have been found to benefit from inward FDI (Girma, Gorg and Gong, 2009; Kneller, Pantea and Upward, 2010). Targeted funding for education and support for

17. In principle the private sector may be uninterested in transfer and diffusion where these may dilute their own gains, but it is more likely that mutually beneficial opportunities from such spillovers are present when the host country has adequate absorptive capacity.

networks between universities and firms may lead to the creation of an ecosystem where experts with the necessary competences can engage in innovation. Where this is not possible, policies incentivising employment of foreigners alongside foreign-trained nationals or incentivising local companies to enter in partnership with foreign firms may be a solution (Ejiwale, 2014).

Several country-level and firm-level factors combine in ensuring that knowledge can freely flow beyond the boundaries of the firm and yield positive impacts for the economy as a whole. In particular, this may happen either horizontally or vertically (Keller and Chinta, 1990). An horizontal mode consists of personnel movements amongst firms, where staff bring their knowledge with them. A vertical mode entails connecting with local suppliers along and up the value chain. However, in presence of rigidities in the labour market and lack of inter-firm ties, as it is the case in many developing countries, spillovers struggle to materialise.

Absorptive capacity is also about the ability of local firms to adequately respond to the technological opportunities, which is in turn closely related to the country's overall entrepreneurship and business climate. First, firms may fail to get funding for R&D or for assimilation of existing technology due to the fragility of local financial institutions or limited corporate financial resources (OECD, 2017). In addition, the degree of competition in the local business environment may be low, increasing the cost of investments and production, reducing the incentives for innovation, and impeding ownership changes. Governments should work towards establishing adequate market conditions encouraging competition, in order to provide local firms with the incentive to innovate. Competition will also matter for effectiveness of other ITT measures discussed below. Third, the absence of stable linkages between MNEs and local suppliers may impede the effective transmission of knowledge along the value chain. Finally, where possible, policies should be put in place alleviating those barriers that take the form of fixed costs and disproportionately hurt local suppliers and SMEs. This can include, for example, reducing rigidities in the labour market.

Absorptive capacity is thus very much related to the level of country's economic and institutional development and often related to broader policies which may not be easy to reform quickly. There is, however, compelling evidence that policies can successfully promote absorption capacity in developing countries, especially when they draw together a wide range of measures discussed above; a clear example is the renewable energy sector in the People's Republic of China (hereafter "China") and India.

In China, government policies played a major role in creating absorptive capacity in the wind turbine industry over a 15 year period. For example, the 2005 Renewable Energy Law focused on the creation of a wind turbine industry and identified the need to enhance Chinese firms' capabilities to innovate. In addition, the government fostered R&D by incentivising collaboration on R&D activities among foreign and local firms and by encouraging training by multinationals. In 2009, in order to improve the quality of locally produced wind turbines, the Ministry of Finance waived import duties on wind turbine inputs, but only for wind turbine producers that had attained a minimum of production, developed a professional R&D team and possessed a minimum of experience in electrical and mechanical engineering. In practice, this enabled technical cooperation and the creation of Chinese-based R&D departments and boosted Chinese partnership opportunities with foreign firms (Sklarew, 2009). A further example of how the R&D goal is being pursued is the foundation of the Goldwind University in 2011, created by the Goldwind Science and Technology Co., and the Chinese wind turbine manufacturing industry's first corporate university. The University provides training to engineers and workers in the wind turbine industry. These policies have consolidated R&D capabilities of Chinese firms while improving the skills of Chinese workers and increasing absorptive capacity in the wind turbine sector.

In India, the government expanded opportunities for Indian firms to deploy personnel overseas for technical training and to engage in development of overseas joint ventures and subsidiaries (Sklarew, 2009), including by relaxing the financial requirements for firms sending remittances and personnel abroad. The main mechanism of acquiring technology has been to engage in strategic asset-seeking investment, mostly directed towards developed nations, while enhancing India's own technological

innovation capacity (Pradhan & Singh, 2009). As a result, the renewable energy sector has been growing at sustained rates and currently companies are consolidating internationally. An example is Suzlon, which has hired skilled foreign personnel to boost its technical training while also training their personnel in Germany. Moreover, the company has also entered into an agreement with Repower, a German company, to found the Renewable Energy Technology Center (RETC) in Germany. This pattern has been observed in other Indian companies investing in R&D and establishing strategic partnerships with foreign partners (Sklarew, 2009).

Multilateral initiatives such as "market facilitation mechanisms" may also play a role in addressing the difficulties developing countries have in transferring and absorbing technology. For instance, the WIPO GREEN initiative connects green technology owners and potential licensors and provides technical assistance for the negotiation of licensing agreements. The idea is to promote the expansion of green technologies and facilitate ITT to developing countries. Market facilitation mechanism may also have an "after-transfer" role by both assisting countries in the absorption of technology by providing the necessary knowledge to implement that technology, and by encouraging capacity building and spillovers to the rest of the economy. For example, KOTEC, a partner of WIPO GREEN, is currently working in Guinea towards not only the construction of solar-powered module-type LED street lamps but also providing assistance and technical support to local SMEs. Thanks to its inclusion in a wider network, KOTEC's work may more easily contribute to the global green technology transfer.

In sum, the literature suggests that in order to foster absorptive capacities, particularly in countries at lower levels of development, it is important to undertake policies which both enable firms to invest in R&D and ensure access to, and training of, highly-skilled workforce. It also points to the importance of broader host country conditions such as adequate financing, infrastructure and education.

3.3 Measures related to intellectual property rights protection

Certain types of technological knowledge are intellectual property and are protected by IPR such as patents, copyrights, trademarks, industrial designs and trade secrets. IPR policies can thus both encourage and impede ITT. IPR policies have evolved considerably over the years and have been the subject of provisions in international instruments, especially the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), other intellectual property agreements administered by the World Intellectual Property Organisation (WIPO) and other international trade and investment agreements. Government measures have the potential to affect the trade of IPR and the nature of technology agreements involving foreign firms. In parallel, competition law regulates technology transfer agreements whenever there is an anti-competitive exercise of IPR through unilateral or collusive conduct which may adversely affect competition and innovation, and in fact hinder technology transfer.

This section reviews five important issues for the protection of IPR in the context of ITT: i) IPR protection and ITT; ii) patent and licensing agreements; iii) trade secrets; iv) test data; and v) IPR-related provisions in competition law.

IPR protection and ITT

Intellectual property refers to creations of the mind such as: inventions; literary and artistic works; designs; and symbols, names and images used in commerce. Intellectual property law grants innovators rights to exclude others in order to help a right holder protect inventions, brands, creative works, valuable information, recoup investment costs, and profit from exclusive use of his/her intellectual property (WIPO,

2004). Even though it is generally accepted that the enforcement and protection of IPR is a necessary condition for innovation and technology transfer, this is not a straightforward statement.[18]

Developing useful knowledge entails a large amount of time, resources and risk. In the absence of intellectual property protection inventors are likely to be discouraged from investing in innovation and commercialisation. Moreover, inventors would also be discouraged from disclosing and sharing their knowledge and works because there are no guarantees that they will not be copied (UNCTAD-ICTSD, 2003). Thus, the underlying rationale of IPR is to achieve optimal resource allocation for innovation, by granting incentives for technological and cultural innovation and dissemination of this innovation, while also preventing early copying.

At the international level, the TRIPS Agreement establishes minimum standards of protection and enforcement for a globalised intellectual property regime. In other words, TRIPS can be regarded as minimum standards for the protection and enforcement of intellectual property.

The objective of promotion of technology transfer embedded in the TRIPS is clearly confirmed in Article 7, which explicitly affirms that IPR are not an end in themselves. On the contrary, the protection and enforcement of IPR are a means that "should contribute" to objectives of social and economic welfare development, including the transfer and dissemination of technology.

In addition, Article 8 of TRIPS also establishes principles in favour of transfer and dissemination of technology. Article 8.1 permits WTO Members to adopt necessary measures "to promote the public interests in sectors of vital importance to their socio-economic and technological development". Article 8.2 gives Members the flexibility to take appropriate measures to prevent the resort to practices, which "adversely affect the international transfer of technology" (Yu, 2009).

Article 66.2 of the TRIPS Agreement provides that developed country Members "shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to LDC Members, in order to enable them to create a sound and viable technological base". Some assert that the impact of Article 66.2 is reduced by the relative absence of the necessary complementary conditions required for ITT to occur in developing countries (see Section 3.2 above).

Considering that much of the technology is privately-owned, TRIPS does not oblige Members to carry out technology transfer themselves, but rather to provide incentives to their "enterprises and institutions" to do so. The TRIPS Council requires developed country Members to submit full reports on activities undertaken to meet these obligations every three years, with annual updates to be provided in intervening years (WTO, 2003). In recent years developed countries have reached a higher level of commitment in the enforcement of Article 66.2, and reports have improved significantly (Lidgard, 2011). For example, the EU, Canada and other developed countries are moving towards a uniform reporting mechanism ensuring LDC specificity. This new approach allows to identify funding provided for each technology transfer project and to differentiate them from the technical assistance provided in the context of capacity building.[19] The latest report indicated support for a total of 78 participations of partners from LDC countries in research projects in the period 2007-2013.[20]

18. Some argue for example that IPR can allow technology holders to act in monopolistic way and thus constrain access to technology. The stronger IPR protection is, the better the right holder can exclude others and, accordingly, the right holder may reach a larger market for his/her technology, with the capacity to charge monopoly prices for that technology (e.g. Maskus, 2004; Park & Lippoldt, 2008; Gehl, Sampath and Roffe, 2012).

19. For example the format used by the EU contains: i) the title of the project; ii) the policy objective; iii) the government agencies or institutions eligible in the provision of incentives for technology transfer in the developed member; iv) enterprises or other institutions eligible for incentives in LDCs; v) the targeted LDC Members; vi) the type of incentive measures for technology transfer; vii) the field or sector of technology

Similarly, the latest report by the US describes the most significant activities and programmes highlighting the memorandum issued by the government in 2011. The memorandum ordered that all federal agencies that conducted R&D activities should take measures to improve their technology transfer programmes leading to commercialisation. Accordingly, each agency developed specific plans and goals to be implemented.[21] The report outlines US technology transfer projects in an array of fields: educational and university-led programs, commercial and legal programs to strengthen capacity, IPR protection and enforcement capacity building, trade and investment policy, development programming and incentives through private sector models, food safety, energy development, environmental protection, health, building labour capacity and transportation.

Apart from the substantive disciplines established in the TRIPS Agreement, another important aspect to consider in the relationship between IPR and ITT is the negotiation of trade and investment agreements which contain stronger terms of IPR protection. The additional level of protection beyond TRIPS minimum standards is based on Article 1(1) of the TRIPS Agreement (which allows Members to implement in their laws more extensive protection than is required by TRIPS) and have the following forms: i) the inclusion of new areas of IPR; or ii) implementation of more extensive levels or standards of IPR protection than is required by TRIPS; or iii) the elimination of an option or flexibility available under TRIPS, i.e. limits on compulsory licensing or parallel importing (Mercurio, 2006).

While developing nations could potentially increase their attractiveness to some developed-country companies by strengthening their protection of intellectual property (UNCTAD, 2005; Stephen, 2013) effects also vary depending on the sector and the level of economic development. Park and Lippoldt (2003) found a fairly strong and positive relation between FDI and the strength of patent rights. A 1% increase in the patent rights indicator was associated with a 0.5% increase in the stock of FDI. As patent rights become stronger, there appeared to be a positive but diminishing association with increased FDI; the effect is largest for the LDCs (where initial IPR conditions tended to be weakest). Patent protection also tended to be relatively important for FDI in such sectors as computer services, finance, chemicals, petroleum and pharmaceuticals (perhaps owing to the threat of imitation).

Finally, multilateral initiatives establishing market facilitation mechanisms are a good example of how to address market failures in the context of ITT. For instance, the WIPO GREEN initiative, mentioned earlier also in the context of absorptive capacity policies, connects green technology owners and potential licensors and provides technical assistance for the negotiation of licensing agreements.[22] The idea is to promote the expansion of green technologies and facilitate ITT to developing countries.[23]

Patents and licensing agreements

A patent is a property right granted to the right owners (or right "holders") recognised in a document issued after application and through technical examination, by a government office (or a regional office acting for several countries) which publically describes, inter alia, how to make and use the invention. A patented invention can normally only be exploited (manufactured, used, sold, imported) for a limited term with the authorisation of the right owner. Once the patent term ends, the protected inventive subject matter

transfer activities; viii) the type of technology transferred; ix) the expected output related to technology transfer; x) the outcomes/impact; xi) the budget allocated; xii) the duration; and xiii) the status.

20. See Council for Trade-Related Aspects of Intellectual Property Rights, Report on the implementation of article 66.2 of the TRIPS Agreement, European Union Addendum IP/C/W/611/Add.7.

21. See Council for Trade-Related Aspects of Intellectual Property Rights, Report on the implementation of article 66.2 of the TRIPS Agreement, United States IP/C/W/616/Add.5.

22. Similar initiatives are being undertaken as the country level through a number of national IP offices.

23. See https://www3.wipo.int/wipogreen/en/network/

may be used by anyone. In this context, "invention" means a solution to a specific problem in the field of technology, and it may relate to a product or a process (WIPO, 2004). In several countries, inventions are also protectable through registration under the name of "utility model" or "short-term patent."[24] Patents are particularly relevant for ITT since they codify technological knowledge and provide protection to the IPR holders. The patent system aims at improving the efficiency of the flow of knowledge and facilitating the transfer of technology by establishing a legal framework that allows technology holders to disclose their inventions, license their patents or sell them in a regulated manner (WIPO, 2010). These conditions allow patents to be traded in technology markets, e.g. through various technology transfer contracts (see Annex Box 1). Moreover, public disclosure of inventions plays a crucial role in the effective transfer of technology since it makes a detailed technological knowledge available to others and also informs the public of the owner, extent and scope of the patent. Once the patent expires, third parties are not required to obtain consent of the patent holder for the exploitation of the patented invention.

At the international level, patents are regulated by different instruments.[25] The TRIPS Agreement requires patents to be available for inventions, whether products or processes, in all fields of technology and without discrimination as to the place of the invention, the field of technology and whether products are imported or locally produced. However, the Agreement also recognises that Members have the ability to exclude inventions from patent protection.[26] Article 28 of the TRIPS confers on patent owners the rights to prevent others from making, using, selling, offering for sale, or importing the subject matter of the patent, as well as the right to assign, transfer or license the patent. For a patent to be granted an invention shall comply with the three substantive conditions for patentability: novelty, inventive step and industrial applicability (TRIPS, Article 27.1). In addition, there is another condition for patentability, namely the disclosure of the invention. Patent applicants must "disclose the invention in a manner sufficiently clear for the invention to be carried out by a person skilled in the art" (TRIPS, Article 29).

A patent is valid only in the country in which it has been granted. Applicants who have first filed in one country and then also seek patent protection in another country may choose between the Paris Convention route or the Patent Cooperation Treaty (PCT) route. The Paris Convention route consists of directly filing separate patent applications at the same time in all of the countries in which the right holder would like to protect the invention (for some countries, regional patents may be available); or, an applicant who filed a first application in one of the Paris Convention Contracting States, may within a certain period of time (12 months for patents and utility models; six months for industrial designs and marks), apply for protection in any of the other Contracting States.[27] The Paris Convention filing strategy gives the right holder the benefit in all those countries of claiming priority from the filing date of the first application. The second option or the PCT route entitles the right holder to file an application under the PCT, directly or

24. According to WIPO, currently 59 countries provide utility model protection. See http://www.wipo.int/sme/en/ip_business/utility_models/where.htm.

25. See, for example, the Paris Convention for the Protection of Industrial Property, the Patent Law Treaty, the Patent Cooperation Treaty, the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure.

26. TRIPS Article 27.2 and 27.3 recognise that Members may exclude from patentability inventions, the prevention of which is necessary to protect public order or morality, including the protection of human or animal or plant life or health, or to avoid serious prejudice to the environment. In addition, Members may also exclude from patentability diagnostic, therapeutic and surgical methods for the treatment of humans or animals, provided that such exclusion is not merely made because the exploitation is prohibited by their law. Members may also exclude "diagnostic, therapeutical and surgical methods for the treatment of humans or animals; (b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes.

27. See e.g., http://www.wipo.int/treaties/en/ip/paris/summary_paris.html which explains the operation of the Paris Convention.

within the 12-month period provided for by the Paris Convention from the filing date of a first application, which single international application is valid in all Contracting States of the PCT.

Another important issue is the protection of utility models, which are also called "petty patents". On the one hand, while novelty is a criterion in all utility model systems, the requirement of inventive step as it exists in patent regimes is not always imposed. Bearing in mind that countries have the flexibility to decide over the level of inventiveness they wish to adopt, the standard of inventive step varies across countries (Grosse Ruse-Khan, 2012). On the other hand, the TRIPS does not impose any obligation on the protection of utility models. Countries are therefore free to determine whether they wish to grant either protection for utility models in certain fields of technology, or exclusive monopoly rights in the same way as patents. In theory, utility models are subject to substantive examination in order to determine whether they fulfil the novelty and inventive step criteria.

Substantive examination is important in all areas of technology in order to prevent abusive and anti-competitive blocking behaviour by local companies. If the utility models are granted too easily or the novelty and inventive step thresholds are too low, local companies may attempt to file for utility model protection and use the acquired rights in order to block foreign competitors from offering their products on the market.

Measurement of the strength of IPR protection across countries is difficult as different regulatory approaches can be aimed at providing similar levels of protection. Nevertheless, one way of measuring the quality and strength of patent protection is the Ginarte and Park (1997) index of patent rights and its subsequent updates and extensions (Park and Wagh, 2002; Park, 2008) (GP Index, thereafter).[28] Results for our sample of countries using this index are presented in Annex Figure 1.

Licensing is one of the major channels for promoting technology transfer, playing a crucial role in creating income for the patentee, and promoting dissemination and further development of technologies by a wider group of licensees, thereby facilitating the commercialisation of innovative products (WIPO, 2010). A license is the permission by the owner of a patented invention to another person or legal entity to perform, in the country and for the duration of the patent rights, one or more of the acts which are covered by the exclusive rights to the patented invention in that country (WIPO, 2004). Any technical licensing contract will be subject to the negotiation of important clauses dealing with the subject of the contract, the licensor's obligation and the obligations common to both parties.[29]

In several countries government authorities require registration of technology licensing contracts in governmental offices in order to monitor such transaction and, eventually, to facilitate the development of ITT in accordance with national policy objectives. In some cases, these controls are related to the foreign exchange regulations directed towards the payment of royalties or their approvals. In others, it can be part of an *ex ante* examination of the terms of the contract by competition authorities, such as in the case of

28. The index includes the following components: coverage (including patentability of utility models, pharmaceutical and chemical products, each weighted 0.33); membership in international agreements (The Paris Convention of 1883, the Patent Cooperation Treaty (PCT) and the International Convention for the Protection of New Varieties of Plants of 1961, each weighted 0.33); loss of protection (including compulsory licensing, working requirements and revocation of patents) and enforcement (preliminary injunctions, burden of proof reversal and pleading of contributory infringement). Modifications (Park and Wagh (2002), Park (2008)) have included a more detailed categorisation of patentable items and regulations on patent duration. However, the index does not cover enforcement and its latest update in terms of data collection dates to 2005.

29. Typically theses clauses will include: i) identification of the parties; ii) the scope of the license; iii) the subject matter; iv) identification of the product or processes; v) identification of the invention; vi) description of the know-how; vii) confidentiality; viii) access to technological advances; ix) limitation of the license and anti-competitive practices; x) territorial exclusivity; xi) permitted field of use; xii) exploitation; xiii) settlement of disputes; xiv) duration of the license contract; and xv) remuneration (WIPO 2004).

Brazil and Thailand (WIPO, 2013). [30] In some jurisdictions, the law permits but does not require public registration of agreements transferring a patent or trademark.[31] In this case, only the parties to the agreement have the information on relevant IPR and, even if a voluntary register exists, third parties cannot assume the information contained therein is complete. This can result in legal uncertainty with respect to IPR ownership and can thus impede the functioning of technology markets.

In other jurisdictions the law may require that a contract relating to assignment, transfer or sale of patent rights or a license contract be presented to the patent office for registration (WIPO, 2016) either making the actual transfer dependent on registration (the positive publicity of a register) or by stipulating that the fact that is not entered in the register does not bind third parties (the so-called negative publicity) (Kelli et al., 2016) The failure to submit the licensing contract for registration or approval to the appropriate government authorities may entail different legal consequences: the agreement may be rendered void or unenforceable, unenforceable for third parties or the responsible party may be subject to a penalty or the suspension of its right to trade (WIPO, 2004).

Lastly, the relationship between licensing, technology diffusion and the degree of IPR protection is multi-layered and complex. One of the reasons for this is the diversity of forms licensing agreements can take (Annex Box 1). However, when observed as a technology transfer channel, licensing acts as a substitute to FDI and can be partially conditioned by the level of IPR protection. Stronger IPR is seen by the licensor as signalling a smooth enforcement of licensing agreements and minimising the risk to valuable intangible assets. Weak IPR protection generates problems of information asymmetry and imitation risks. In the case of economic sectors with a low level of technological intensity, strong patent rights will most likely act as an incentive for choosing FDI over licensing as a technology transfer channel (Maskus et al., 2003). Accordingly, strengthening the IPR protection can be used as a medium term strategy by the governments of low income and middle income developing countries, in creating sustainable public policies with respect to attracting FDI in low technology intensive sectors.[32]

Trade secrets

Trade secrets aim to protect those businesses that have developed proprietary information that provides a competitive advantage in their commercial activities because it is unknown to others (Saunders, 2006). This category may include advanced technological information, chemical formulae, manufacturing techniques, product design, and technical data. However, it may also include information such as customer lists, business leads, marketing strategies, pricing schedules, and sales techniques.[33] Nevertheless, trade secrets do not grant the holder the exclusive right to exploit the secret information. On the contrary, others may develop the information independently or even through reverse engineering with no protection for the secret holder.

The TRIPS establishes natural and legal person's rights to prevent parties under obligation of confidence from disclosing information which: i) is secret; ii) has a commercial value because of such secrecy; and iii) has been subject to reasonable efforts to maintain such secrecy (TRIPS, Article 39.2).

30. In Thailand the official involved is from the DIP, not directly the competition authorities.

31. Kelli et al. (2016) report this to be the case in Germany, Sweden, Norway and Denmark, for example, although they also point out that the German Model law proposes to make registration mandatory.

32. In a study about the impacts on FDI of the IPR regime in Greece concluded that foreign investors entering high technology industrial sectors in Greece choose to solve any "appropriability problem" stemming from the low level of effective IPR protection by establishing majority owned subsidiaries. (Kyrilis & Koboti, 2015).

33. Importantly, negative information, i.e. unsuccessful attempts by a company to remedy a particular problem can also be protected under trade secrecy, insofar as such negative information has value to a competitor as a guide on what not to do, potentially providing a competitor with a no-cost initial advantage.

Contrary to patents, trade secrets are not subject to registration and are protected automatically without any procedural formalities. Moreover, trade secrets can be protected for an unlimited period of time.

Trade secrets play a key role in innovation policy insofar as they establish incentives to innovate by providing a mechanism for firms to capture the benefits of their inventions (Risch, 2010). Trade secrets allow for the protection of valuable information or technology without public disclosure or the expense and uncertainty of the patent application process providing innovators a choice of privileging potentially longer term secrecy over limited exclusive protection (patent rights).

According to Article 39 of the TRIPS, trade secrets are protected against unauthorised use "in a manner contrary to honest commercial practices" (this includes breach of contract, breach of confidence and unfair competition). Articles 42 to 49 of the TRIPS Agreement cover enforcement, requiring that civil judicial proceedings be available to enforce all IPR and that "confidential information" is protected from disclosure. Nevertheless, the enforcement of trade secret rights around the world is generally viewed as uneven. A recent study by the OECD establishes an index comparing the standard of trade secret protection in different countries (Lippoldt and Schulz, 2014, LS Index). The index surveyed legal provisions and practices with respect to: source of law, definition and scope; covered acts; definition of duties and misappropriation; restrictions on liability; remedies; enforcement, investigation and discovery, and related regulations; and expert characterisation of the operation of the system in practice. Subsequently, the survey of legal provisions confirms that there is great variation among approaches to trade secret protection. The results using this index for the countries under analysis covered by the Schultz-Lippoldt trade secret protection index are in Annex Figure 2.

An important trend that has been observed regarding trade secrets regulation is that the latest PTAs, for example the draft text of the TPP, are more focused on trade secret protection than they have been in the past.[34]

Test data

According to Article 39.3 of TRIPS, if a country requires the submission of undisclosed data that entails considerable effort to originate as a condition for the marketing of a new pharmaceutical or agricultural chemical product, then it must protect such data against unfair commercial use. Members must also protect such data against disclosure, except where necessary to protect the public or unless steps are taken to ensure that the data are protected against unfair commercial use. The TRIPS does not provide a definition of what constitutes unfair commercial use, leaving Members the possibility of deciding whether such data should be protected through exclusive rights or through a system of unfair competition rules (UNCTAD-ICTSD, 2005).

As opposed to a patent, which entitles the right holder to exclude others from making, using, selling, offering for sale, or importing the patented product, the protection that governments must accord proprietary test data does not, per se, exclude others from the possibility of running their own tests and submitting the results to the regulatory authorities. Under a system of exclusive rights, the data originator may prevent third party competitors from submitting the same test data for marketing approval, provided that the third party has obtained the data by dishonest commercial means. That said, there is debate about whether the stipulation against unfair commercial use extends to use by the regulatory authorities themselves of the original data to assess submissions by third party competitors relating to similar products

34. The text of the TPP, which has not entered into force, would require that countries provide protections against the disclosure, acquisition, or use of trade secrets by others, explicitly including state-owned entities, in a manner contrary to honest commercial practices (TPP, Article 18.78). In addition, the TPP would require that criminal procedures and penalties be available for trade secret misappropriation under certain circumstances. If TPP is brought into force, such obligations would be more stringent than the mere discretionary obligation contained in the TRIPS.

(UNCTAD-ICTSD, 2005). Some argue that this considerably facilitates the market entry by competitors, as they are not obliged to repeat the same clinical and toxicological tests as already undertaken by the data originator. Such tests are time costly and time-consuming, and often represent insurmountable barriers for the market entry of small producers of generic pharmaceutical products (Roffe and Spennemann, 2006). However, others equally plausibly argue that when regulatory authorities use test data shortly after marketing approval of the originator's products that this can undermine incentives for innovative companies to bring new products to the market and address unmet medical needs.

Indeed, the generation of the data necessary for the original marketing approval often requires a substantial investment of time, expertise and resources. Therefore, it can be argued that inventors should have the right to recoup the costs involved in generating such data before a competitor is permitted to rely on those data for the approval of their alternative. When followers receive the benefit of the data generated by the originator without any investment on their part, the originator may be placed at a significant commercial disadvantage. This situation undermines the investment potential insofar as the results of the originator's tests are immediately available to competitors at no cost. In addition, the potential litigation burden is placed entirely on the originator to pursue any patent rights. Given the imbalance between the cost to the originator of gaining marketing approval for its drug, or other research-intensive product, and the copier's cost of coming on to the market, the research industry may have a reduced incentive, without such protection, to engage in R&D activities.

Most WTO members have implemented some sort of data protection, but jurisdictions have adopted three ways of interpreting the TRIPS standards in practice: i) fixing an exclusive period of protection during which the data cannot be used by competitors; ii) allowing others to access the data for financial compensation; and iii) protecting the data from dishonest acquisition by competitors but allowing data usage on the part of the regulator (Taubman, 2008). Of these, data exclusivity grants a higher level of protection because the originator holds exclusive rights over the data and can prevent competitors from using it when seeking regulatory approval to their competing products. In a number of OECD countries protection of registration data against "unfair commercial use," as reflected in TRIPS Article 39.3, is interpreted as requiring governments to prevent reliance, by regulatory authorities or third parties, on the data for the marketing of subsequent versions of the drug during the period of exclusivity without the originator's consent.[35]

The importance of this standard of protection granted to test data, which goes beyond the minimum required by TRIPS, is testified by inclusion of appropriate provisions in a number of US and EU PTAs (Roffe and Spennemann, 2006). For instance, US PTAs usually mandate the protection of regulatory test data for specific lengths of time (five years for new pharmaceuticals and 10 years for new agricultural chemicals) during which the firm originating the data has the exclusive right to use it.

IPR and Competition Law

Competition law encourages companies to offer consumer goods and services at the most favourable terms as efficiency and consumer welfare are at the core of competition regulations. From the competition perspective, exclusive rights granted by IPR may sometimes create monopoly power, which can be at odds with consumer interests.[36] By limiting a possible abuse of IPR, competition law aims at promoting technical progress for the ultimate benefit of consumers.

35. This is the case, for example, in the European Union, the United States and Switzerland, although there are differences in the length of the period of data exclusivity, with the United States having a five year period, the EU a six or ten year period and Switzerland a ten year period.

36. Nonetheless, the relationship between IPR and competition has been subject to debate for many years. From the perspective of IPR protection, competition law may be considered as an interventionist instrument, which infringes right holders' entitlements (WTO, 1998).

At the international level, the TRIPS Agreement contains some competition rules, although they do not stipulate precise obligations subjecting the exercise of IPR to the application of competition law principles. Article 8.2 recognises WTO Members' power to formulate or amend their domestic legislation to adopt appropriate measures to prevent three inter-dependent kinds of IPR-related practices: (i) IPR abuses by right holders; (ii) practices that unreasonably restrain trade; and (iii) practices that adversely affect international technology transfer. Such restrictive practices cover both unilateral abuse by a firm and contractual restraints on IPR-related trade.

Similarly, Article 40.1 acknowledges that some licensing practices or conditions which restrain competition may have adverse effects on trade and may impede the transfer and dissemination of technology. However, it does not specify those practices, allowing WTO Members to specify in their national legislations those licensing practices or conditions that may, in specific cases, constitute an abuse of IPR (Article 40.2). The article lists certain anti-competitive practices in contractual licences, namely exclusive grantback clauses, conditions preventing challenges to validity, and coercive package licensing, which it indicates are to be assessed on a case-by-case basis by a national authority (WIPO, 2010). However, the list is not exhaustive, and it is up to the Members to determine, in their domestic law, which practices are deemed anti-competitive.

Several jurisdictions have adopted IPR-related competition provisions within their existing intellectual property laws. In fact, the Working Group on Trade and Transfer of Technology of the General Council stipulated that, in order to increase inward technology transfer into developing countries, the latter should effectively establish a competition policy concerning IPR (WTO, 2005). Technology transfer agreements have a special nature and should be regulated differently than typical commercial agreements. Thus, the very existence of specific regulation and guidelines in respect of technology transfer agreements is a signalling device that a public policy is in place and provides legal certainty on the extent of protection that the country grants to IPR in the ITT context.

In the field of technology transfer agreements there are also specific concerns about price-related anti-competitive practices, where restrictions on product prices occur, but also in the technology market, where anti-competitive royalty issues can arise (see Annex Box 2) (Nguyen, 2010).

At first glance, technology transfer agreements have a pro-competitive nature since they facilitate the integration of technology with complementary factors of production and distribution (see Annex Box 1). Moreover, technology transfer agreements can stimulate innovation, disseminate technology, and save costs in production or distribution (Nguyen, 2010). Nonetheless, in the absence of appropriate legislation in host countries, companies may attempt to limit technology transfer to developing countries by: (i) refusing to work the IPR; (ii) refusing to license; (iii) charging excessive prices for technology transferred; or (iv) incorporating anti-competitive restrictions into technology transfer agreements (Jeffries, 2001).[37]

When addressing anti-competitive practices in technology transfer agreements, countries have opted for different strategies. To begin with, there is a clear trend towards the adoption of directives or guidelines clarifying the objectives and the ways of implementing the relevant national statutes. Guidelines and directives provide legal security and confidence for investors. In addition, some countries, including for

37. This topic has been on the multilateral agenda since the 1960s and, for a number of years, UNCTAD held discussions on how to harmonise the criteria to address anticompetitive clauses in technology transfer agreements. Those discussions did not lead to an agreement, although a code of conduct for the transfer of technology was drafted and discussed among Members. The Draft International Code of Conduct on the Transfer of Technology and the documents reflecting discussions between 1974 and 1985 are available at www.unctad.info. Although the ToT Code was finally abandoned in 1985, its negotiations reflected the policies and laws of developing countries relating to restrictive practices in technology transfer in the 1970s-1980s. Thus, there is no international instrument defining the scope of anti-competitive practices in ITT apart from the above-mentioned provisions in the TRIPS Agreement.

example the Philippines, Thailand, China and the countries of the Andean Community, have enacted a list of clauses deemed anti-competitive, which are identified as hard-core restrictions to competition (see Annex Box 3). Some other countries like the US and Brazil rely instead on a rule of reason approach where the alleged anti-competitive conduct must be examined on a case-by-case basis. However, they do recognise that some clauses (such as those identified as anticompetitive in Article 40.2 of TRIPS) are quite likely in breach of competition law (WIPO, 2013). The Treaty on the Functioning of the European Union contains a list of clauses that are deemed hard-core restrictions to competition, although they make a distinction between whether the parties to the agreement are competitors or whether the agreement is between non-competitors.[38] In Japan, the Unfair Trade Guidelines list several types of clauses as being highly likely to be deemed unfair trade practices, such as restricting the price of goods, imposing obligations after the termination of the agreement or expiration of the patent, and imposing limitations on R&D programs of the licensee (WIPO, 2008) (WIPO, 2013).

3.4 FDI promotion measures

Defined as the establishment of a lasting interest in, and significant degree of influence over, the operations of an enterprise in one economy by an investor in another economy[39], FDI is one of the principal modes of international application and transfer of technology. Technology transfer can thus be influenced by general and specific policies and regulations in this area and investment policy is often shaped with technology transfer effects in mind.

As set out in the OECD Policy Framework for Investment (PFI), investment policy is a broad concept encompassing not only laws relating to the admission and treatment of investors, or expectations related to the contribution of investment to a country's economic and other goals, but also more general laws such as the country's Constitution, laws regulating the behaviour of companies (e.g. commercial and competition law), laws regulating IPR and other regulations and administrative requirements related to doing business. Investment policy can thus overlap greatly with domestic regulation. In fact, some countries do not have a specific investment law, while others may have laws that apply either jointly or separately to domestic and foreign investors. An additional layer of a country's investment policy is also added by its international investment agreements (BITs and PTAs) which contain additional provisions which apply to states and investors covered by the treaties (OECD, 2015a).

The OECD PFI distinguishes between four key general components of domestic investment policy: the non-discrimination principle; the degree of openness to foreign investment; the protection of investors' property rights; and mechanisms for contract enforcement and settling of disputes. Some of these, as well as several other aspects of investment policy, can be compared across countries using the OECD Services Trade Restrictiveness Index (STRI) database and the OECD FDI Regulatory Restrictiveness Index (both of which are discussed in the next sub-section on FDI restrictions and screening), the World Bank Doing Business Indicators, the World Economic Forum's (WEF) Competitiveness Indicators and the Heritage Foundation's Economic Freedom Index (Items A.i through A.iii in Box A).

38. According to Regulation No 316/2014 of 21 March 2014 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of technology transfer agreements, the list of hard-core restrictions differ depending on whether the parties to the agreement are competitors or not. In general, agreements between competitors will be regarded as having hard-core restrictions of competition if the agreement, directly or indirectly, has as its object the restriction of a party's ability to determine its prices, the limitation of output and the allocation of markets or customers. With regard to agreements between non-competitors, in general they will be regarded as hard-core restrictions if they, directly or indirectly, have as their object the restriction of a party's ability to determine its prices, the restriction of passive sales based on the territory or on the customers and the restriction of active or passive sales to end-users by a member of selective distribution system.

39. OECD benchmark definition of FDI.

The latter three indicators capture the levels of the general investment climate across countries, without specifically targeting measures that may have been established to promote ITT.[40] In this context, additional aspects of FDI policy can be considered. In particular, most countries have established investment promotion agencies (IPAs) and charged them with functions, including image building, investment generation, investor servicing, aftercare and policy advocacy (OECD, 2015a). Most, although not all, IPAs target some sectors or activities, and such prioritisation is considered to be a best-practice by innovation and investment promotion communities (OECD, 2010 and OECD, 2015a). Among those IPAs that target specific sectors, particularly in their investment generation and servicing functions, some target investment projects based on their technology characteristics. These typically include advanced manufacturing sectors such as automobiles, information and communication technology (ICT) or biotechnology but, depending on the country, can also include advanced activities in agriculture or natural resources which the country may deem have high technology transfer potential. In many cases, these are also sectors where the country may have a comparative advantage or particularly well developed absorptive capacity and thus these are the areas it prioritises for ITT with a view to further development of a competitive sector. Some countries do not pursue targeting as a principle, in order not to influence the composition of the incoming FDI. This aspect of FDI policy is intended to be captured in Question A.1 proposed in Box A.

Less habitually, certain countries also maintain simplified regulatory or administrative procedures for certain investment projects based on their technology characteristics or in specific sectors. In particular, some countries may provide targeted "one-stop-shop" services to facilitate procedures including registration or approval and provide various forms of assistance in obtaining utilities and sites. (Question A.2 in Box A). Some countries may also leverage their IPAs to provide aftercare services to actors in specific sectors, to promote retention of existing investment. Aftercare services comprise all potential services, including legal advice, designed to facilitate continuous development of the original investment, in particular establishment of new plants or facilities (Question A.3. Box A).

IPAs' facilitation of business linkages connecting investors with domestic suppliers may also incentivise investment. Business linkages programmes may include organisation of matchmaking activities in the form of meetings, forums and workshops and provision of information services regarding domestic suppliers. In some cases, they may also comprise IPA-led technology partnership with those suppliers. For example, in China, Motorola and China's State Development and Planning Commission cooperated in order for Motorola to secure a supplier base in the country. According to UNCTAD (2006), business linkages programmes tend to focus on certain industries, depending on the region and the broader policy objectives; for example, IPAs in the Asia Pacific region focus on information technology, electronics and manufacturing (Question, A.4. Box A).

Facilitation of investor access to human capital may also constitute an incentive to FDI and increase technology transfer. According to the UNCTAD World Investment Prospects Survey, availability of skilled labour and talents is among the most important FDI location factors, after market size, market growth, presence of suppliers, market access and stable environment. These policies include, for example, maintenance of networks between public science and engineering institutions and companies or policies facilitating recruitment of highly skilled foreign personnel. Prompt availability of talent in technology-intensive areas incentivises companies operating in those sectors to invest and therefore yields potential for transfer of technology (UNCTAD, 2001) (Question A.5, Box A).

40. Some of these indicators are, however, also compiled for specific economic sectors (OECD FDI Regulatory Restrictiveness Index) or are composed of sub-indicators for more specific policy areas (World Bank Doing Business and WEF Competitiveness Indicators).

Box A. Measures to encourage FDI

Readily available codified information:

A.i Position on World Bank's Doing Business Indicators

A.ii Position on WEF's Competitiveness Index

A.iii Position on the Heritage Foundation's Economic Freedom Index

Additional regulatory information collected:

A1. In its investment generation and servicing functions does the country's investment promotion agency (IPA) target investment projects in specific sectors?

A2. Does the national investment facilitation framework provide simplified regulatory or administrative treatment for certain investment projects or in specific sectors?

A.3 Does the country's investment promotion agency (IPA) provide aftercare services for projects in specific sectors?

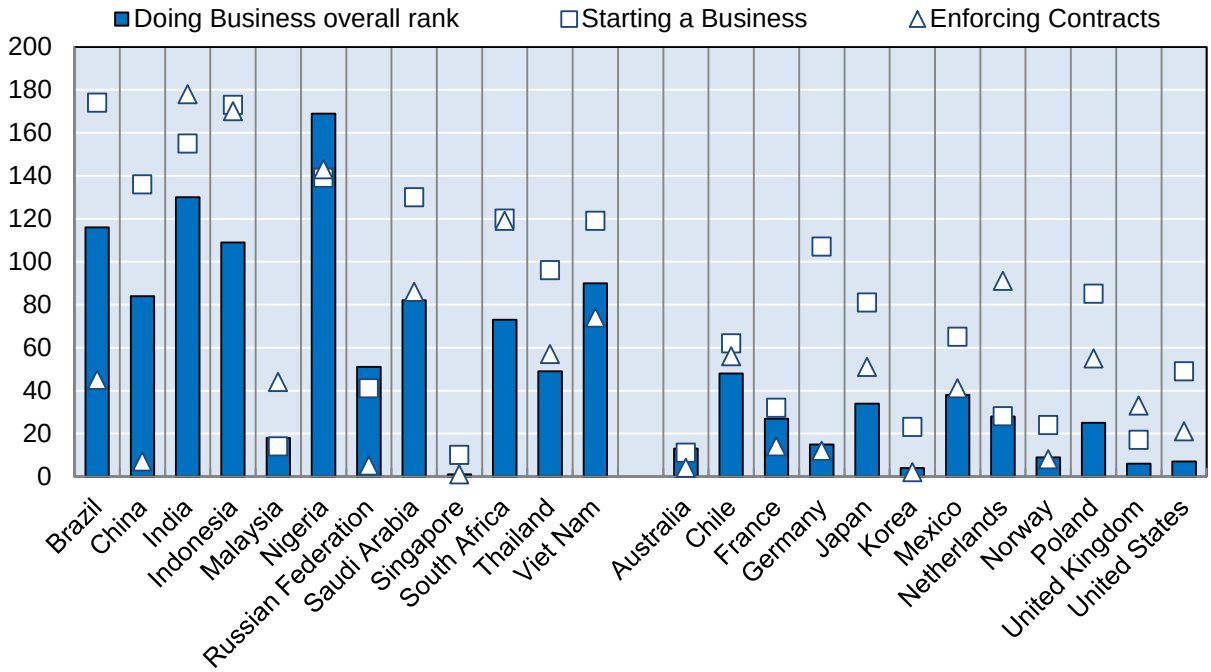
A.4. Does the IPA promote business linkages with domestic suppliers in specific sectors?

A.5. Has the country put in place policies that facilitate investor access to human capital in technology-intensive areas?

Measures to encourage FDI—use across countries

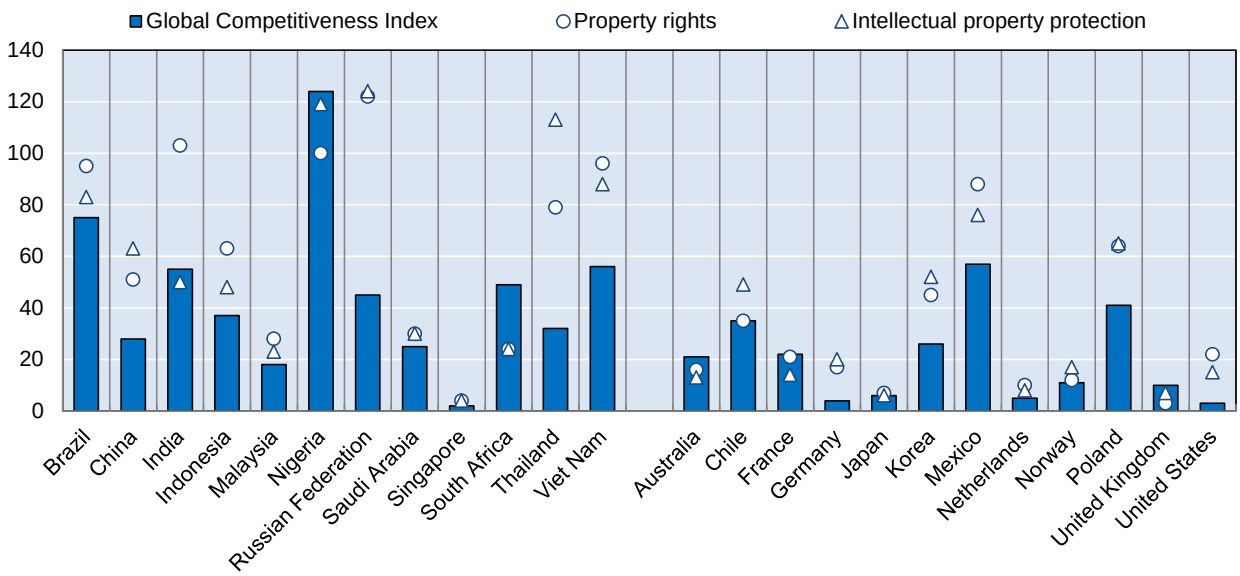
Figure 2 presents the World Bank's Doing Business rankings for the overall business climate as well as its starting a business and enforcing contracts sub-components which can be deemed to be of particular relevance. Figure 3 shows the WEF's Competitiveness Index country rankings in terms of overall competitiveness and competitive aspects related to its property and intellectual property components and Figure 4 the Heritage Foundation's Economic Freedom overall index of economic freedom as well as its business and investment restrictions components. The three indicators suggest that Germany, Australia and Malaysia have the most accommodating business climates while Brazil and Viet Nam have the most restrictive ones.

Figure 2. World Bank's Doing Business rankings, 2016



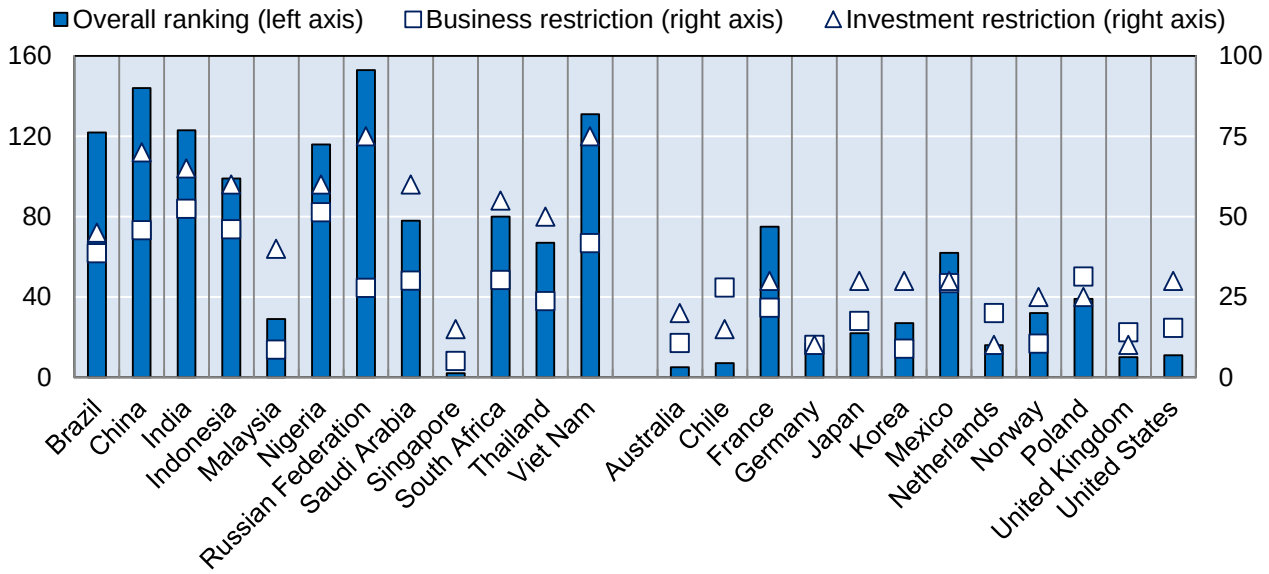
Source: World Bank Doing Business Indicators.

Figure 3. WEF Competitiveness index and property rights index, rankings over 140 countries, period 2015-2016



Source: World Economic Forum, Global Competitiveness Index rankings.

Figure 4. Overall index of economic freedom and business and investment component, 2016



Note: The original measures for business and investment freedoms where full freedom was scored at 100 were inverted according to the formula [restriction = 100 – original score on freedom]. Higher scores mean higher freedom restrictions.
Source: Heritage Foundation Index of Economic Freedom.

Table 1 and Figure 5 present the answers to the additional questions for the countries under analysis. In general, IPAs of seventeen out of the twenty four countries target investments based on their technology characteristics (A.1). This is the case for most of the emerging countries. In Brazil, for example, the IPA explicitly targets the automotive sector, renewable energies, oil and gas and life sciences while the Malaysian IPA focuses on high technology, machinery and equipment and renewable energy activities. In India, the IPA supports the investment framework for manufacturing development "Make in India", which focuses on attracting FDI in sectors such as defence, civil aviation, broadcasting, banking, railway, etc. IPA technology targeting is less clear in developed countries, where some EU countries and the United Sates seem not to follow this approach. This may reflect other policy considerations, for example, a focus on SMEs in Germany or deliberately sector and technology-neutral investment promotion which may be seen as being less interventionist.[41,42]

There is more variation in country approaches to sector- or technology-specific administrative simplifications, with ten countries having measures of this kind (A.2). In Thailand, for example, permits to bring into the country skilled workers and experts are only granted in investment-promoted activities which include, for example, biotechnology, engineering design and scientific laboratories. In Chile, foreigners who have a professional or technical degree may obtain a waiver of social security contributions. India is an example of a structured approach to sectoral administrative simplification. In the targeted sectors, the Indian government provides FDI access through an "automatic route", which involves

41. For example, while there are no specific EU-wide rules on investment promotion, the EU rules on state aid which, along with other necessary criteria, consider sectors-specific financial advantages as prohibited.

42. Question A.1 is a good example of how interpretation of policies may also be rendered difficult when technological considerations are implicit or embedded in other policy objectives. The Polish Investment Promotion Agency (PAIIZ) for example declares it does not treat any activities as privileged and acknowledges openly on its website that it is the investors that know best where profitable opportunities exist. The agency however indicates that also it has sector specialists which can offer expert sector knowledge. In this specific case, the approach has been interpreted as a "no" noted for Poland on Question A1.

a lower bureaucratic burden. For example, applicants from the defence, telecommunications or broadcasting sectors do not need the approval of the Reserve Bank of India for establishment of a branch office or project office.

Sectoral IPA approaches to aftercare services (A.3) are absent in most of the countries under analysis. In the majority of countries studied, aftercare services, where present, are provided to all investors. In some countries, such as Russian Federation, such services are provided through an Ombudsman which provides cross-sectoral legal support. Some countries do, however, target aftercare services in specific sectors. For example, in Malaysia, the IPA provides specific consultation with the relevant authorities only for services and manufacturing. In India, aftercare services are provided to specific sectors in the context of the "Make in India" programme.

IPA promotion of business linkages with domestic suppliers in specific sectors is also not a common approach (A.4); this policy is implemented in only six out of twenty four countries. In general, IPAs connecting firms with suppliers do not distinguish between sectors in promoting these linkages. For example, in Thailand, the BOI Unit Industrial Linkage Development (BUILD) provides a general database of subcontractors in Thailand. However, in some cases, preferences are expressed. For example, in Chile, the Investment Promotion Agency, CORFO, promotes business linkages with SME suppliers, especially for solar energy.

More than one half of the countries analysed have however put in place policies that facilitate investor access to human capital in technology-intensive areas (A.5). In particular, this approach is prominent in developed countries, where the facilitation takes the shape of linkages between technical schools and enterprises. For example, in France an established network is present between engineering schools and firms, while in Korea the Ombudsman office promotes "on campus recruiting for foreign investment companies" looking for quality employees in fields such as the automotive industry, electronics and IT. Similar policies are present in some developing countries such as Brazil, where the investment promotion agency helps foreign investors to identify local companies, universities and research centres to establish partnerships and joint ventures.

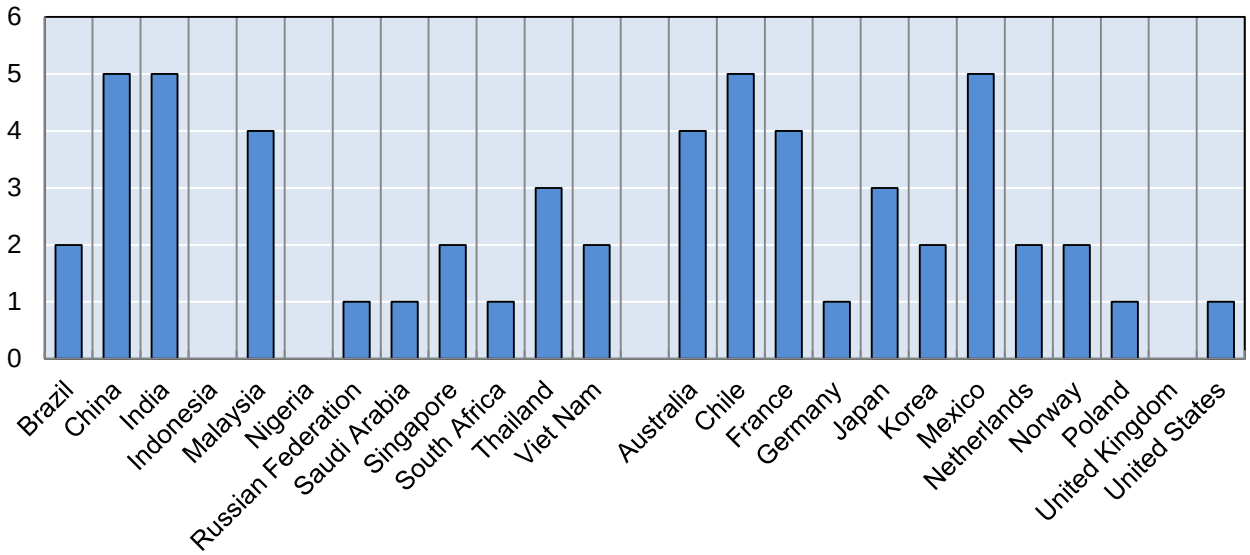
Table 1. Measures to encourage FDI

	Question	Brazil	China	India	Indonesia	Malaysia	Nigeria	Russian Federation	Saudi Arabia	Singapore	South Africa	Thailand	Viet Nam	Australia	Chile	France	Germany	Japan	Korea	Mexico	Netherlands	Norway	Poland	United Kingdom	United States
A1	In its investment generation and servicing functions does the country's investment promotion agency (IPA) target investment projects in specific sectors?	yes	yes	yes	no	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	no	yes	yes	yes	no	no	no
A2	Does the national investment facilitation framework contain regulatory or administrative simplifications targeting investment projects based on their technology characteristics?	no	yes	yes	no	no	no	no	no	no	no	yes	yes	no	yes	yes	no	yes	yes	yes	no	no	yes	no	no
A3	Does the country's investment promotion agency (IPA) provide aftercare services for projects in specific sectors?	no	yes	yes	no	yes	no	no	no	no	no	no	no	yes	yes	yes	no	no	no	yes	no	no	no	no	no
A4	Does the IPA promote business linkages with domestic suppliers in specific sectors?	no	yes	yes	no	yes	no	no	no	no	no	no	no	yes	yes	no	no	no	no	yes	no	no	no	no	no
A5	Has the country put policies in place that facilitate investor access to human capital in technology-intensive areas?	yes	yes	yes	no	yes	no	no	no	yes	no	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes

Source: Authors' elaboration.

Figure 5. Summary chart: measures to encourage FDI

Number of positive responses to questions A1 through A5



Note: This figure graphically summarises the information from Table 1 above. When interpreting it, it should be remembered that the different measures likely have very different impacts on technology transfer, the quality of such transfer and competition. Some measures may more important than others. Therefore, the number of measures that a country has adopted is only a rough measure of that country's commitment to attracting foreign technology and facilitating its spillover.

Source: Authors' elaboration.

FDI promotion measures—preliminary observations on effectiveness in terms of technology transfer and impact on competition

Although the literature on targeting of investment promotion is limited, the few existing studies seem to indicate that it is effective in the achievement of the IPA goal of increasing FDI in technology intensive-sectors. For example, an analysis of the effect of investment promotion on inflows of FDI from the US by Harding and Javorcik (2011) shows that sectors explicitly targeted by investment promotion agencies in their effort to attract FDI received more investment in the post-targeting period than other sectors. This is particularly effective in developing countries where information asymmetries and burdensome bureaucratic procedures hamper FDI. In addition, OECD (2015a) shows that targeted promotion missions in carefully identified sectors are more effective than international marketing campaigns. Past experience of national IPAs show that such an approach may indeed yield positive results.

For example, targeting in microelectronics in Ireland led to a significant increase in FDI in the desired activities (Tavares-Lehmann et al., 2016).

In order for targeting to be justified and to achieve the maximum economic benefit from targeting-related spending, the targeted activities should arguably be characterised by more extensive positive externalities than non-targeted sectors. Externalities are indirect effects on the consumption and production opportunities of others. From a welfare perspective, achieving positive externalities along FDI encouragement maximises the social rate of return from the financial contribution by the IPA. In the above study by Harding and Javorcik (2011), for example, the fact that the targeted sectors continued to receive more FDI in the post-targeting period suggests that a positive dynamic has been sustained in a period when the investors were no longer receiving special treatment. In the case of technology-intensive sectors in particular externalities may be present precisely because technology may spill over to other actors in the economy through "learning by doing" by part of local suppliers and staff. Another positive externality may

be an increased demand for technical staff, leading to further funding of local universities or international partnerships.

For example, in Costa Rica the investment promotion agency targeted the semiconductor producer Intel and supported the construction of an Intel plant in the country which is reported to have generated two kinds of externalities. First, Intel provided technical and managerial knowledge to some of its collaborators. For example, a 2000 survey of 80 Intel suppliers indicated that 37% of service providers and 17% of good providers received direct training from Intel. Second, there were important demonstration effects for investors in electronics. In particular, within three years of the arrival of Intel, the country tripled its FDI stock, reportedly as a consequence of the signalling role provided by the opening of the Intel plant (Moran, 2011).

In a similar fashion in Korea, the establishment of InvestKorea in 2003, with the mandate to promote FDI in R&D and the subsequent inflow of FDI in the area led to setting up of the Korea Foundation for International Cooperation of Science and Technology which further served as a bridge between domestic and foreign R&D centres. This is seen as having further contributed to the technological development of the country (UNCTAD, 2005).

A standing concern regarding IPAs targeting is connected to the potential distortions such policy might cause (e.g. Herrmann and Lipsey, 2003). As with any policy that targets certain actors, to the extent that benefits stemming from such promotion are not extended to firms that do not meet the eligibility criteria and that such criteria are established by countries on a discretionary basis, the playing field may not be level (see Box 1). From a domestic point of view, however, the question is whether the cost in terms of competition is outweighed by the positive externalities thereby generated. In an international context, the question is whether the competition distortions are significant enough to be tackled in international fora.[43] In absence of rigorous empirical studies in this area it is, however, difficult to have a feeling of the extent targeting may be a problem for competition. Better quantifying the benefits and, in parallel, competition implications of investment targeting performed by IPAs, seems a clear area where further research may be beneficial.

3.5 FDI restrictions and FDI screening

Despite a general trend towards liberalisation and encouragement of FDI (e.g. Shan, 2010), limitations on the share of equity which can be owned by foreigners are still applied in some countries and sectors. In certain circumstances, these limitations can oblige foreign investors to involve local partners (e.g. through joint ventures) or license technology to local firms, which may have implications in terms of control of proprietary IPR and know-how.

Screening and selective authorisation of FDI projects can also shape ITT. First, certain screening procedures can be seen as infringing confidentiality and may deter investors holding certain types of technology. Second, FDI projects can be approved or rejected selectively based on their perceived

43. As argued above (see e.g. Section 3.1 and Box 1), what constitutes a competitive distortion is debatable and depends on the context. While some investment promotion measures can be less distorting (e.g. a general investment promotion of a country for investment from any partner country), measures which help only some types of investors with, for example, administrative procedures reduce costs of the project and may be equivalent in their economic impact to financial investment incentives. Depending on their definition, some of the FDI promotion measures could be classified as investment incentives and vice versa. This paper proposes an organising categorisation of ITT measures, but in fact these measures are on a continuum. Some may be similar in some respects (e.g. both investment promotion and investment incentives may be administered by one investment promotion agency) but they may also have some differences (e.g. in terms of the extent of their targeting on specific activities). Each of the measures is likely to have specific ITT and competition effects and may need to be considered individually.

technology transfer potential. However, both equity restrictions and screening measures can either be established specifically to optimise technology transfer from the point of view of the host economy or for other economic or non-economic reasons (e.g. strategic or security considerations)–which do not however preclude them from affecting ITT.

Some aspects of national policies with respect to foreign establishment are regulated at the multilateral level, most notably by the WTO General Agreement on Trade in Services (GATS) and the associated country Schedules of Specific Commitments, and at the bilateral or regional level in International Investment Agreements (IIAs) and investment chapters of preferential trade agreements (PTAs). For example, GATS Schedules of Specific Commitments specify horizontal and sectoral commitments of individual countries in the areas of market access (e.g. with respect to equity restrictions and joint ventures, authorisation, procedural and other legal requirements), as well as national treatment (NT) (where countries can indicate limitations on non-discrimination in national regulation and policies of like services provided by foreign investors). These commitments set maximum restrictions Member countries can apply (i.e. "bindings") but many countries in fact apply lesser restrictions in practice (e.g. Miroudot and Pertel, 2015). This means that currently there exists a margin within which countries can pursue more restrictive national policies without being in breach of their GATS commitments. Crucially, the agreement applies to services sectors only; beyond MFN and NT rules covering trade in goods under GATT foreign establishment in agriculture, natural resources or manufacturing sectors is not disciplined in the WTO.[44]

The OECD FDI Regulatory Restrictiveness Index (OED FDI RR Index thereafter; Kalinova, Palerm and Thomsen, 2010) provides a measure of the overall level of regulatory FDI restrictiveness, as well as scores in specific areas relating to foreign equity limits, screening and approval, restrictions on key foreign personnel and other restrictions (Item B.i in Box B). More detailed information on equity restrictions and other investment related measures, including some local content and performance requirements in services sectors is available in the OECD Services Trade Restrictiveness Index (STRI) and regulatory database. [45] The subsequent version of this paper will also draw from the STRI database, which is currently being updated to 2016.

Equity restrictions

An additional regulatory question that can be asked in this context is whether equity restrictions and joint venture requirements apply in specific sectors (Question B.1 in Box B). The literature indicates that this is the case in China, for example, where several restrictions are explicitly aimed at mandating technology transfer. In particular, China maintains a Catalogue for the Guidance of Foreign Investment Industries, which categorises investment as "encouraged", "restricted" or "prohibited". Restrictions are mainly concentrated in manufacturing of key automobile components (Catalogue, Section XIX), civil planes and ship equipment (Section XX). In addition, China sets restrictions in the communication sector (Section XXII). While the nature of the restrictions can differ from one case to another, in several instances the Catalogue sets joint-venture requirements. For example, manufacturing of electronic power steering (EPS) controllers (Art 206) and civil planes (Art 210) must be carried out in equity joint ventures.

In some cases, the requirement to set up joint ventures includes encouragement or obligation to transfer technology to the local partner (Question B.2 in Box B). Taking the case of China again, Art 43 of the Regulations for the Implementation of the Law on Sino Foreign Equity Joint Venture requires technology transfer agreements between the parties of the joint venture to comply with a list of stipulations

44. That said, the WTO TRIMS agreement restricts some trade-related investment measures which apply to investment but have an effect on trade in goods (e.g. a concession to establish in a foreign country conditional on local sourcing of material inputs). See section 4.C on performance requirements.

45. See: http://www.oecd.org/tad/services-trade/services-trade-restrictiveness-index.htm

favouring the importing party. For example, the conditions for mutual exchange of information between the parties should be reciprocal and, after the expiration of the agreement, the technology-importing party has the right to continue to use the technology.

Screening requirements

Unless they have undertaken international treaty obligations to the contrary (e.g. under GATS), host states have discretion in deciding the conditions under which foreign direct investment may be accepted (Shan, 2010). According to the screening and approval component of the OECD FDI RR Index, in 2015 several countries still applied screening procedures. The reasons for screening may be as disparate as preventing formation of cartels or maintaining national security. For example, in South Africa, the Competition Act (1998) requires screening and approval of Mergers and Acquisitions for public interest considerations, including the effect on competitiveness of specific sectors and employment. Similarly, in Lithuania, the Law on Enterprises and Facilities of Strategic Importance requires review of investments targeting "enterprises of strategic importance to national security". However, in some jurisdictions, screening is undertaken with the objective of assessing the potential impact of the proposed FDI on the economy. In some of these cases, technology-related considerations are amongst the specific determinants for approval of FDI by related regulatory agencies (GAO, 2008) (Question B.3 in Box B). In addition, in some cases approval can be conditional on releasing IPR-related information (Question B.4 in Box B).

In China, for example, Art 12 of the 2006 Provisions for Mergers and Acquisition of Domestic Enterprises by Foreign Investors requires Ministry of Commerce review for transactions where a foreign investor would take a controlling interest in a major domestic company or which would affect national economic security. While submission of technology-related information is not explicitly required, the Ministry of Commerce may require additional IPR-related documents in order to approve the transaction (Wehrle and Pohl, 2016). Government approval is also required for joint ventures, and this explicitly involves a significant exchange of technology-related information with officials. In particular, Chinese authorities retain the right to examine the machinery and proprietary technology provided by foreign parties, and require submission of documentation on industrial property or proprietary technology, including photocopy [sic] of the patent certificate or trademark registration certificates.[46]

In other cases, technology-related considerations during screening are less marked as they coexist with wider goals. For example, in Saudi Arabia, the Saudi Arabian General Investment Authority (SAGIA) establishes a foreign investment appraisal process in order to ensure that investments are associated with economic and social contributions. In particular, in order to grant FDI licences to scientific and technical offices, the SAGIA sets a range of requirements such as enhancement of the Kingdom's revenue, jobs to be provided to citizens and technological benefits to the economy. The Kingdom also requires renewal of such licences and keeps the right to revoke them should it deem that the investor is not contributing enough to the local economy.

Concessions for operating

Although they may be not targeted specifically at foreign investors, several countries also set additional restrictions related to licencing or concessions in specific sectors (Question B.5 in Box B). In Malaysia, for example, the Industrial Coordination Act 1975 requires manufacturing companies (both local and foreign) with shareholder funds of at least RM2.5 million or employing at least 75 people to hold a manufacturing licence. The licence is issued by the Ministry of International Trade and Industry on the basis of project consistency with "economic and social objectives" to "promote the orderly development of manufacturing activity in Malaysia" (Art 4, para 3). Amongst the conditions for approval, the Ministry considers technology-related aspects such as a certain score in a technical index and inclusion of the

46. The 2011 Notice and the 2011 Regulation detail information that must be submitted to gain approval.

project in a List of Promoted Activities and Products (MIDA). In addition, the guidelines used for approval of industrial projects in Malaysia are based on capital investment per employee; total full-time workforce; total number of staff at managerial, technical and supervisory levels or value added.

Box B. FDI restrictions and FDI screening

Readily available codified information:

B.i OECD FDI Regulatory Restrictiveness Index (overall and equity restrictions and screening components)

Additional regulatory information collected:

B.1 The country sets joint-venture requirements in specific sectors.

B.2 National legislation requires transfer of technology to the local partner in the joint-venture.

B.3 The country reviews FDI on the basis of potential technology-related benefit.

B.4 Companies may be required to submit IPR-related information to regulator to gain FDI approval.

B.5 The country grants business licenses conditional on the technological benefits of the projects undertaken.

FDI restrictions, FDI screening and concessions— use across countries

Figure 6 presents the overall OECD FDI RR Index and its equity and screening and approval components. It shows declining levels of FDI restrictions in most countries in our country sample. However, the levels of restrictiveness differ considerably across countries in both the developed and emerging sub samples. Malaysia shows the highest levels of overall restrictiveness and Germany the lowest.

Annex Figure 3 presents equity restrictions for a larger sample of countries with details by economic sector. Equity restrictions are not frequent and are concentrated in only a few sectors and countries. In 2015, the most restrictive foreign equity limits were recorded for Indonesia, China, Saudi Arabia and India.[47] In Indonesia and China, for example, the average index scores across all sectors suggest that restrictions were approximately equivalent to a requirement of minority domestic shareholdings.[48, 49] In most other countries, the average incidence of equity limitations was insignificant and reflected scattered restrictions in a few specific sectors. Among our countries, Malaysia had the highest average level of restrictions across sectors, start-ups and acquisitions—although (at 0.17) still below the minority domestic holding requirement.

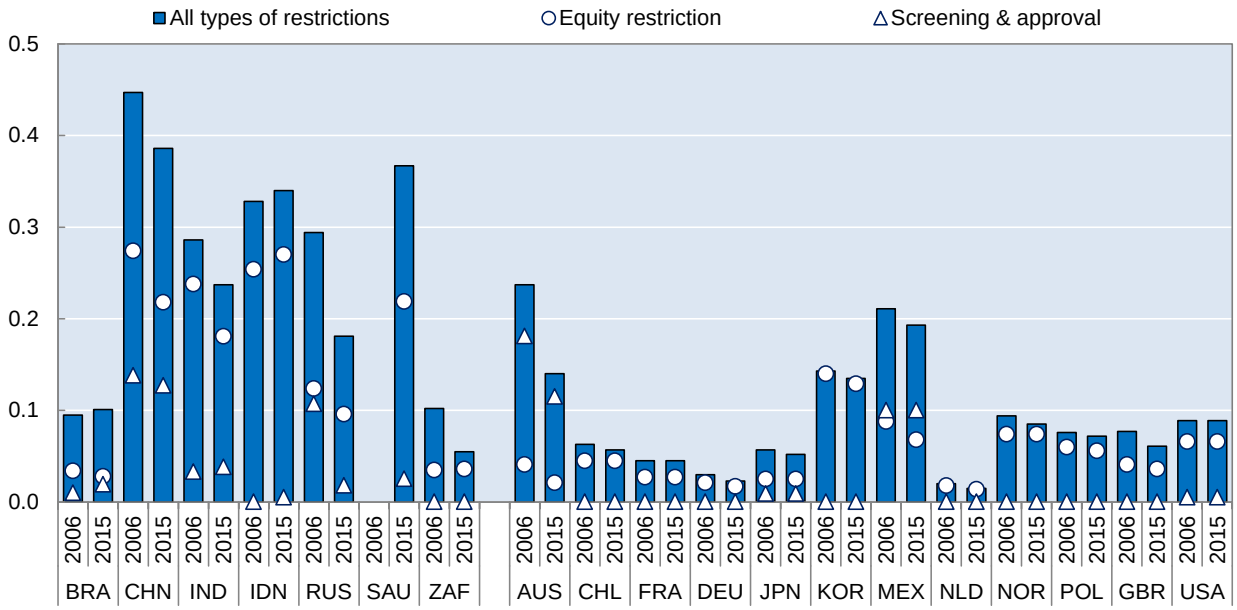
47. India modified its FDI policy in 2015 and 2016. FDI caps have now been removed for most sectors, including the automobile and defence industry. (see https://www.ukibc.com/india-guide/how-india/fdi-restrictions/ and http://thewire.in/44074/changes-in-fdi-policy-government-relaxes-norms-allows-100-fdi-in-defence-and-aviation/ and http://www.makeinindia.com/policy/foreign-direct-investment)

48. 0.25 is the value entered when minority domestic holding is a statutory requirement for investment in a given sector in a given country. Indonesia's score is 0.27 and China's is 0.22.

49. Although the minority holding requirements present in Indonesia, China, Saudi Arabia and India are unlikely to mean significant control by domestic firms, they can still mean effective access to technical information and know-how. A joint venture agreement can contain legal clauses restricting the use of such information beyond the scope of the venture but their effectiveness is *a prori* uncertain as it depends on the way any potential disputes might be resolved.

The OECD FDI RR data indicate that equity restrictions tend to be higher in *Radio and TV Broadcasting* and *Other media* (scores of 0.38 and 0.20 respectively), which are typically restricted for cultural, security and political reasons. *Air transport* (0.50) has traditionally been characterised by significant state control and protection of national flag carriers. Other sectors with relatively high restrictiveness include *Fisheries* (0.32), *Real estate investment* (0.24) and *Legal* services (0.21). Other individual country cases of strong equity restrictions also point to non-technological motives.[50, 51]

Figure 6. OECD FDI restrictiveness Index for selected developed and emerging countries



Note: Malaysia, Nigeria, Singapore, Thailand and Viet Nam are not included in the OECD FDI RR index.
Source: OECD FDI Regulatory Restrictiveness index

Manufacturing, which has traditionally been seen as a driver of innovation, technology transfer and technological development of other sectors (De Backer, Desnoyers-James and Moussiegt, 2015), records very low equity restrictions in almost all countries. The only exception is the transport equipment sector in China and Russian Federation. Another pocket of equity restrictions which may be related to technological motives, are the communications sector which include fixed and mobile telephony and other ICT activities. These are generally considered as highly IPR-intensive (OHIM, 2013) [52] and have seen dynamic innovation

50. For example, the Saudi Arabia General investment Authority Board (SAGIA) maintains a negative list for foreign direct investments which bans foreign participation in oil exploration, drilling and production. Such limitation may be interpreted as a way to maintain the public monopoly, as the sector is dominated by the state-owned Saudi Aramco.

51. There are also a few other cases in which foreign participation is fully excluded, as with real estate investment in India and Indonesia, fisheries in China and Saudi Arabia and legal services in Norway.

52. OHIM (2013) defines IPR-intensive industries as those having an above-average use of IPR per employee. For example , in the EU, the top 20 IPR-intensive industry by GDP are: rental and operating of real estate, engineering activities and technical consultancies, management consultancy activities, activities auxiliary to financial services, manufacture of motor vehicles, computer consultancy activities, computer programming activities, manufacturing of pharmaceuticals, wireless communication activities, wholesale of pharmaceutical goods, development of building projects, sport activities, wholesale of other machinery and equipment, research and experimental development on natural sciences and engineering, telecommunication activities, manufacturing of accessories for motor vehicles, extraction of crude petroleum, betting, buying and selling of real estate, advertising.

over the course of the last twenty years (Lugard, 2014). However, security and public service motivations cannot be excluded.

Half of the countries in the sample recorded a positive value for the screening and approval restrictions component of the OECD FDI RR. The countries with the highest value are China and Australia.

In China, the approval process for FDI is complex. Investors in non-prohibited sectors need to apply for antitrust review to the MOFCOM. The review process lasts 30 days but in some cases a second 90 day phase and a third "exceptional" 60 day phase may apply. Upon successful completion of the antitrust review, investors who obtain actual control on a Chinese company need to pass a national security screening. As part of the security screening, the MOFCOM sends the application to a Ministerial Panel, which requests written opinions from relevant government agencies. The relevant governmental agencies have twenty days to respond to the Ministerial Panel, which takes a final decision on the basis of the opinions received. Investors which pass the security review then have to ask for further approvals from the local Development and Reform Commission (DRC) for the use of the land and the general implementation of the project. Once the relevant DRC has approved a project, the investor needs to seek further approval from the local Commerce Department, which uses very broad criteria in making a decision, including the development of China's national economy and potential transfer of technology to local firms. This phase usually takes 20 days. Required documents for submission may also include confidential information.

In Australia, the regulatory framework for foreign direct investment requires approval to hold a substantial interest in Australian businesses valued above a certain threshold.[53] While to date only a few potential FDI deals were rejected under this procedure[54], investors need to apply to the Foreign Investment Review Board (FIRB), which examines the proposal and submits a recommendation to the Treasurer. The application is then approved or rejected by the Treasurer within 30 days from the application date. Acquisitions are approved unless they are "against the national interest". However, this concept is not clearly defined in the Act and Regulations governing FDI, giving the Treasurer discretion to determine what constitutes "national interest" on a case by case basis. Under the Foreign Investment Policy, relevant criteria include national security, competition, and impact on the economy. In particular, the Policy states that investments developing new technology are "less likely to be contrary to national interest". According to the Business Application Checklist, parties are required to submit information including details on investors, assets and commercial rationale. However, in the case of new businesses established by foreigners, applicants are also required to submit details of any patents, royalty, franchises or licensing arrangements.

Overall, while only a handful of countries have an official screening procedure, in reality many other measures related to investment promotion and facilitation can play similar roles in promoting investment of certain technological characteristics or in soliciting similar kinds of information from potential investors. Therefore the information collected on these questions should be interpreted in a broader context, including in combination with measures discussed in other sections of this paper.

Table 2 shows additional regulatory information on FDI and licencing requirements collected for this project (Questions B.1 through B.5 in Box B). At a glance, there are few such requirements in the countries under analysis, confirming the trend in the literature towards more open investment regimes. In particular, making FDI in technology-related sectors conditional upon joint ventures (B.1) or requiring direct transfer of technology to the local partner (B.2) are not found in most of the countries. This may be a result of

53. For example, for general business acquisitions the substantial interest is set at 20% and the threshold corresponds to USD 252 million.

54. For example, the 2001 takeover bid by Shell for the mining and exploration company Woodside Petroleum (Kalfadellis and Freeman, 2006).

awareness that such laws deter investors and may be counterproductive. However, such measures are still present in two developing countries, namely China and Nigeria. In particular, in Nigeria, oil and gas investment is limited to joint ventures and the foreign oil and gas operator has the obligation to transfer technology to the local partner (Art 44 of the Nigerian Oil and Gas Industry Content Development Act).

Screening on the basis of potential technology-related benefits (B.3) is present in only five countries. For example, in China, for a project to be approved, it should meet the requirements of mid and long term planning for national economic development, de facto meaning that the government will screen investment on the basis of its technology-transfer potential[55]. In Mexico, the National Commission on Foreign Investment will undertake a review for FDI in certain sectors such as operation of railway and shipping if the foreign investor owns the majority of shares after the acquisition. In this regard, Article 49 of the Foreign Investment Law specifies that the final decision is taken according to criteria including "technological contributions" and "contributions to productivity and competitiveness". In Viet Nam, the granting of a business license for several activities on a "conditional list", including for example infrastructure development for telecommunication networks, needs investment registration and approval. However, even if technology or sector targeting is one element of these measures, they seem to be predominantly motivated by security or broader economic reasons.

Submission of confidential information as part of the screening process (B.4.) is required in only four countries overall. For example, in Brazil, while screening mechanisms are not present for several sectors, investments involving royalties and technology transfer must be registered with Brazil's patent office, the National Institute of Industrial Property (INPI). Similarly for Australia, in the case of establishment of a new business by foreign applicants, details of any patent, royalty or licensing agreements must be submitted to the relevant authority. Note however that there are also benefits to registration of technology transfer agreements (see Section 3.3, Patents and licensing agreements) and some measures discussed here may also be playing that role.

Likewise, conditioning the grant of business licenses on the basis of the technological benefits of the project (B.5) is not common, with the exception of Malaysia, where technology-related aspects are amongst the criteria for granting manufacturing licenses for establishments of a certain size (as discussed above).

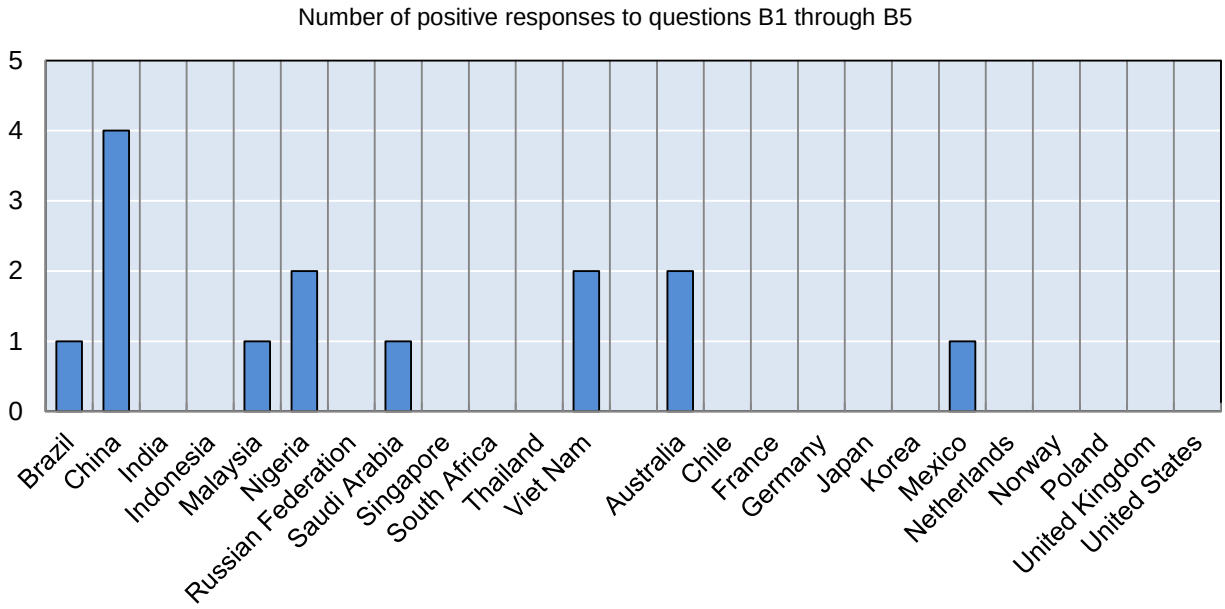
Table 2. FDI restrictions, FDI screening and concessions

	Question	Brazil	China	India	Indonesia	Malaysia	Nigeria	Russian Federation	Saudi Arabia	Singapore	South Africa	Thailand	Viet Nam	Australia	Chile	France	Germany	Japan	Korea	Mexico	Netherlands	Norway	Poland	United Kingdom	United States
B1	The country sets joint-venture requirements in specific sectors	no	yes	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
B2	National legislation requires transfer of technology to the local partner in the joint-venture	no	yes	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
B3	The country reviews FDI on the basis of potential technology-related benefit	no	yes	no	no	no	no	no	yes	no	no	no	yes	yes	no	no	no	no	no	yes	no	no	no	no	no
B4	Companies may be required to submit IPR-related information to regulator to gain FDI approval	yes	yes	no	no	no	no	no	no	no	no	no	yes	yes	no	no	no	no	no	no	no	no	no	no	no
B5	The country grants business licences conditional on the technological benefits of the project undertaken	no	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no

Source: Authors' elaboration.

55. https://www.uschamber.com/china%E2%80%99s-approval-process-inbound-foreign-direct-investment-impact-market-access-national-treatment

Figure 7. Summary chart: FDI restrictions, FDI screening and concessions



Note: This figure graphically summarises the information from Table 2 above. When interpreting it, it should be remembered that the different measures likely have very different impacts on technology transfer, the quality of such transfer and competition. Some measures may more important than others. Therefore, the number of measures that a country has adopted is only a rough measure of that country's commitment to attracting foreign technology and facilitating its spillover.

Source: Authors' elaboration.

FDI restrictions and FDI screening—preliminary observations on effectiveness in terms of technology transfer and impact on competition

The use of FDI restrictions and screening, but also performance requirements and investment incentives discussed in the following sections of this paper, has become a delicate balancing act especially in the context of GVCs where the most successful and technologically advanced goods and services are bundles of tasks and inputs originating from multiple regions and countries. One of the principal policy implications of GVCs is that, aside from being competitive in a task or product, participation in GVCs requires intensive and multidirectional movement of parts and components, services, technology and assets within and across borders. National success depends thus very much on international factors (e.g. Cadestin et al., 2016). Some performance requirements such as, for example, strict foreign ownership limits or local content measures, may be counterproductive in the sense that they deter GVC activities and thus reduce the potential for ITT.

Nevertheless, GVCs are not just about foreign sourcing but also about imperfect competition, product differentiation, rents and monopoly powers. The distribution of economic gains in GVCs thus depends not only on trade costs and competitive advantages but also on power and governance structures underlying them (Kaplinsky, 2001). This led some commentators to question the extent and indeed desirability of opportunities associated with GVCs for developing countries (e.g. UNCTAD, 2014). These observers argue that the emergence of value chains, and in particular the asymmetries in the governance structures that underpin these, offer limited gains to the developing world. Thus, they see a stronger role for governments in regulating and shaping GVC participation. This view of GVCs argues for a careful consideration of measures that can rebalance the distribution of gains from GVCs.

According to the literature there is a degree of ambiguity regarding the effectiveness of FDI restrictions and screening in terms of their impact on technology transfer.

In general, it seems that foreign equity restrictions and forced joint ventures are neither necessary nor sufficient conditions for technology transfer. Moreover, it seems that, even if in some cases they have been argued to have made a positive contribution, in a majority of cases such measures are highly ineffective. In particular, joint venture requirements yield three risks.

First, mandatory joint ventures may suffer from a lack of trust between the partners, especially when the local partner has little to offer (UNCTAD, 2003), and this may lead to reluctance to transfer the latest technology available. Moran (2002), for example, estimates that technology employed in mandatory joint ventures tends to be on average 3 to 10 years out of date, while technical training provided to local staff is less intensive than that provided in wholly owned subsidiaries. Focusing on China, Chang (2013) finds that firms in technology-intensive industries forced to enter into a joint venture tend to refrain from bringing in advanced technology or adopt strict measures in order to prevent technology leakages.

Second, mandatory joint ventures may be at higher risk of failure than wholly owned subsidiaries. Cosbey and Mann (2014), for example, found that among 50 agricultural joint ventures set up in Nigeria in the mid-eighties, only 10 were still operating in the 1990s. While there may be a range of factors at play, Cosbey and Mann (2014) suggest that reliance on older technology or other constraints related to the mandatory nature of joint ventures mentioned above are amongst the principal causes.

Third, such requirements may discourage investment and cause foreign firms already present to leave for formal or compliance reasons. For example, in India in 1973 the Foreign Exchange Regulation Act capped foreign equity to 40 percent for new projects and required existing foreign-owned companies to dilute their equity holdings. While some companies such as Colgate Palmolive complied with the law, others such as IBM left. Discretion in the application of the law at the time also made investment decisions in the country subject to uncertainty (UNCTAD, 2003).

That said, there is debate in the literature about whether some joint venture mandates may have sped up technology transfer and also led to positive externalities, and to what extent these effects depended on timing of adopting and removing these measures as well as the accompanying sourcing and marketing requirements. For example in Malaysia, at a time when legislation stipulated that foreign investors needed to seek Malaysian partners to create joint ventures, Proton, a joint venture between Mitsubishi and a Malaysian state-owned enterprise, led to the development of the first Malaysian-designed car and the capacity building of local suppliers and manufacturers of key components (Ricken and Malcotsis, 2011).

Proton was destined mainly for the local market and was intended to be based on local inputs.[56] It eventually developed its own engine and Proton cars are still produced in Malaysia today but Proton struggled with competitiveness due to relatively high production costs which Baldwin (2011) argues was related to the fact that local sourcing was at odds with global sourcing practices and economies of scale which started to prevail in the automobile GVCs at the time. In contrast, Korea used similar measures at an earlier stage and now boasts booming exports of cars, car parts, and cost effective imports of cars. This, Baldwin (2011) contends, is because they managed to build an efficient supply chain *before* the appearance of GVCs.

Baldwin (2011) further contrasted the Malaysian strategy with that of the neighbouring Thailand which started with similar ambitions to Malaysia but more quickly and pro-actively addressed global market forces. Towards the 1990s, Thailand relaxed trade and ownership restrictions. It kept some local content requirements, such as requiring engine assemblers to use only engine parts that had undergone specific local processing. These requirements are argued to have had some success, with Japanese joint venture partners implementing advanced technology in local factories that built up Thai industrial capacities. Thailand then launched the 1993 “Export Promotion Project” that provided a package of

56. Athukorala (20140 reports that the government and Mitsubishi clashed on several issues including local content and exports, both of which the government of Malaysia wanted to increase and Mitsubishi resisted.

incentives for assembling automobiles for export such as tariff exemptions on parts and an 8-year tax holiday. Local content restrictions were eliminated in 1998 and tariffs and excise taxes were liberalised in 1999. The goal was to take part in the GVCs of as many large car making firms as possible and to be able to source competitive inputs from abroad; according to Baldwin, it worked.[57]

Another Malaysian join-venture case shows that the objective of local marketing may have been an additional important constraining factor in the case of Proton. Another mandated joint-venture in Malaysia with General Motors which, in contrast to Proton, was designed to serve export markets was profitable because of this export orientation (Kehl, 2009). The venture with General Motors also led to positive externalities in terms of the construction of a high-tech telecommunications satellite for Malaysia by a subsidiary of General Motors. According to Kehl (2009), this would have not happened without the presence of the foreign company in the country, although it remains unclear whether a mandated joint venture was the only way of attracting foreign investors and what where the negative effects of these policies.

With regard to specific requirements to transfer technology to the local party of the joint venture, all the risks discussed above are likely to be present, but the literature suggests, in addition, that the effectiveness of this policy is conditional upon the presence of significant incentives or subsidies and the size of the market. For example, when in 2005 China required foreign companies bidding on high-speed railway projects to form joint ventures with state-owned equipment producers and transfer to them the latest designs, most companies complied with these strict requirements (Hout and Ghemawat, 2010). This was, however, arguably due to the attractiveness of the Chinese market and to the incentives offered by the government, which makes this strategy hard to replicate.

The effectiveness of review mechanisms for possible FDI on the basis of potential technology-related benefits and the granting of business licences on the basis of the technological benefits of the project undertaken is also less clear. In particular, selectively allowing companies to enter the market does not necessarily imply that these companies will transfer technology to local firms and it may deter some potential transferors. However, as we have seen above, technology-related considerations during screening usually coexist with wider goals and both their ITT and competition effects will depend on how exactly these reviews are conducted.

FDI restrictions, while not necessarily effective in promoting technology transfer, may have distortionary impact on global markets and local industries. First, the selective nature of the restrictions based on priority sectors and industries means that companies are treated differently. For example, in Malaysia in the past, joint-ventures in the automotive industry were subject to different treatment on the basis of the destination of their supply (local versus international markets). Second, the fact that in some cases the application of equity restrictions and technology transfer requirements is subject to negotiation and includes some discretion, as in the case for India and China, may be non-transparent and may serve to favour some companies over others, therefore possibly causing further distortion. Finally, the frequent dependence of these policies on higher tariff and non-tariff barriers in order to force foreign companies to produce in the country (Long, 2005) may further hamper competition.

That said, as for the case of investment promotion, there is no rigorous and comprehensive empirical literature accounting for the technology transfer and distortionary impacts of FDI restrictions and screening measures. Further research on this topic could shed light on the areas which need further regulatory attention.

57. See also the discussion of the importance of foreign content in the automobile industry in the forthcoming OECD paper on spectral GVC issues in developing countries, including the automobile industry (OECD, 2017).

3.6 Technology-related performance requirements

Performance requirements can be defined as "stipulations imposed on investors requiring them to meet certain specific goals with respect to their operations in the host country" (UNCTAD, 2003). They are usually conditions to receive authorisation to do business in the country (Shan, 2010; Nikièma, 2014) Performance requirements have often been presented as a way to maximise the benefits from FDI and to offset asymmetries in bargaining power between foreign firms and the host country firms and workers, especially over terms of investment and distribution of gains from GVC activities (e.g. employment conditions, technology transfer, training, local sourcing) (WTO, 2002; UNCTAD 2013, 2014). In particular they have been used in natural resource sectors and economies with large domestic markets. For example, several countries have leveraged their ownership of scarce natural resources to increase the use of local inputs by foreign firms (e.g. granting of an FDI licence on condition of a certain local content of production) or to achieve social outcomes (e.g. employment). ITT-related performance requirements aim at strengthening domestic capacity in the regulated sector (e.g. Cosbey, 2015) and include obligations to transfer technology, invest a certain amount in research and development (R&D) activities and train local workers.

Some types of performance requirements are regulated at the multilateral level in the WTO Agreement on Trade-Related Investment Measures (TRIMS) which prohibits investment measures which can restrict or distort trade. The TRIMS Agreement refers to GATT Article III (national treatment) which requires countries not to discriminate between imports and like domestic products, and prohibits investment measures requiring a "purchase or use by an enterprise of products of domestic origin or from any domestic source". Referencing GATT Article XI (prohibition on quantitative restrictions), it bans investment-related restrictions on importation or exportation of goods which can be specified in terms of either restrictions or bans on specific products, or conditions on volume of imports and exports or their proportions, in particular in relation to domestic production (Annex to TRIMS). Therefore, according to the TRIMS Agreement, states cannot impose on firms local content requirements, some of which could be put in place with a view of encouraging technology transfer.

However, the TRIMS Agreement is rather limited in its ability to discipline other ITT-related performance requirements. First, the aim of the TRIMS Agreement is to regulate investment-related measures that violate national treatment and quantitative restrictions obligations and privilege domestic sourcing. In trying to encourage ITT, many measures are designed to work in the opposite direction; they require or encourage the use of foreign technology. Second, the TRIMS Agreement applies only to trade in goods and neither the GATS nor the TRIPS Agreement have comparable disciplines on performance requirements. Third, the TRIMS Agreement does not cover government procurement, therefore leaving to governments the freedom to discriminate against foreign suppliers themselves or to impose local content requirements. In sum, several performance requirements related to technology transfer such as obligations to transfer proprietary technology[58], perform R&D, or deliver training, can be deemed TRIMS Agreement-compliant.

TRIMS-plus provisions in international trade and investment agreements

It is in this context that some preferential trade and international investment agreements contain additional obligations, often labelled "TRIMS-plus provisions", such as prohibitions of requirements to transfer technology, act as an exclusive supplier, locate the headquarters of the investor in a specific region, hire a percentage of nationals or locate research and development activities domestically. For example, the North American Free Trade Agreement (NAFTA)—the first agreement to introduce such provisions—prohibits any requirements to "transfer technology, a production process or other proprietary

58. Requirements within the scope of the law may be, for example, licensing or sale of intellectual property (e.g. Guadamuz, 2000).

knowledge" "in connection with the establishment, acquisition, expansion, management, conduct or operation of an investment of an investor of a Party or of a non-Party in its territory" (Art 1106). Similar language is included in Art 8 of the United States Model Bilateral Investment Treaty which has been used as a framework for other treaties in the international arena. Art 9.10 para 1 of the Trans-Pacific Partnership (TPP), for example, forbids technology transfer and exclusive supply requirements as a condition for receiving authorisation to operate.

Similar prohibitions are contained in some agreements signed by Japan, such as the Japan-Viet Nam BIT, which, in relation to investment authorisation, forbids requirements such as transferring proprietary technology to a person in the jurisdiction (Art 4 para 1g), locating the headquarters in a specific area (Art 4 para 1h), achieving a given value of research and development in the area (Art 4 para 1i) or supplying one or more goods exclusively from the area in which the investment takes place (Art 4 para 1j). However, other jurisdictions have not included performance requirements provisions in their treaties. For example, in the EU, most member countries' investment agreements do not usually contain specific provisions prohibiting performance requirements (Dimopoulos, 2011).[59] The EU-Canada Comprehensive Economic and Trade Agreement (CETA) is amongst the few treaties containing such provisions.

Interestingly, all treaties which currently discipline technology-related and other performance requirements do so not only with respect to investments from the treaty Parties but to investment from non-Parties. This means that countries which have at least one such agreement have committed not to impose technology transfer-related performance requirements on any investments (see Question C.1 in Box C).

Box C. Performance requirements

Readily available codified information:

None

Additional regulatory information collected:

C.1 The country does not have a PTA or BIT where performance requirements related to technology transfer are explicitly prohibited.

C.2 Firms are required to disclose either software source code to government agencies.

C.3 Local data storage requirements are present.

C.4 Jurisdiction requires a quota or other target of national employees.

C4i If C4=yes, does this apply to specific technical or management positions?

C.5: Jurisdictions either require or encourage training of national employees or substitution of foreign with national employees.

C.6: Investment in country-based R&D is required.

C.7. A country applies local content requirements.

C.7i. If C7=yes, do these apply in specific sectors?

C.8: In its procurement, the government accords preferences to local suppliers or local content in specific sectors.

That said, only a handful of countries have agreements with TRIMS-plus provisions on performance requirements and national policies regarding performance requirements tend to vary. Some jurisdictions impose requirements such as handing over of source code for information technology, local data storage or hiring of national employees.

59. Dimopoulos (2001), EU Foreign Investment Law.

Handing over of source code

Concerns have been expressed by the business community about new measures in high-technology industries and in particular ICT (traditional software, but also new technologies such as cloud products and services) which require the transmission of proprietary information or transfer of technology as a condition of market access. Such measures include requirements to disclose sensitive designs – such as via conformity assessments that require the disclosure of source codes and encryption keys; domestic standards which do not follow international standards, challenging interoperability and forcing foreign firms to partner with domestic firms; and restrictions on the free flow of data and information, which require partnerships with domestic firms for the use and development of local data centres (USITC, 2010; USITO, 2013).

Source code is any collection of computer instructions which are processed and executed and which are usually kept encrypted in order to protect proprietary information. In some cases, jurisdictions may require handing over of source code as a condition for authorisation to do business or for a licence. Usually these requirements are motivated by security or data protection considerations but the concern remains that in some circumstances such requirements may be vehicles for transfer of technology and that they may deter investment (Question C.2 in Box C).

In China, for example, the China Banking Regulatory Commission (CBRC) Notice 317 –recently suspended- required 75% of the technology supplied to Chinese banks to be "safe and controllable" by 2019. In order to fulfil this condition, firms were required to disclose to the CBRC the source code of the software and firmware supplied to Chinese banks. Although the Notice was suspended for revision in 2016, the new Cybersecurity Law contains provisions requiring tech companies to provide unspecified "technical support" to security agencies, potentially including source code.[60] Similarly, in Indonesia, Article 8 of Regulation n. 82 of 2012 on the Operation of Electronic Systems and Transactions requires providers developing software created specifically for a government agency[61] to submit the source code and documentation of the software concerned either to the agency itself or to a third party.

Localisation of data storage

Localisation of data storage can also be seen as a performance requirement with consequences for transfer of technology, as proprietary information and trade secrets may leak or be accessed by local firms if relevant laws do not ensure sufficient protection (Question C.3 in Box C). The legal landscape on data storage is heterogeneous. While most countries do not oblige foreign investors to localise all data[62], others have implemented regulations requiring local data storage (OECD, 2016). In some jurisdictions, data storage requirements are motivated by law enforcement or security objectives.[63, 64] However, in some

60. http://knowledge.freshfields.com/en/global/r/1514/china_introduces_comprehensive_new_cyber_security_rules (accessed on 16 August 2016).

61. Legislative, executive and judicial institutions, according to the definitions in the regulations.

62. For example, Chile, France, Germany, Japan, Korea, Mexico, the Netherlands, Norway, Poland, the United Kingdom, the United States, Brazil, India, Malaysia, Saudi Arabia, Singapore, South Africa and Thailand. In Russian Federation, local data storage is required only for personal information (Law FZ-242). That said, an OECD (2016) business survey indicated that firms could find it difficult or costly to separate personal from other data.

63. In Australia, for example, the Telecommunications (Interception and Access) Amendment (Data retention) Bill 2015 requires telecommunications service providers to locally retain for two years data including the source of the communication, the destination of the communication and the type of service used (Art187AA). The Bill also requires service providers to protect the confidentiality of information by means of encryption and preventing unauthorised access. However, in the spirit of the law, the Communications Access Co-Ordinator may grant exemptions by taking into account "the interest of law enforcement or national security" (Art 187K

countries local data storage requirements are motivated explicitly by technology transfer. This seems to be the case in Nigeria, for example. The Guidelines for Nigerian Content Development in Information and Communications Technology 2013 require firms to host data locally with the explicit purpose of supporting local firms on employment and improvement of technical capabilities. In addition, no clear provisions require data confidentiality.

Requirements to hire national employees

Several jurisdictions impose limitations on the business activities in which non-nationals may engage or stipulate targets for national employees (Question C.4 in Box C). While these are likely to be motivated principally by employment objectives[65], technology transfer is also at stake given the role of human capital in managing knowledge; in technology-related sectors in particular, there are important demonstration effects (Saggi, 2004) through which employees may absorb the technology and knowledge from foreign investors and then apply it outside the boundaries of the firm. In some cases the objective is to provide local workers with the opportunity to learn from foreign colleagues. In particular, targets on specific technical or management positions or requirements with respect to employment categories of certain skill characteristics have the potential to influence ITT (Question C.4i in Box C). In addition, provisions may require a training plan for local personnel or require or encourage a gradual substitution of local for foreign employees (e.g. Korinek and Ramdoo, 2016) (Question C.5 in Box C).

Some relevant examples include Thailand's Alien Employment Act and Alien Business Act which mandate the hiring at least four Thai workers for every one foreign worker. Moreover, foreigners cannot engage in a range of professions including civil engineering and architecture. In Indonesia, Law No. 13, 2003 requires employers of a foreign worker to appoint an Indonesian citizen as a working partner to facilitate transfer of technology. Employers employing foreigners are also obliged to train Indonesian workers to promote substitutions of foreigners by nationals (Art 45). Moreover, employers cannot hire foreign persons who have less than five year work experience in their sector. In Brazil, according to Art 254 of the Labour Law, two thirds of employees should be Brazilian nationals, unless Brazilian specialists in the field are unavailable. In India, employers may employ foreigners only for some technical roles, including consultants on contract, IT support, engineering and senior management, and employment is conditional upon the absence of any qualified Indian national available to do the job.

Requirements to invest in R&D

In some cases, jurisdictions require firms to invest in R&D locally, which may be a vehicle for technology transfer (Question C.6 in Box C). For example, in Brazil, concession contracts for exploration and production of oil and gas include a clause requiring concessionaire companies to invest at least 1% of their gross revenue in R&D, when exploring larger oil and gas fields. Half of the amount should be allocated to the company's own R&D facilities or, if these are not present, in national companies, while the other half should be invested in R&D institutions accredited by the National Agency of Petroleum, natural Gas and Biofuels.

para 7). Similarly, in Indonesia, the Government Regulation no.82 of 2012, requires operators to place their data centres in Indonesia (Art 17.2) but to also ensure confidentiality of the source of the software (Art. 9). Information may nonetheless be disclosed to the relevant authorities for criminal prosecution purposes (Art.17. 3).

64. In Viet Nam, for example, the Decree on management, provision, use of Internet services and online information 2013 requires organisations providing information services on mobile networks to maintain at least one server system in Viet Nam (Art. 28 para 2).

65. In some cases, the objective is to protect some traditional activities such as local craft.

Local sourcing requirements

Some countries require firms to source locally. In Nigeria, the government favours local content requirements in the oil and gas sector and in the information technology sector (Box 2). Some of these local sourcing requirements apply in specific sectors on the basis of their technology characteristics (see Questions C.7 and C.7i in Box C).

Box 2. Local sourcing and related technology transfer measures in Nigeria

According to the Nigerian Oil and Gas Industry Content Development Act, "all regulatory authorities, operators, contractors, subcontractors, alliance partners and other entities involved in any project" are required to "consider Nigerian content as an important element of their overall project development" (Art 2). In bidding for licenses, operators should submit a Nigerian Content Plan to the Nigerian Content Development and Monitoring Board (NCDMB), including provisions giving "first consideration to services provided from Nigeria and goods manufactured in Nigeria (Art 10 para 1a). Moreover, the plan needs to show preference for training and employment of Nigerian people (Art 10 para 1b).

The Guidelines for Nigerian Content Development in Information and Communication Technology (ICT), set similar local content requirements to be applied by both original equipment manufacturer (OEM) and original design manufacturers (ODM). According to Article 10.1 OEMs need to ''maintain at least 50% local content by value either directly or through outsourcing to local manufacturers"' (Art 10.1 para 3) and keep in-country R&D departments. ODMs are required to "maintain local capacity to assemble and install at least one million devices per annum". The Guidelines set even stricter requirements for ICT service provisioning, which need to use only manufactured SIM cards for the provision of telephone services (Art 12.1 para 3), deal exclusively with local companies to build "sites, tower and stations" (Art 12.1 para 7) and use Nigerian companies for the provision of 80% value added after the second year of operations (Art 12.1 para 8)

The implementation of these local content requirements has been widely criticised by the United States, Australia and the European Union as inconsistent with the GATT (see WTO, 2014; G/TRIMs/M/36). In particular, Australia asked for clarification of the TRIMS consistency of Section 11 of the Act, which establishes a minimum percentage of Nigerian content in goods, services and investment for oil and gas projects. To date, no formal decision regarding infringement of the TRIMS has been taken at the WTO.

In addition to content requirements, some provisions of the Nigerian Oil and Gas Industry Content Development Act favour both inter-firm technology transfer and disclosure of confidential information to the NCDMB In particular, the Act sets the obligation for oil and gas operators to set out programmes aimed at promoting transfer of technology from the operator to the local partner (Art 44). Operators should also encourage the formation of joint ventures and licensing agreements as channels of technology transfer between Nigerian and foreign contractors (Art 45) and submit a report to the NCDMB detailing these initiatives and their results. The NCDMB also monitors research and development (R&D). In particular, the operator is required to submit to the NCDMB, every six months, an outline of any upcoming R&D initiatives, including a breakdown of the expected expenditures (Art 38, para 2a). Moreover, there is a risk that the information disclosed to the government agency may leak to local firms.

Local content requirements in government procurement

Performance requirement-related measures can also take the form of requirements for preferential market access in government procurement in specific sectors according to their technology characteristics. (Question C.8 in Box C). While the 1994 Government Procurement Agreement (GPA), revised in 2012, specifically states that each Party should provide non-discriminatory treatment to suppliers of any other Party (Art 3, para 1), only 42 countries are currently part of the Agreement. In India, for example, which is not a party to the GPA, local content requirements are present for public procurement in electronic products. A 2012 Notification from the Department of Telecommunication gives preferential treatment to nationally manufactured products which have security implications for the country. The list includes, for example, broadband and wireless equipment. A 2013 Notification from the Department of Electronics and Industrial Technology also lists 18 products, including photocopiers, PC Projectors, scanners and ATMs. Similar policies have been implemented in public procurement in Brazil, which has local content requirements for 4G telecommunications, and in South Africa, which accords preference to national

suppliers for electrical components (Kedia, 2014). Preferences given to local suppliers in this way may be an incentive for foreign investors to licence technology to local firms or to manufacture them locally, with implications for ITT.

Performance requirements—use across countries

The regulatory information collected according to the proposed taxonomy (Table 3 and Figure 8) indicates that technology transfer-related performance requirements are not pervasive in developed countries, although they still seem common in the emerging part of the group, especially regarding sectoral local content requirements in government procurement, local employee quotas and provisions setting training requirements and requiring substitution of foreign with national employees.

At the supranational level, most developed countries under analysis have signed PTAs or BITs explicitly prohibiting performance requirements related to technology transfer (C.1), in the developing country group only two countries, namely Singapore and Viet Nam, have included this clause in the Singapore-Korea FTA and in the US-Viet Nam BIT respectively. This does not necessarily mean that these countries allow or endorse performance requirements related to technology transfer but it does mean that they can apply such policies without breaching international agreements.

Only three countries, mainly developing countries such as China and Nigeria, require firms to disclose software source code to government agencies (C.2). In Russian Federation, the Government has recently suggested that Apple should disclose its source code to make sure the software is not used to spy on Russian citizens. However, the lack of codification of this suggestion into law raises doubts regarding its actual implementation.

Similarly, local data storage (C.3.) is required in only eight countries. For example, in Indonesia, Regulation no 82 of 2012 requires operators to place their data centres within the country. In Nigeria, similar requirements are present with the purpose of supporting local firms and employment. Whilst India does not have any data storage requirement, according to the National Telecom M2M Roadmap, all application servers servicing customers in India should be located in the country. However, this has not yet been transposed into law.

Half of the countries surveyed have targets regarding national employees (C.4) and in six countries these apply specifically to technical or management positions (C.4i). For example, in India, companies operating in the telecom and broadcasting industry must ensure that the majority of their board of directors are Indian nationals. In Russian Federation, the ratio of Russian employees in a subsidiary of a foreign bank is set at 75%. Moreover, at least 50% of the bank's managing body should be composed of Russian citizens.

Eight jurisdictions also require or encourage training of national personnel or substitution of foreign with national employees (C.5). In Malaysia, the government envisages training and gradual substitution of Malaysian staff for foreigners in technology-intensive sectors. Most posts are fixed term, with duration depending on the industry. For example, in R&D companies, foreign employee employment is limited to five years. In Saudi Arabia, the Labour Law requires all non-Saudi contracts to be fixed terms. At the same time, establishments employing more than 50 people must train at least 12% of their Saudi national employees with a view to enhancing their technical skills and making them suited to replace non-Saudi employees.

Only three countries have local R&D requirements (C.6). Brazil, for example, has a R&D investment clause in contracts for exploration, development and production of oil and natural gas.

Data collected for the countries under analysis show that local sourcing requirements (C.7.) are still present in some form in seven developing countries whilst no OECD country contains these provisions. In five of these seven countries, the approach to local sourcing is sectoral (C.7.i). In China, local sourcing

requirements have long been present in the automotive industry. While upon accession to the WTO, these requirements have been removed from official laws, evidence shows that they are still informally applied through financing arrangements and government suggestions. In Indonesia, according to a 2015 Regulation, smartphones within the 4G LTE spectrum that are sold on the Indonesian market need to have 30% local content in both hardware and software. Local sourcing requirements are also present in South Africa. As part of the Broad-Based Black Economic Empowerment Policy, an important element in eligibility for doing business with the South African government is working with local suppliers. These measures apply across all sectors (C.7i).

Governments of nine developing countries accord preferences to local suppliers or local content in specific sectors in their procurement (C.8). For example, in Viet Nam, legislation restricts international bidding in government procurement of machinery and pharmaceuticals. Similarly, in Indonesia, a 2009 Regulation requires the state-owned electricity company and oil and gas company to source a certain proportion of their components from local manufacturing. In Russian Federation, federal and municipal bodies have been instructed to procure only vehicles manufactured in Russian Federation, Belarus and Kazakhstan.

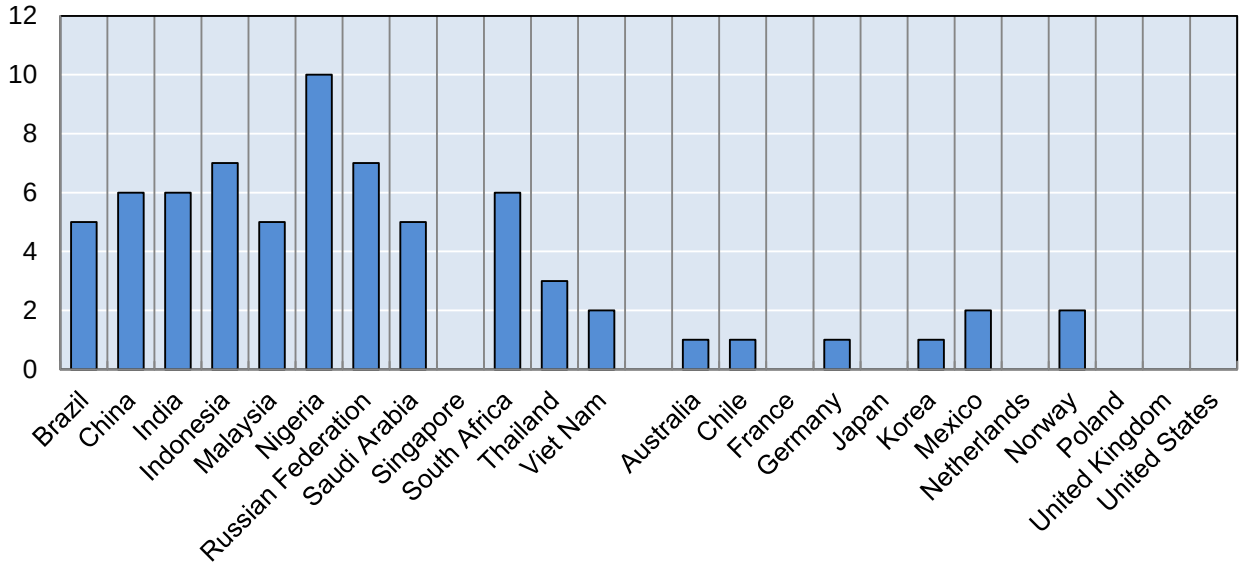
Table 3. Performance requirements

	Question	Brazil	China	India	Indonesia	Malaysia	Nigeria	Russian Federation	Saudi Arabia	Singapore	South Africa	Thailand	Viet Nam	Australia	Chile	France	Germany	Japan	Korea	Mexico	Netherlands	Norway	Poland	United Kingdom	United States
C1	The country does not have a PTA or BIT where performance requirements related to technology transfer are explicitly prohibited	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	no	no	no	no	no	no	no	no	yes	no	no	no
C2	Firms are required to disclose software source code to government agencies	no	yes	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
C3	Local data storage requirements are present	no	yes	no	yes	no	yes	yes	no	no	no	no	yes	yes	no	no	yes	no	yes	no	no	yes	no	no	no
C4	Jurisdictions require a quota or other target of national employees	yes	no	yes	yes	yes	yes	yes	yes	no	yes	yes	no	no	yes	no	no	no	no	yes	no	no	no	no	no
C4i	If C4=yes, does this apply to specific technical or management positions?	no	n/a	yes	no	yes	yes	yes	no	n/a	yes	no	n/a	n/a	no	n/a	n/a	n/a	n/a	no	n/a	n/a	n/a	n/a	n/a
C5	Jurisdictions either require or encourage training of national employees or substitutions of foreign with national employees	yes	no	no	yes	yes	yes	no	yes	no	yes	yes	no	no	no	no	no	no	no	yes	no	no	no	no	no
C6	Investment in country-based R&D is required	yes	no	no	no	no	yes	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no
C7	A country applies local sourcing requirements	no	yes	yes	yes	no	yes	yes	yes	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no
C7i	If C7=yes, do these apply in specific sectors?	no	yes	yes	yes	no	yes	yes	no	n/a	no	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C8	In its procurement, the government accords preferences to local suppliers or local content in specific sectors	yes	yes	yes	yes	yes	yes	yes	yes	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no

Source: Authors' elaboration.

Figure 8. Summary chart: performance requirements

Number of positive responses to questions C1 through C8



Note: This figure graphically summarises the information from Table 3 above. When interpreting it, it should be remembered that the different measures likely have very different impacts on technology transfer, the quality of such transfer and competition. Some measures may more important than others. Therefore, the number of measures that a country has adopted is only a rough measure of that country's commitment to attracting foreign technology and facilitating its spillover.

Source: Authors' elaboration.

Performance requirements—preliminary observations on effectiveness in terms of technology transfer and impact on competition

Many of the qualifications associated with the use of FDI restrictions in the context of GVCs, which were discussed above (see Section 3.5), apply equally to performance requirements; it is not clear to what extent countries can use local content requirements, for example, and still be able to attract activities that would result in ITT.

In addition, the literature on the effectiveness of performance requirements in terms of technology transfer is mixed. Urata and Kawai (2000), for example, analysed Japanese FDI in Asia and found that performance requirements were not a determinant for intra-firm transfers of technologies. Similarly, when studying the imports of technology from the United States by American companies operating in 33 host countries, Blomstrom et al. (2000) found that technology transfers were negatively correlated with the imposition of performance requirements in the host countries.

In contrast, Gallagher and Shafaeddin (2009), for example, made a positive case for the use of certain performance requirements, arguing on the basis of the potentially negative impacts that full-fledged liberalisation can have for local industries if no tools rebalancing the playing field are put in place[66]. In their view, different stages of technological development may require different types of investment requirements. Much depends on the specific context and design of measures but they argue that, in some cases, during the initial phase of economic development, certain performance requirements may be useful to help build domestic technological capabilities.

66. There is significant debate, of course, on this issue. Others point to the role of market opening in raising standards in local firms, or the best way to raise the performance of local firms in the context of market opening.

Mandatory quotas or other forms of targeting employment of national employees, which aim to integrate the local workforce into multinational companies, can be a way to expand the impact of technology transfer beyond the firm level (WIPO, 2014). According to Faro (2016), who analysed local content regulations in the oil and gas sector in Latin America, the wide use of local employment strategies can be traced back to four factors. Benefits or impacts can be seen relatively quickly and local employment measures are relatively easy to administer. Such requirements are also very visible and thereby projects receive the social license to operate. In fact, if the skills are available in the host country market, companies themselves have an interest in building such a social licence with local population and are often seeking to hire locally (Korinek and Ramdoo, 2016). Moreover, local hiring can help them to reduce the wage bill given that expatriate packages are often more expensive.

However, as argued by Korinek and Ramdoo (2016), natural resources may be different from other sectors in important ways—most notably, that as the relevant resources are owned by the state (and thus citizens), and being made available to private companies, there is a much stronger case for insisting on certain benefits for society in return. Also the social or environmental impacts of large scale resource extraction projects are often qualitatively different from investing in, for example, manufacturing or services activities, given the need for, for example, resettlement. Moreover, investment in natural resource sectors is determined by the geographical location of those resources, rendering investment climate considerations less potent than for other sectors. It is therefore unclear to what extent national employment requirements can be effective beyond natural resources, although their relatively widespread use in developing countries beyond natural resources documented in the literature and in this paper suggests that there is such an expectation.

In order to be effective, local employment quotas need to be paired with efforts to build skills and absorptive capacity of the local workforce (see also Section 3.2). The latter can be attained through training but the local employment requirements can result in highly distortive effects if the local workforce is unskilled and there is a large absorptive capacity gap between the skills required and the skills available. This may cause problems for investors and hamper the investment climate. Therefore, a failure to tackle absorptive capacity and roll out efficient supportive education and training courses may lead to policies mandating highly prescriptive employment requirements that "risk generating inefficiencies that are greater than those they aim to offset" (Korinek and Ramdoo, 2016).

In contrast to financial R&D incentives (see Section 3.7 below), mandatory R&D requirements are relatively rare (see also Cosbey and Mann, 2014). However, China maintains requirements to setup R&D labs in return for market access. While large companies may reject such stringent requirements by other countries, market access to the second largest economy and most populous country in the world is a powerful incentive (Atkinson, 2012). The automobile sector was prioritised by China and the 2004 industrial policy required a 500 million yuan (about USD 73 million) investment in an R&D facility in order to approve an automotive project (Ricken and Malcotsis, 2011). Similarly, albeit to a lesser extent, India established local R&D requirements by demanding that companies setup local in-house R&D facilities or enter into long-term consultancy contracts with local R&D institutions within two years of approval (Ricken and Malcotsis, 2011). However, the requirement has only been applied in few cases, where foreign equity levels or technology related payments were high.

In spite of the use of R&D requirements by some of the largest emerging economies, the literature has not elaborated extensively on the effectiveness of these new R&D centres, the associated budgetary implications for foreign investors, the real costs of the incentives provided, or the real impact on technology transfer. UNCTAD (2003) suggested that R&D activities are likely to have a limited positive impact in the absence of local expertise to develop and absorb the available know-how. Still, Huang (2006) linked the rapid increase of R&D facilities that had been setup by multinationals in China between the 90's and early 2000's to the R&D requirements imposed by the government and to the complementary policies directed to foster the absorption capacity of local companies.

In the case of local content requirements, despite the controversy of their compliance with the WTO law, they have been quite popular in the oil and natural resources sectors. In Brazil, the government has also targeted the wind power sector, as it is seeking to become the wind-power producing hub in Latin America. Strict local content requirements for investors wanting to benefit from the FINAME accreditation and the associated attractive financing terms from the Brazilian Development Bank (BNDES) have also been introduced. As discussed above, there are questions about the effectiveness of such requirements in the context of GVCs in general and it is also not clear to what extent the experience from the natural resources can be generalised to other sectors.

Nevertheless, if they can be justified in specific contexts, the distortive effects of local content requirements will likely be closely related to their stringency as well to the extent they prevent competition more generally. If the targets are set taking into account the capacity of the local supply industry, these measures may not be so distortive insofar as international companies would source domestic inputs regardless of the measure for cost efficiency reasons, as in the case of quotas of local employees (Korinek and Ramdoo, 2016). However, when the targets are set at a rate that dramatically changes procurement behaviours, the main concerns raised in the literature are the protection of uncompetitive domestic industries from imports and the increased opportunities for corruption (Hufbauer et al., 2013). In these cases, there is a high risk that these policies will end up benefitting local elites and, as in the case documented by Ovadia (2014) in the extractive industries of Angola and Nigeria, these requirements may favour political nexuses, rather than consolidating a competitive supplier industry.

As far as the role of competition is concerned, China's experience with local content and technology transfer requirements in the automobile industry shows that such requirements have initially failed to trigger transfer of up-to-date technology. Only the competitive pressures brought by other entrants such as Nissan, Toyota, and Hyundai/Kia, which also faced equity restrictions and local content requirements, drove companies such as Volkswagen, which initially had been producing old models in China, to begin using newer technology (Chang, 2013).

The use of performance requirements is a policy that although highly contested by developed countries, is still quite popular among developing countries who see them as attractive in advancing their national economic development agendas. Nonetheless, countries without large markets, natural resources, or other strong pull factors may not be in the competitive position to be able to effectively impose such requirements on increasingly mobile FDI. Thus, the scope for replicating what may be seen as successful performance requirements imposed by China and India or other similar countries may be quite limited. Furthermore, even if governments were to have the power to impose these requirements, experience indicates that the design, implementation and monitoring are all challenging tasks.

Lastly, the future of performance requirements appears to be quite uncertain considering that they are being progressively disciplined under international trade and investment law (see above). The trend among the latest IIAs and, possibly future negotiations under the WTO, appears to be in the direction of expanding the list of prohibited measures. Therefore, to a large extent, they are likely to become more and more problematic as national industrial policy tools.

3.7 Technology-related investment incentives

Investment incentives have been posited to be among the most important policy instruments employed by governments to influence locational decisions of multinational firms (Sauvé and Soprana, 2016). Technology transfer is among their primary objectives; a recent survey of 80 investment promotion agencies in 74 countries by UNCTAD (2014), for example, showed that technology transfer is mentioned as the second most important objective of investment incentives after job creation. The results of the survey highlighted further that training and skill transfer and R&D are mentioned in the top five of the most important performance requirements linked to investment incentives – respectively about 70% and 40% of the time (UNCTAD, 2014).

Investment incentives can take multiple forms, including tax incentives, direct transfers of funds and other financial incentives, provision of goods and services, buildings, infrastructure or various regulatory incentives. They can be direct or not, general or sector or firm-specific, unconditional or contingent; or regulation-based or discretionary. They can be extended to domestic and foreign investors or they can be directed specifically at foreign investors or cover investments in certain economic sectors or areas (e.g. in special economic zones).

Technology-related investment incentives bear certain similarities to other ITT-related measures discussed in previous sections. They are similar to regulatory incentives or investment facilitation measures in that they follow the approach of competing for FDI. Since they often impose on investors obligations such as, for example, employment of high-skilled local employees or managers, localisation of activities in a specific area, or carrying out a certain level of research and development (R&D), investment incentives contain some elements of performance requirements. These obligations are however attached to fiscal, financial or other benefits. They require leveraging public resources and impact the conditions of competition for investors in domestic or, indeed, international markets and must therefore be designed with care to reduce local and global distortions.

As far as international regulation of investment incentives is concerned, a number fall within the scope of the WTO Agreement on Subsidies and Countervailing Measures (ASCM). The ASCM covers a broad range of financial contributions, grants, in-kind subsidies or income or price support measures (Art 1). It prohibits subsidies contingent on export performance and use of domestic over imported goods (Art 3.1). Other types of subsidies, including tax incentives, are generally allowed, although certain subsidies that are specific to an enterprise or industry or a geographical region (Art 2) can be challenged through the WTO dispute settlement or be subject to countervailing measures (i.e. actionable subsidies) where they cause injury to a domestic industry of another Member State, constitute a serious prejudice to the interests of another Member State or nullify or impair benefits accruing to WTO Members under the GATT 1994, such as reduction in market access due to subsidisation (Art 5). Importantly, assistance for R&D activities, such as, for example, costs of research personnel, costs of instruments, costs of consultancy, generally fall under the category of non-actionable subsidies, as does assistance to disadvantaged regions (Art 8). The ASCM covers trade in goods only and the GATS does not contain equivalent disciplines in the area of services.

Within the EU, Art 107.1 of the Treaty on the Functioning of the European Union prohibits state aid which distorts competition and affects trade between EU member States by favouring certain undertakings or the production of certain goods. Selectivity of the aid on the basis of the industry, the number of jobs or the geographical spread is sufficient for a measure to qualify as state aid under Article 107.1 (Luya, 2015). However, similar to the WTO's ASCM, there are exceptions for R&D tax incentives and development of innovation clusters. Art 107.3C permits aid to "facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest".[67]

67. According to the 2014 Framework for State Aid for Research and Development and Innovation (2014/C, 198/01), R&D is included in the meaning of Art 107.3C, implying that EU states may implement laws aimed at reducing R&D costs for selected enterprises in areas including overheads, operating expenses, cost on contractual research and costs for feasibility studies. Compatibility with Article 107.3c of TFEU is assessed by the European Commission on the basis of a series of criteria. First, aid should contribute to a well-defined objective of common interest; second, there must be a need for State intervention due to externalities, asymmetric information and coordination failures. Third, the measure may be appropriate considering the alternatives. Fourth, there must be an incentive effect on R&D. Fifth, the aid must be proportional to the market failures which it is intended to address and, sixth, the negative effect of the aid measure in terms of distortions of competition must be outweighed by the positive effect to the contribution to the common interest.

As foreshadowed in Section 3.6, some preferential trade and international investment agreements prohibit, in connection with the establishment, acquisition, expansion, management, conduct or operation of an investment, requirements to: transfer technology, act as an exclusive supplier, locate the headquarters of the investor in a specific region, hire a percentage of nationals or locate R&D activities domestically (see NAFTA, Art 1106 para 1). However, they typically leave room for certain performance requirements as a condition for receipt of advantages. Such a clause appears for the first time in Art 1106 of NAFTA, para 4, which states that parties can condition "the receipt or continued receipt of an advantage on compliance with requirements to locate production, provide a service, train or employ workers, construct or expand particular facilities or carry out research and development" in a Party's territory. Similar provisions are contained in such agreements as the TPP and the Japan-Peru Bilateral Investment Treaty. It is noteworthy that these lists of permitted investment incentives-related requirements as a rule do not mention specific obligations to transfer technology, although requirement to locate R&D domestically could be seen as close to such a requirement.

Investment incentives can be generally classified into two main categories, namely fiscal incentives and financial incentives (or direct government funding or support). Fiscal incentives are an indirect form of support consisting of tax reduction or tax relief, while financial incentives include direct subsidies to cover capital, production or marketing costs of investment projects, subsidised loans or government-based guarantees and insurance at preferential level (UNCTAD, 2014).

According to a 2014 survey on IPAs conducted by UNCTAD, fiscal incentives are the most important type of incentives for attracting FDI (UNCTAD, 2014). In order to maximise potential technology transfer, these incentives often directly target R&D activities or apply to high technology industries, such as communication or the automotive industry. Fiscal incentives for R&D —the most common form of technology-related investment incentive—are aimed at attracting and localising R&D activities in the host economy, therefore facilitating potential spillovers to local firms. Such incentives can take several forms, including R&D tax credits, enhanced allowances[68], accelerated depreciation[69] and reduced corporate tax rate on IPR income (EC, 2014). Countries maintain different forms of support (Box 3).

Box 3. Selected examples of investment-related fiscal incentives

Belgium uses three kinds of R&D tax incentive. First, a patent box is available which permits deduction of 80% of the income from patents from the taxable basis. Second, the government allows either a one-shot 13% investment deduction for R&D related investment or a 20.5% deduction on the annual depreciation. Finally, employers enjoy a 75% exemption from withholding tax on the remuneration of researchers engaged in R&D program (Wolfs, 2011).

In France, the government allows a tax credit equal to 30% of R&D expenses limited to €100 million euros and a 5% tax credit for expenses exceeding the threshold. A patent box scheme is available which offers a reduced tax rate of 15% (French Tax Code, accessed through Bird&Bird LLP, 2014[70]).

In Japan, the 2014 Tax Reform and the 2015 Tax Reform Act have established a R&D tax credit scheme against corporate tax aimed at rewarding increases in R&D spending. The credit amount is set from 8% to 10% of the gross R&D cost and may be extended to 12% in case of collaboration with a public research institution. Moreover, the Japanese government allows a credit equal to 5% to 30% of incremental R&D costs. The Regional Revitalisation Act also provides incentives for localising some operations in specific areas other than Tokyo, Osaka or Nagoya. These incentives take mainly the form of either 15-25% additional depreciation of the acquisition cost in the first year or a tax credit (PwC, 2016).[71]

68. Enhanced allowances inflate the R&D expenditure base, therefore decreasing the base amount which is taxed.

69. Accelerated depreciation permits firms to depreciate R&D-related fixed assets at higher rates, thus reducing taxable income. Such incentives are aimed at supporting firms in the purchase of R&D-related machinery and equipment.

70. http://www.twobirds.com/en/news/articles/2014/global/tax-july-2014/france-r-and-d-tax-incentives

71. http://taxsummaries.pwc.com/uk/taxsummaries/wwts.nsf/ID/Japan-Corporate-Tax-credits-and-incentives

The overall extent of fiscal and investment incentives for R&D directed to both domestic and foreign firms can be gauged from the OECD measure of direct government funding of business R&D and tax incentives for R&D (OECD, 2015c) (Item D.i in Box D and Figure 9).[72] The data, which include both national and subnational policies, show that fiscal incentives are indeed an important form of supporting R&D activities in many countries. Most countries provide some kind of favourable tax treatment of R&D expenditures although this is not the case in, for example, Germany, Estonia, New Zealand and Switzerland.

Tax credits are the most popular type of fiscal R&D incentive in OECD countries (OECD, 2014a). A tax credit R&D incentive decreases the corporate income tax rate a firm has to pay to the government. Such rate may be applied to corporate tax or payroll tax paid for R&D workers. In addition, some countries, such as, for example, Colombia, Denmark, Korea and Turkey, also apply tax credits for personal income tax of high skilled workers engaged in R&D, with the aim of attracting and retaining talent (Question D.1 in Box D).

Box D. Investment incentives

Readily available codified information:

D.i OECD Tax Incentive Support for Business R&D

Additional regulatory information collected:

D.1 The country offers credit for personal income tax of high skilled workers.

D.2 The country has patent box schemes.

D.3 A fiscal incentive or a grant scheme depends on R&D spending by investing firm.

D.4 A fiscal incentive or a grant scheme depends on the technological characteristics of investments.

D.5 A fiscal incentive or a grant scheme depends on either building suppliers capacity or using local facilities.

D.6 A fiscal incentive or a grant scheme depends on employment of highly skilled local workforce.

D.7 An incentive scheme depends on locating either headquarter or management in the country or in specific locations.

D.8 The country has either SEZ or incentive programmes based on geographical location for where advantages depend on sector of operation.

A reduced corporate tax rate on IPR income (the so called "patent box" or "IP box" scheme) decreases the tax on income from royalties, licensing and R&D capital gain, thus potentially encouraging the commercialisation of R&D but also exploitation of the patent in the country in which R&D is performed and then transfer of technology to local firms (OECD, 2014a) (Question D.2 in Box D). However, the effectiveness of these provisions in attracting technology is unclear to the extent that in some countries, IP-related income of investors is eligible for the patent box even if the companies involved are

72. This measure is based on the OECD B index which is a "measure of the level of pre-tax profit a "representative" company needs to generate to break even on a marginal, unitary outlay on R&D (Warda, 2001), taking into account provisions in the tax system that allow for special treatment of R&D expenditures. It is customary to present this indicator in the form of an implied subsidy rate, namely one minus the B index. More generous provisions imply a lower breakeven point and therefore a higher subsidy." See: https://www.oecd.org/sti/b-index.pdf

not carrying out related activities in the country. For example, in the case of the Netherlands, the "innovation box" applies to any company as long as they are paying tax in the country. A recent proposal, following the recommendation of the OECD BEPS initiative on tax evasion, aims at restricting the "innovation box" to those companies which have substantial economic activities in the Netherlands.

Some countries provide fiscal and direct incentives specifically for technology-intensive sectors or activities, often with the explicit purpose of attracting foreign companies and encouraging transfer of technology and innovation.[73] In particular, several jurisdictions have targeted technology intensive industries such as the automotive industry, ICT and telecommunications. It should be stressed that specificity of R&D subsidies is consistent with the WTO subsidy rules (Art 8.1 and 8.2 of the ASCM).[74] This is likely reflecting the reality that such specificity is required to efficiently correct the market failures these subsidies are aiming to correct. At the same time, more generally, specificity is one of the key criteria used for determining the potential for trade distortion of subsidies under the WTO's ASCM. In our context, it is therefore interesting to first identify which countries provide fiscal investment incentives or grants which are conditional on R&D spending by investing firms[75] (Question D.3 in Box D) as well as which countries provide other fiscal incentives or grants which depend on technological characteristics of investments or are applied in specific sectors (Question D.4 in Box D).

ITT-related investment incentive measures can be further categorised according to the conditions attached to them which are indicative of the channels of technology transfer they are aiming to facilitate. In order to improve the links with local business and therefore maximise the probability of technology transfer, some fiscal incentives or grant schemes depend on either building supplier capacity or using local facilities (Question D.5 in Box D). Other schemes, which are aiming to facilitate the flow of knowledge from foreign to local management, depend on employment of highly skilled local workforce (Question D.6 in Box D) or on locating either headquarters or management in the country or in specific locations (Question D.7 in Box D). Finally, since economic activity is often geographically concentrated, in order to facilitate transfer of technology to a specific domestic industry, some countries are setting up incentive programmes based on geographical location (for example in special economic zones or industrial clusters) and linking them with sector of operation (Question D.8 in Box D).

Investment incentives—use across countries

The responses to questions in the taxonomy show that among the countries considered as part of this exercise tax credits for high skilled workers (D.1.) and patent box schemes (D.2.) are rare (Table 4 and Figure 10). In particular, only five countries provide some form of tax deduction to highly qualified personnel. In some provinces in Malaysia knowledge workers enjoy a tax credit on income from employment with a company engaged in a qualified activity. In Korea, foreign technology experts enjoy a 50% income tax reduction in accordance with technology introduction contracts. Similarly, only six countries run patent box schemes. For example, Korea grants a patent box scheme to SMEs for income arising from transfer of technology. Korean Corporation Tax Amendment 2015 also introduces a tax credit applying to income derived from the leasing of patents or utility model rights. France, on the other hand, provides a reduced tax rate of 15% on net income from royalties for French enterprises. Amongst the developing countries sample, China offers "patent-box" –like schemes for income earned from qualified technology transfer (see Box 4).

73. Greece, Belgium, Canada and the US, for example, award tax incentive on the basis of the type of technology developed (OECD, 2014a).

74. Note however that in order to be deemed non-actionable under the ASCM, R&D subsides need to also fulfil a specific set of criteria (Art 8.1 and 8.2 of the ASCM).

75. Note that a subsidy conditional on R&D spending cannot be automatically deemed non-actionable (Art 8.1 and 8.2 of the ASCM).

Box 4. Tax exemptions and deductions for technology transfer in China

Art 27(4) of the China's Enterprise Income Tax Law (2007) and Art 90 of the relative Implementation Rules introduce tax exemptions and deductions for income earned from qualified technology transfer. In particular, the first five million yuan of qualified income from the transfer of technology is exempted from the corporate income tax and the portion which exceeds five million yuan is subject to a 50 percent reduction. Guoshuihan No.2012 and Caishui No. 111 establish the criteria to be used to determine which forms of technology transfer are eligible for special fiscal treatment. In particular, according to Guoshuihan No.2012 six types of technology transfer qualify: patented technology, copyright of software, design or composition right of integrated circuits, new plant variety, new biological and medical varieties and others as prescribed by the relevant authorities. Caishui No. 111 further limits the scope of the tax incentives to technology transfers of ownership or global exclusive licensing rights for a period of at least five years. Moreover, it excludes transfer of technology to related third parties under 100% control (PwC, 2011).

In contrast, almost all the countries have incentives for R&D investments (D.3), although their nature varies considerably from one case to another. In Malaysia, for example, one of the conditions for companies to achieve either an investment tax allowance or status which offer further advantages (so-called Pioneer Status) is spending at least 1% of gross sales on local R&D. In Viet Nam on the other hand, enterprises investing 25% or more of their revenue in R&D investment projects are entitled to a five year import duty exemption on goods imported for direct use for R&D. In France, the *Credit Impôt Recherche* covers 30% of all R&D expenses. Interestingly, such incentives are not accessible to foreign investors in Saudi Arabia, where the government limits funding only to state-owned oil and gas companies.

In addition, most countries actively target specific sectors or technology in awarding incentives (D.4). For example, Malaysia grants a Bio Nexus status to biotechnology companies, which involves tax exemptions. Chile's *Fortalecimiento y Creación de Capacidades Tecnológicas Habilitantes para la Innovación* provides support for healthcare-applied IT. Similarly, the *Programa Teccnologico Desarrollo Tec. Energia Solar Fotovoltaica* provides incentives for solar energy. In the developed country part of the sample, Korea and Japan provide corporate tax reduction for business supporting high technology. However, no such sectoral schemes have been identified for France which instead seems to focus on firm size, namely small and medium sized enterprises, in supporting technological activities. Incentives depending on building supplier capacity or using local facilities (D.5) are only present in Chile and Korea among the developed countries but they are common in the developing country group. In Brazil, for example, the Brazilian Development Bank (BNDES) provides incentives for development of renewable energy conditional on local sourcing of suppliers. Thailand provides merit-based incentives for development of local suppliers with at least 51% Thai shareholding in advanced technology training. In India, the government provides incentive for carrying R&D in Indian structures.

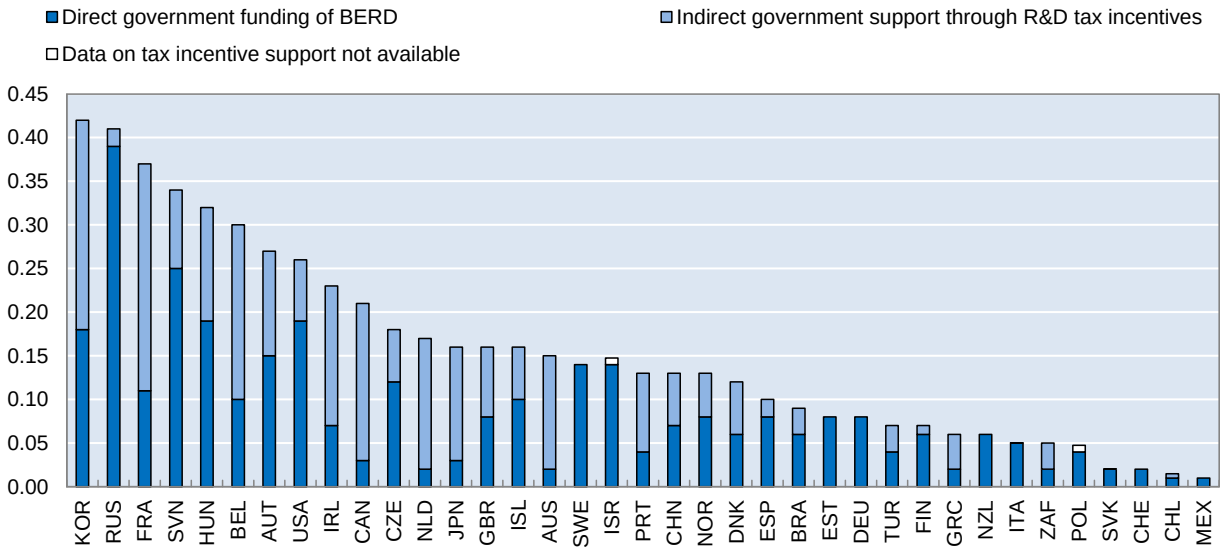
Incentives depending on employment of highly skilled local workforce (D.6) appear to be unusual, as they are present in only seven countries. In Malaysia, for example, in order for companies to qualify for the preferential Pioneer Status or an Investment Tax Allowance, scientific and technical staff with degrees or diploma and with minimum five years of experience should comprise at least 15% of the company's total workforce. In Poland, one of the conditions for receiving a grant to create new employment in R&D activities is creating workplaces for individuals with higher education.

Only two developed countries condition investment incentives on keeping the headquarters or management in a specific location (D.7), while such measures are in place in six developing countries. Korea provides grants to foreign companies owning businesses in three or more countries and establishing headquarters in Korea. In the developing country group, Malaysia, for example, makes a concessionary 10% corporate tax rate available to companies which set up their headquarters in the country. In South Africa, the Foreign Investment Grant provides firms with headquarters in the country with grants up to R10 million. In Brazil, in the oil and gas industry, BNDES and FINEP fund programmes such as Enova Petro, providing loans for topside, subsea or well technology, and Finem O&G, which finances acquisition of

machinery and equipment, offers funding conditional on keeping both the headquarters and management in the country.

Conditional investment incentives based on location (D.8) are present in more than half of the countries analysed. Some of these incentives are set up in special economic zones or areas specialised in high technology. For, example, in Viet Nam, industries such as high-tech, electronics and electrical equipment manufacturing may localise their projects in the Cong Hoa-Chi Linh park and be therefore be entitled to receiving special funding loans from government sources. Another example is South Africa's Industrial Development Zone (IDZ) offering free import of production related material and a VAT exception. Other South African special economic zones where firms enjoy tax incentives are also being created to include innovation centres. The ELIDZ Science and Technology Park, in particular, supports industrial research and development and technology transfer. Amongst the developed countries, Korea and Japan provide incentives for investing in designated zones in fields of high technological potential. For example, Korea runs a system to reduce corporate tax for cutting-edge technology companies in foreign-invested zones, such as the Saemanngeum project area and the Juju advanced science and technology zone. In Japan, both the Fukushima and the Fukuoka Prefecture provide subsidies to foreign corporations establishing facilities in fields including pharmaceuticals or robotics.

Figure 9. Direct government funding of business R&D and tax incentives for R&D, 2013



Note: The figure shows an implied subsidy rate, see also: https://www.oecd.org/sti/b-index.pdf
Source: OECD Science, Technology and Industry Scoreboard 2015.

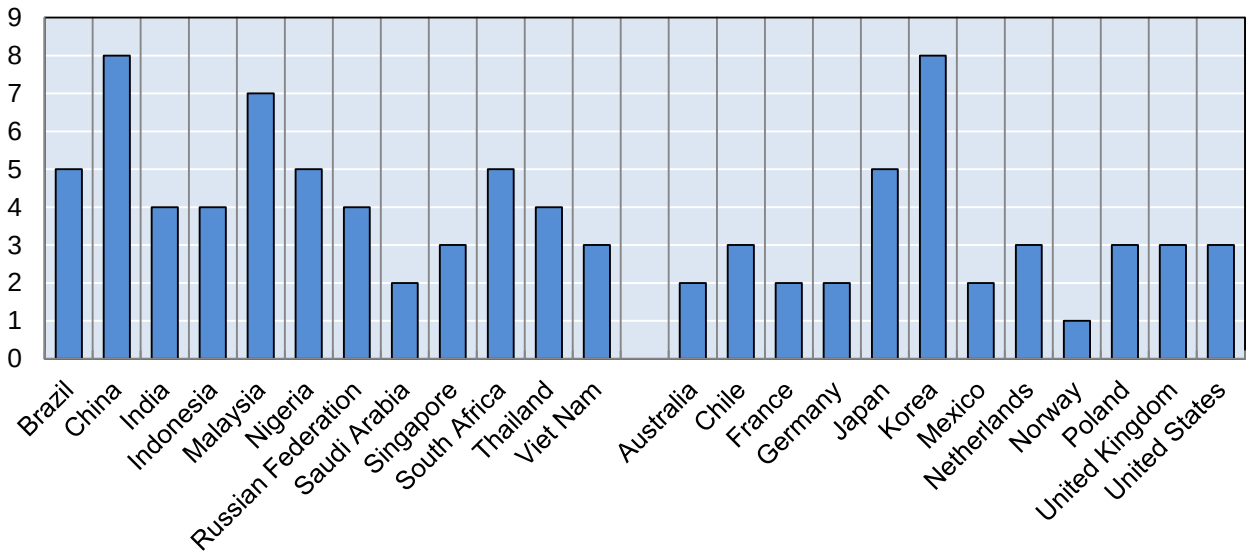
Table 4. Investment incentives

	Question	Brazil	China	India	Indonesia	Malaysia	Nigeria	Russian Federation	Saudi Arabia	Singapore	South Africa	Thailand	Viet Nam	Australia	Chile	France	Germany	Japan	Korea	Mexico	Netherlands	Norway	Poland	United Kingdom	United States
D1	Tax credit for personal income of highly skilled workers	no	yes	no	no	yes	yes	no	no	no	no	no	no	no	no	no	no	no	yes	no	yes	no	no	no	no
D2	The country has patent box schemes	no	yes	yes	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	yes	no	yes	no	no	yes	no
D3	A fiscal incentive or a grant scheme depends on R&D spending by investing firm	yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
D4	A fiscal incentive or a grant scheme depends on the technological characteristics of investments	yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	no	no	yes	no	yes
D5	A fiscal incentive or a grant scheme depends on either building suppliers capacity or using local facilities	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	no	yes	no	no	no	yes	no	no	no	no	no	no
D6	A fiscal incentive or a grant scheme depends on employment of highly skilled local workforce	no	yes	no	no	yes	no	no	yes	yes	no	no	no	no	no	no	no	yes	yes	no	no	no	yes	no	no
D7	An incentive scheme depends on keeping either headquarter or management in the country or in specific locations	yes	yes	no	yes	yes	no	no	no	yes	yes	no	no	no	no	no	no	yes	yes	no	no	no	no	no	no
D8	The country has either SEZ or incentive programmes based on geographical location for where advantages depend on sector of operation	yes	yes	yes	no	yes	yes	yes	yes	n/a	yes	yes	yes	no	no	no	yes	yes	yes	no	no	no	no	yes	yes

Source: Authors' elaboration.

Figure 10. Summary chart: investment incentives

Number of positive responses to questions D1 through D8



Note: This figure graphically summarises the information from Table 4 above. When interpreting it, it should be remembered that the different measures likely have very different impacts on technology transfer, the quality of such transfer and competition. Some measures may more important than others. Therefore, the number of measures that a country has adopted is only a rough measure of that country's commitment to attracting foreign technology and facilitating its spillover.

Source: Authors' elaboration.

Investment incentives—preliminary observations on effectiveness in terms of technology transfer and impact on competition

Effectiveness of technology-related fiscal and financial investment incentives has not been widely discussed in the literature yet. However, from the available sources, it seems that these incentives can be effective in encouraging technology transfer only when they are tailored, governed and used in combination with other policies that are appropriate (Tavares-Lehmann et al., 2016). When this is not the case these incentives may constitute an unreasonable burden on governments while contributing to local and global distortions. In the analysis of the effectiveness of technology-related fiscal incentives it is worth distinguishing between those incentives which are targeted are specific industries, firms, activities, or people without requiring technology-transfer related actions by the firm and those which are conditional on the fulfilment of some performance requirements, directly or indirectly related to technology transfer.

The evidence of the effectiveness of targeted incentives is mixed and arguably depends on the context. However, apart from credit on personal tax income of high-skilled workers and some incentives depending on the technological characteristics of the underlying activity, this group of incentives has limited effectiveness.

While specific studies on the effectiveness of credit for personal income tax of high-skilled workers are rare, the literature has shown that these policies can actually influence location of technical experts such as, "star scientists", which are at the frontier in terms of patent counts and are typically involved in biotech, nano-tech and software industries. For example, Moretti and Wilson (2015) found that different income tax rates in the US impact on the geographical location of "star scientists". As the activities associated with the presence of these experts have a potential impact on learning and technology transfer, a lower income tax rate may trigger positive externalities in this direction. Another study by Akcigit et al. (2015), which looked at tax rates in eight OECD countries, found that the "superstar top 1 percent" inventors were affected by top tax rates in the decision of where to locate and these findings were confirmed by (Picker, 2015).

In the case of IP boxes, the literature shows that effectiveness of these measures is limited, as they are often poorly targeted at incentivising new innovative activities. Indeed, in general IP boxes target the income from successful projects and not the underlying innovative activities. In particular, in a review on patent box schemes in Belgium, France, the Netherlands and Spain no positive effect of patent boxes on R&D spending was found for Belgium and the Netherlands. In the case of France and Spain some effect was found, but it still depended on a financial commitment which by far exceeded those for other policy tools (IMF, 2016; Furman, 2016).

Evidence is also mixed regarding effectiveness of targeted investment incentives which depend on the technological characteristics of investments. While targeted programs such as the "High Technology Investment Programme" for IT, telecoms, biotech and electronics in Chile, for example, seem to have yielded positive externalities including creation of backward linkages with local companies through which technology could flow freely, it is difficult to determine whether these results would have materialised absent the incentives (UNCTAD, 2003). In a similar fashion, the literature is unable to conclusively assess whether the incentives to foreign investors bringing new machinery to South Africa, as part of the Foreign Investment Grant, had a decisive effect on influencing investment decisions (Lemma, 2011). Often bureaucracy hampers the effective functioning of these incentives. In Malaysia, for example, the Human Resources Development Fund, introduced in 1993 had a limited impact, with firms citing rigid procedures, excessive red tape and unnecessarily burdensome queries as the main culprits (UNCTAD, 2003).

In the case of incentives associated with R&D spending, the literature hints at the fact that effectiveness is limited, both on the investment attraction and the R&D spending sides. For example, an analysis of US FDI and data on investment incentives offered by 12 developing countries from 1985-2005 found that R&D FDI incentives do not have any effect on the distribution of US companies' FDI

(Wellhausen, 2013). In a similar vein, Thursby and Thursby (2006) found that incentives were not amongst the main factors influencing R&D decision of EU and US based MNEs. Finally, Gonzalez and Pazo (2008) found that R&D subsidies did not stimulate R&D by firms which had already decided to undertake R&D activities. While acknowledging that some impact is instead present for smaller low-technology firms, they caution regarding the social profitability of the measure.

The impact of incentives conditional on the fulfilment of some performance requirements varies depending on the specific measure in question and the context.

First, combining local content requirements with investment incentives has yielded some positive results in Brazil, where the BNDES targeted the assembly of wind turbines as a part of a move to increase local content. According to IEA (2015) the strategy led to a rapid development of the industry. It should, however, be kept in mind that, as was the case with FDI restrictions and performance requirements before, a proper assessment of costs and benefits of such policies is difficult because of the unknown counterfactual situation. Ideally, the value added domestically by the newly emerged local industry and the foreign investor, and the value of technology transferred in these circumstances, reduced by the amount of the incentive granted, would have exceeded the corresponding effects that would be present without local content targets. But in this and in most other cases the literature regrettably does not provide enough evidence to make a full cost-benefit analysis assessment.

Second, according to the literature, effectiveness of grants schemes depending on employment of highly skilled workforce and their impact on technology transfer are unclear. However, at least in the case of Malaysia, which used to provide incentives on investors who employed 500 or more full time Malaysians, the documented impact on hiring in managerial positions was low (UNCTAD, 2013).

Finally, incentives depending on geographical locations seem to be yielding mixed results. The literature shows that in some cases, incentives to attract multinational companies' headquarters to a country are effective, if aligned with other economic policies, state-of-the art infrastructure and political stability. Singapore is a successful example of this. The country attracted the regional headquarters of multinational corporations through its use of tax incentives and other measures (including grants and loans) that were aligned with other economic policies (including human capital formation), state-of-the-art infrastructure, political stability and other attractive qualities (a safe environment, good schools, etc) and was able to attract thousands of multinational Asia-Pacific regional headquarters (Tavares-Lehmann, 2016). However, when it comes to technology transfer, the impact was less clear (Tavares-Lehmann et al., 2016).

There is however some evidence that that attraction of firms from high-technology sectors in SEZs may be effective in creating clusters spurring technology transfer. For example, in India, foreign firms which were located in the Software Technology Parks (STPs) and which enjoyed various incentives, were found to have established linkages with local firms (White, 2011). Still, the author found that this result was difficult to generalise as in many other cases technology transfer did not happen due to factors including poor infrastructure connecting the SEZ to other locations.

While ineffective in several cases, investment incentives may also be highly distortive, given that they offer financial benefits and often target specific firms, sectors or technologies.

In particular, IP Box schemes (see above) may actually disproportionately favour large profitable firms with significant market share, and support products which would have been highly successful even without the benefit (Furman, 2016). In a similar way, they can discriminate against innovations which are not protected by IP rights which may actually reduce technology spillovers (IMF, 2013). As far as R&D subsidies are concerned, distortions depend on the firm and the R&D activity (Busom et al., 2012). As in the case for IP Box schemes, these subsidies may favour some firms over others, therefore tilting the playing field (see Box 1). Incentives targeting firms on the basis of their technology characteristics may be equally distortionary as some sectors are favoured over others. The same reasoning goes with requirements to build supplier capacity, which may favour some specific types of local suppliers.

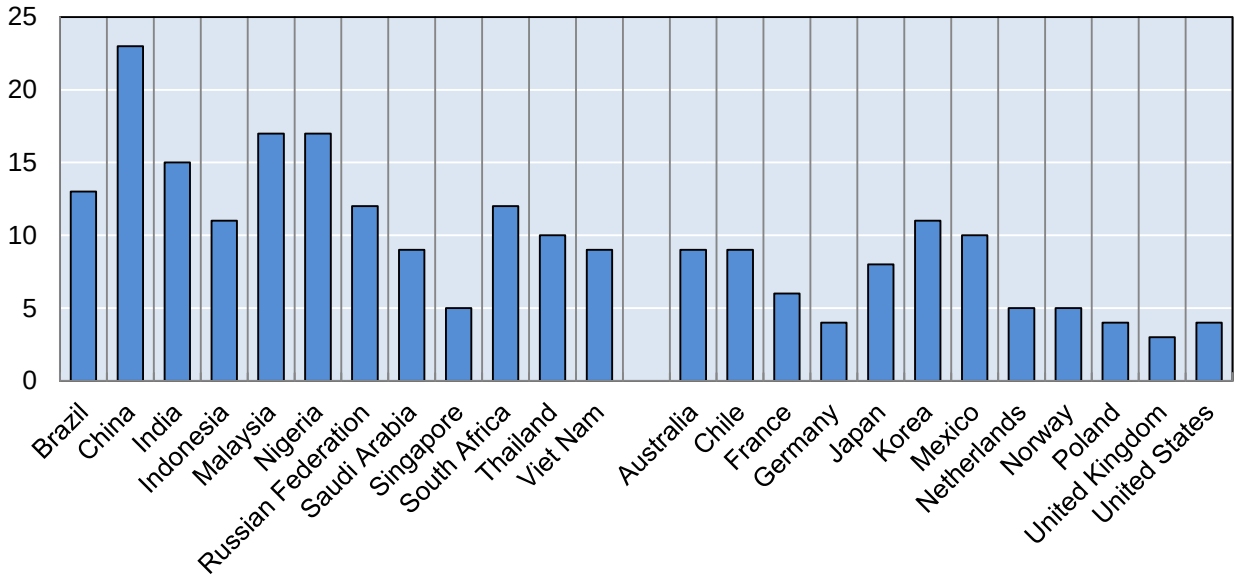
The widespread use of technology-related investment incentives, rarely effective unless they are carefully designed and associated to other policies, may also cause distortions at the global level without yielding social profitability in the aggregate. Indeed, in order to attract firms and talent and encouraging technology transfer, countries may be tempted to provide further incentives to compete with their counterparts, therefore contributing to further distortions such as the favouring of some firms and sectors without achieving a satisfactory rate of return on their initial investment.

3.8 Incidence of all measures documented according to the proposed methodology

Overall, our findings from the regulatory data collected for this project suggest that all countries have adopted measures to encourage technology transfer, although these are still more frequent in developing countries (see Figure 11).

Figure 11. Summary chart: all ITT-related measures

Number of positive responses to regulatory questions in sections A through D



Note: This figure graphically summarises the information from Tables 1 through 4 above. When interpreting it, it should be remembered that the different measures likely have very different impacts on technology transfer, the quality of such transfer and competition. Some measures may more important than others. Therefore, the number of measures that a country has adopted is only a rough measure of that country's commitment to attracting foreign technology and facilitating its spillover.

Source: Authors' elaboration.

4. Conclusions

In a global economy characterised by increasing competition and geographically fragmented production activities, knowledge and innovation are becoming an even more important source of sustainable competitive advantage and a central focus of economic policy. Although much technology is developed, held and managed by private actors, regulation can influence firms' choices and thus shape the global distribution of technology-related economic gains.

International trade and FDI have always been seen as important channels of international technology transfer which can be influenced by policy. However, the nature of technology and the economic context have evolved considerably in recent decades. The emergence of global value chains, in particular, has created new opportunities for the application and transfer of technology, has sharpened the

interdependencies between different economic policies and has changed the debate about the role of openness in technology and innovation strategies. These interdependencies have also raised concerns regarding a set of policies which have a potential to generate distortionary commercial effects across international markets.

However, there is as yet no widely agreed definition of what constitutes a competition-distorting ITT measure, and drawing a clear line between measures that have significant distortionary commercial effects and those that do not is not a simple task.

Effectiveness in terms of technology transfer and distortionary competition effects are two relevant sets of criteria which are likely to determine the incentives for further international co-ordination of ITT measures. Of the wide spectrum of policy measures which can be used to promote ITT, some will arguably be more effective in terms of technology transfer and its absorption, and some will also have less distortionary impacts on market competition. Incentives to co-ordinate ITT policies in the international context could in principle be highest when the competition distortions are high and when policies have limited impact on ITT. In any case, data on ITT policies and their likely impacts are needed. The current paper presents an initial methodological approach to collect such data across a number of broad ITT policy categories for which comparative information is currently unavailable.

Following the literature, technology transfer-related policies are grouped into six categories: 1) absorptive capacity policies; 2) measures related to intellectual property rights (IPR); 3) FDI promotion measures; 4) FDI restrictions and FDI screening; 5) performance requirements; and 6) investment incentives. A list of regulatory questions about measures in place is devised for categories 3 through 6 and results are presented for twenty four developing and developed countries which are important actors in world FDI, technology and product markets. The findings of the literature addressing both the impact of these measures on technology transfer and on market competition are summarised for each of the four policy categories. The paper also explores the extent to which various ITT measures are covered by existing international agreements, with a view to helping inform future approaches.

All countries studied maintain measures to encourage technology transfer, although these are more frequent in developing countries. There is considerable heterogeneity in emphasis on the different elements of technology transfer policies across countries and across countries at different levels of development.

While important for ITT, absorptive capacity policies are usually horizontal domestic policies related to education and workforce training, educational and scientific institutions and their links with business, the business climate and access to finance. They do not usually discriminate between different types of technology or technology holders or economic sectors and are thereby arguably associated with limited distortionary international effects. They are therefore less likely to be co-ordinated in an international context.

Particularly for foreign participants, IPR protection plays a significant role in creating the necessary market conditions for technology transfer and for the operations of technology markets to the extent it recognises an appropriate level of protection for innovators and provides incentives to innovation. Moreover, IPR protection enables further commercialisation of intellectual property by creating the business conditions for its dissemination. IPR protection is thus a prerequisite for ITT.

FDI promotion measures which target technology-related investment in specific sectors are widespread, although the evidence is limited regarding their impacts on technology transfer and on international competition. The few existing studies on the former suggest that targeting investment promotion at technology intensive-sectors can be effective in attracting additional FDI in these sectors. Research and empirical evidence on the potential distortions it might cause are even scarcer.

Policies directly setting limits to FDI are rare although some countries have joint-venture requirements in specific sectors, screen FDI or grant business licences on the basis of potential technology-

related benefits. The literature suggests that joint-venture requirements are often highly ineffective, because of reluctance to transfer the latest technology, asymmetries in perceived benefits from entering into a partnership agreement, and a high risk of failure of such ventures and possibility of exits.

Technology transfer-related performance requirements are not pervasive in developed countries, although they still seem common in developing countries, especially regarding sectoral local content requirements in government procurement, local employee quotas and provisions setting training requirements and requiring substitution of foreign with national employees. This might suggest that in some cases policy makers have been guided by the deterrent effect restrictions and performance requirements can have on FDI inflows, while in other cases policy makers may have concluded that the size of local markets and natural resource endowments are sufficient to offset the deterrent effect of these measures.

The literature on impact of performance requirements is mixed, and sectoral specificities arise (notably in the natural resource sectors). Some measures such as local employment quotas, for example, may be ineffective unless accompanied by efforts to build skills and absorptive capacity of the local workforce. Likewise, mandatory R&D requirements may have a limited positive impact in the absence of local expertise to absorb and develop the available know-how. There is considerable evidence that such requirements may have significant competition impacts because they affect conditions under which firms from different sectors, or equipped with different technologies, compete in markets. These measures may be particularly detrimental to effective participation in GVCs

The FDI-deterring effect of performance requirements and restrictive regulation might also help explain the relative popularity of investment incentives which are used more commonly across the studied developing and developed countries. For example, the majority of the countries have investment incentives which depend on R&D spending or technological characteristics of investments. In many cases the effectiveness of these measures is limited, although in a few cases they may support ITT. However, providing selective investment incentives to industries or firms with certain technological characteristics may distort resource allocation, favour uneven development of some industries at the expense of others, and create unfair competitive advantages over non-subsidised companies. In addition, investment incentives require leveraging public resources and their use by some governments can encourage similar or more generous measures by others, resulting, potentially, in a “race-to the bottom” on FDI subsidisation (Sauvé and Soprana, 2016).

Developing effective disciplines in future international agreements, assuming there is interest in doing so, would require identifying measures that encourage FDI and ITT but do not (or only ‘minimally’) create distortions or undermine international competition. Some inspiration in this respect can perhaps be drawn from existing approaches such as the WTO ASCM and the EU rules on state aid.

REFERENCES

Akcigit, U., S. Baslandze and S. Stantcheva (2016), Taxation and the international mobility of inventors. *The American Economic Review*, 106(10), 2930-2981.

ANEXO VII (Redação dada pelo Decreto nº 7.819, de 2012). (n.d.). Retrieved September 07, 2016, from http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/Decreto/D7819.htm.

Atkinson, R.D. (2012), President and Founder, Information Technology and Innovation Foundation, Written Statement submitted to the Hearing on "The Impact of International Technology Transfer on American Research and Development", Before the House Science Committee, Subcommittee on Investigations and Oversight, US House of Representatives, 5 December.

Baldwin, R. (2011), Trade and Industrialization after Globalization's 2nd Unbundling: How building and joining a supply chain are different and why it matters, *NBER Working Paper* 17716.

Blomstrom, M. and A. Kokko (2003), Human capital and inward FDI, *CEPR Discussion Paper*, No.3762. Available at SSRN: https://ssrn.com/abstract=387900.

Blomstrom, M., R. Lipsey and E D. Ramsteter (2000), Outward FDI and Parent Exports and Employment: Japan, the United States and Swededn, *NBER Working Paper* 7623, 2. Chang, S (2013), *Multinational Firms in China: Entry strategies, competition, and firm performance*, Oxford University Press.

Busom, I., B. Corchuelo and E. Martínez-Ros (2011), Tax incentives and direct support for R&D: what do firms use and why?, *Business and Economics Working Papers 11-0.*

Chang, S-J. (2013), Multinational Firms in China: Entry strategies, competition, and firm performance, Oxford University Press.

Cohen, W.M., and D.A. Levinthal (1990), "Absorptive capacity: A new perspective on learning and innovation". *Administrative science quarterly*, 128-152.

Cosbey A. (2015), "Everyone's Doing It: The Acceptance, Effectiveness and Legality of Performance Requirements", *Investment Treaty News*, quarterly February 2015, International Institute for Sustainable Development, retrieved from: http://www.iisd.org/itn/2015/02/19/itn-quarterly-february-2015/.

Cosbey, A and H. Mann (2014), Bilateral Investment Treaties, Mining and National Champions: Making it work (Background paper for the Ad Hoc Experts Group Meeting: Bilateral Investment Treaties and National Champions, 18th Meeting of the Inter-Governmental Committee of Experts, "National Champions, Foreign Direct Investment and Structure Transformation in Eastern Africa").

Criscuolo, P., R. Narula and B. Verspagen (2002), The relative importance of home and host innovation systems in the internationalisation of MNE R&D: a patent citation analysis, No 35, Research Memorandum from Maastricht University, Maastricht Economic Research Institute on Innovation and Technology (MERIT).

De Backer, K., I. Desnoyers-James and L. Moussiegt (2015), "Manufacturing or Services - That is (not) the Question': The Role of Manufacturing and Services in OECD Economies", *OECD Science, Technology and Industry Policy Papers*, No. 19, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/5js64ks09dmn-en.

De Mello Jr, L.R. (1997), "Foreign direct investment in developing countries and growth: A selective surve". *The Journal of Development Studies*, 34(1), 1-34.

Dimopoulos, A. (2011), "EU foreign investment law". *Oxford University Press.*

Eaton, J. and S. Kortum (1996), "Trade in ideas Patenting and productivity in the OECD". *Journal of international Economics*, 40(3), 251-278.

Ejiwale, J. (2014), "Breaking Impediments to Technology Transfer through Foreign Trained Nationals", *International Journal of Business, Humanities and Technology*, 4(4).

Faro, G. (2016), Local Content Frameworks in Latin American Oil and Gas sector: Lessons from Ecuador.

Fu, X. and J. Zhang (2011), "Technology Transfer, Indigenous Innovation and Leapfrogging in Green Technology: The Solar-PV Industry in China and India", *Journal of Chinese Economic and Business Studies*, 9(4), 329-347.

Furman, J. (2016), Encouraging Innovation and the Role of Tax Policy (March 11) (Remarks of Jason Furman, Chairman, Council of Economic Advisors to the Obama Administration, Joint International Tax Policy Forum & Georgetown University Law Center Conference).

G7 (2017), G7 Taormina Leaders' Communiqué, G7, available at: http://www.g7italy.it/en/the-taormina-g7-summit.

Gallagher, K.P. and M. Shafaeddin (2010), Policies for industrial learning in China and Mexico. *Technology in Society*, 32(2), 81-99.

Ginarte, J. C. and W.G. Park (1997), "Determinants of patent rights: A cross-national study" *Research policy*, 26(3), 283-301.

Girma, S., Y. Gong and H. Görg (2009). "What determines innovation activity in Chinese state-owned enterprises? The role of foreign direct investment". *World Development, 37*(4), 866-873.

Girma, S. and H. Görg (2007), "The role of the efficiency gap for spillovers from FDI: evidence from the UK electronics and engineering sector", *Open Economies Review, 18*(2), 215-232.

González, X. and C. Pazó (2008), Do public subsidies stimulate private R&D spending?. *Research Policy*, 37(3), 371-389.

Grossman, G. and E. Helpman (1994), Foreign investment with endogenous protection (No. w4876). National Bureau of Economic Research.

Harding, T. and B.S. Javorcik (2011), Roll out the red carpet and they will come: Investment promotion and FDI inflows. *The Economic Journal*, 121(557), 1445-1476.

Herrmann, H. and R.E. Lipsey (2003), *Foreign direct investment in the real and financial sector of industrial countries*. Springer Science & Business Media.

Hoekman, B.M., K.E. Maskus and K. Saggi (2005), "Transfer of Technology to Developing Countries: Unilateral and Multilateral Policy Options", *World Development*, 33(10), 1587-1602.

Hout, T. M, and P. Ghemawat (2010), "China vs the world whose technology is it?" *Harvard Business Review, 88*(12).

Hu, A.G., G.H. Jefferson and Q. Jinchang (2005), "R&D and technology transfer: firm-level evidence from Chinese industry", *Review of Economics and Statistics*, 87(4), 780-786.

Huang, X. (2006), Trade and Technology Transfer: The Case of Automobile, Electronic and Telecommunication Sectors in China. In International Conference: WTO, China and the Asian Economies, IV: Economic Integration and Economic Development. University of International Business and Economics, Beijing, China (pp. 24-25).

Hufbauer, G.C. et al. (2013), Local Content Requirements: A Global Problem, The Peterson Institute for International Economic, September.

Information Technology and Innovation Foundation (2012), Hearing on "The Impact of International Technology Transfer on American Research and Development", before the House Science Committee Subcommittee on Investigations and Oversight, U.S. House of Representatives, 5 December, 2012.

International Energy Agency (IEA) (2015), Energy Investments and Technology Transfer Across Emerging Economies: The Case of Brazil and China.

International Monetary Fund (2016), Fiscal Monitor: Acting Now, Acting Together.

Jefferies, C. (2001), "A Preliminary Evaluation of the Proposed Text', in Surendra Patel et al. (eds.), "International Technology Transfer: The Origins and Aftermath of the United Nations Negotiations on a Draft Code of Conduct", The Hague: Kluwer Law International.

Kalfadellis, P., J. Gray and S. Freeman (2006), The environmental factors that impact on foreign subsidiaries operating in Australia. *Working Paper* 15/06, *Monash University Working Papers series*.

Kalinova, B., A. Palrem and S. Thomsen (2010), "OECD FDI Restrictiveness Index; 2010 Update", *OECD Working Papers on International Investment*, OECD Publishing.

Kehl, J. R. (2009), *Foreign Investment & Domestic Development: Multinationals and the State*. Lynne Rienner Publishers.

Kelli, A. et al. (2016), "Different Regulatory Models of Transfer of Industrial Property Rights in the Baltic States: A Plea for Harmonized Approach". *International Comparative Jurisprudence.*

Kinoshita, Y. (2000), R&D and technology spillovers via FDI: Innovation and absorptive capacity. Workign Paper Number 349, *Davidson Institute Working Paper Series.*

Keller, R.T. and R. Chinta (1990), "International Technology Transfer: Strategies for Success". Academy of Management Executive, Vol 4 No. 2.

Kneller, R. (2005), "Frontier technology, absorptive capacity and distance". *Oxford Bulletin of Economics and Statistics, 67*(1), 1-23.

Kneller, R., S. Pantea and R. Upward (2010), Does Absorptive capacity affect who benefits from international technology transfer. *Draft Research Paper*, University of Nottingham.

Kokko, A., R. Tansini and M.C. Zejan (1996), "Local technological capability and productivity spillovers from FDI in the Uruguayan manufacturing sector". *The Journal of Development Studies, 32*(4), 602-611.

Korinek, J and I. Ramdoo (2016), "Local content policies in minerals-exporting countries", OECD Publishing, forthcoming.

Lemma, Y. (2011), The Impact of Foreign Direct Investment (FDI) on Technology Transfer, Addis Ababa University.

Lidgard, H.H. (2011), Assessing Reporting Obligations Under TRIPS Article 66.2, in Lidgard, Atik, Nguyen (editors), *Sustainable Technology Transfer*, Kluwer, 2011. Available at SSRN: https://ssrn.com/abstract_id=2318501.

Lippoldt, D. and M. F. Schultz (2014), "Uncovering Trade Secrets - An Empirical Assessment of Economic Implications of Protection for Undisclosed Data", *OECD Trade Policy Papers*, No. 167, OECD Publishing, Paris, DOI: http://dx.doi.org/10.1787/5jxzl5w3j3s6-en.

Long, G. (2005), "China's policies on FDI: Review and evaluation. Does foreign direct investment promote development, 315-336, Institute for International Economics.

Lugard, P. (2014), "The New EU Technology Transfer Regime, Like a Rolling Stone?" *Communications & Strategies*, (95), 41.

Luya, R. (2015), *EU State Aid Law and National Tax Ruling, European Parliament*, Directorate General for Internal Policies.

Maskus, K.E. (2000), *Intellectual Property Rights in the Global Economy*, Washington, DC: Institute for International Economics.

Maskus, K.E. (2004), *Encouraging International Technology Transfer* (Vol. 7), Geneva: International Centre for Trade and Sustainable Development.

Maskus, K.E. (2013), "Technology Transfer: Regulatory Issues and International Investment Agreements", in Drabek, Z., Mavroidis, PC. *Regulation of Foreign Investment: Challenges to International Harmonization*. World Scientific Studies in International Economics, Vol. 21. Hackensack, N.J. and Singapore: World Scientific, 2013.

Maskus, K.E. (2015), "Intellectual property in a globalizing world: issues for economic research". *Asia-Pacific Journal of Accounting & Economics*, 22(3), 231-250.

McMillan, M. S. and D. Rodrik (2011), *Globalization, Structural Change and Productivity Growth* (No. w17143). National Bureau of Economic Research.

Mercurio, B.C. (2006), "TRIPS-Plus Provisions in FTAs: Recent Trends". In "Regional Trade Agreements and the WTO Legal System", Lorand Bartels and Federico Ortino (eds.), pp. 215-237, Oxford University Press.

Miroudot, S. and K. Pertel (2015), "Water in the GATS: Methodology and Results", *OECD Trade Policy Papers*, No. 185, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/5jrs6k35nnf1-en

Moran, T.H. (2011), Enhancing the contribution of FDI to development: a new agenda for the corporate social responsibility community, international labour and civil society, aid donors and multilateral financial institutions. *Transnational Corporations*, 20(1), 69-103.

Moran, T. (2002), The relationship between trade, foreign direct investment, and development: new evidence, strategy, and tactics under the Doha Development Agenda negotiations. *Asian Development Bank's Study on Regional Integration and Trade: Emerging Policy Issues for Selected Developing Member Countries, September*.

Moretti, E. and D. Wilson (2015), *The effect of state taxes on the geographical location of top earners: evidence from star scientists* (No. w21120). National Bureau of Economic Research.

Nelson, R.R. and E.S. Phelps (1966), Investment in humans, technological diffusion, and economic growth. *The American economic review*, *56*(1/2), 69-75.

Nguyen, T.T (2010), *Competition Law, Technology Transfer and the TRIPS Agreement Implications for Developing Countries*, Edward Elgar Publishing, Inc., 2010.

Nikièma, S.H. (2014), "Performance Requirements in Investment Treaties", *Best Practices Series*, The International Institute for Sustainable Development, December 2014, http://www.iisd.org/sites/default/files/publications/best-practices-performance-requirements-investment-treaties-en.pdf .

Nolan A. and D. Pilat (2016), Benefitting from the Next Product revolution, OECD Insights.

OECD (2017), *Financing SMEs and Entrepreneurs 2017: An OECD Scoreboard*, OECD Publishing, Paris.

OECD (2016), "Localising Data in a Globalised World", forthcoming.

OECD (2015a), OECD Policy Framework for Investment, OECD Publishing, Paris.

OECD (2015b): Stone, S., J. Messent and D. Flaig (2015), "Emerging Policy Issues: Localisation Barriers to Trade", *OECD Trade Policy Papers*, No. 180, OECD Publishing, Paris, DOI: http://dxdoi.org/10.1787/5js1m6v5qd5j-en.

OECD (2015c), OECD Science, Technology and Industry Scorecard, OECD Publishing, Paris.

OECD (2015d), Market Openness Review of Lithuania, OECD.

OECD (2014a), "Tax incentives for R&D and innovation", in *OECD Science, Technology and Industry Outlook 2014*, OECD Publishing, Paris. http://dx.doi.org/10.1787/sti_outlook-2014-18-en

OECD (2014b), "Levelling the International Playing Field Between Public and Private Business: What have we Learnt so Far?", document prepared for the Meeting of the OECD Council at the Ministerial Level, 6-7 May, 2014, C/MIN(2014)20.

OECD (2011), "Globalisation, Comparative Advantage and Changing Dynamics of Trade", OECD Publishing.

OECD (2010), *Attractiveness for Innovation: Location Factors for International Investment*, OECD Publishing.

Office for Harmonization in the Internal Market (2013), "Intellectual Property Rights Intensive Industries: Contribution to Economic Performance and Employment in the European Union". Industry-Level Analysis Report, September 2013. Available at http://ec.europa.eu/internal_market/intellectual-property/docs/joint-report-epo-ohim-final-version_en.pdf

Ovadia, J.S. (2014). Local content and natural resource governance: The cases of Angola and Nigeria. The Extractive Industries and Society, 1(2), 137-146.

Park, W.G. (2008), "International patent protection: 1960–2005". *Research policy*, 37(4), 761-766.

Park, W G. and S. Wagh (2002), "Index of patent rights". *Economic freedom of the world*: 2002 annual report, 33-43.

Park, W. and D. Lippoldt (2008), "Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries", OECD Trade Policy Papers, No. 62, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/244764462745.

Picker, L. (2015), *Taxation and the Mobility of Inventors and Scientists*, The NBER Digest.

Pradhan, J.P. and N. Singh (2009), Outward FDI and Knowledge Flows: A Study of the Indian Automotive Sector. *International Journal of Institutions and Economies* 1 (1): 156-187.

PwC LLP, Japan - Corporate tax credits and incentives. (n.d.), Retrieved September 07, 2016, from http://taxsummaries.pwc.com/uk/taxsummaries/wwts.nsf/ID/Japan-Corporate-Tax-credits-and-incentives

Ricken, B. and G. Malcotsis (2011), *The Competitive Advantage of Regions and Nations: Technology Transfer Through Foreign Direct Investment.* Gower Publishing, Ltd.

Risch, M. (2010) "Trade Secret Law and Information Development Incentives," in "The Law and Theory of Trade Secrecy: A Handbook of Contemporary Research", R.C. Dreyfuss and K.J. Strandburg (eds.), Edward Elgar Publishing.

Roffe, P. and C. Spennemann (2006), "The impact of FTAs on public health policies and TRIPS flexibilities". *International Journal of Intellectual Property Management*, 1(1-2), 75-93.

Romer, P.M. (1994), "The origins of endogenous growth" *The journal of economic perspectives*, 8(1), 3-22.

Ruse-Khan, H.G. (2012), "The International Legal Framework for the Protection of Utility Models". Max *Planck Institute for Intellectual Property & Competition Law Research Paper*, (12-10).

Saggi, K. (2004), International technology transfer to developing countries, Commonwealth Economic Paper Series, Commonwealth Secretariat.

Sampath, P. G. and P. Roffe (2012), Unpacking the international technology transfer debate: fifty years and beyond. *ICTSD, Issue Paper*, 36.

Sauvant, K.P. and K. Hamdani (2015), An International Support Programme for Sustainable Investment Facilitation. ICTSD.

Sauvé, P. and M. Soprana (2016), Disciplining Investment Incentives: A Lost Cause? E15Initiative. Geneva: International Centre for Trade and Sustainable Development (ICTSD) and World Economic Forum, 2016. www.e15initiative.org/

Shan, W. (2010), Towards a Balanced Liberal Investment Regime: General Report on the Protection of Foreign Investment, International Academy of Comparative Law.

Sklarew, J.F. (2011), How can China and India serve as models for developing nations striving to build absorption capacity for renewable energy technologies. *Renewable Energy L. & Pol'y Rev*., 181.

Solow, R.M. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics Statistics*, 39 (3), 312-320. http://dx.doi.org/10.2307/1926047 .

Taubman, A. (2008), "Unfair competition and the financing of public-knowledge goods: the problem of test data protection". *Journal of Intellectual Property Law & Practice*, 3(9), 591-606.

Tavares-Lehmann, AT. et al. (eds.) (2016), *Rethinking Investment Incentives: Trends and Policy Options*, Columbia University Press.

Thursby, J.G. and M.C. Thursby (2006), *Here or There? A Survey on the Factors in Multinational R&D Location and IP Protection, Marion Ewing Kauffman Foundation*, Washington DC.

Tretheway, M. and R. Andriulaitis (2015), What Do We Mean by a Level Playing Field in International Aviation?, *International Transport Forum Discussion Papers*, No. 06, OECD, Paris.

Traore, N. and A. Rose (2003), Determinants of biotechnology utilization by the Canadian industry. *Research Policy*, *32*(10), 1719-1735.

UNCTAD (2014), *World Investment Report*, UNCTAD, Geneva.

UNCTAD (2013), *World Investment Report*, UNCTAD, Geneva.

UNCTAD (2006), *A Survey of Support by Investment Promotion Agencies to Linkages*, UNCTAD, New York and Geneva.

UNCTAD (2005), *World Investment Report 2005: Transnational Corporations and the Internationalisation of R&D*, Geneva, United Nations.

UNCTAD (2003), Foreign Direct Investment and Performance Requirements: New Evidence from selected countries, New York and Geneva.

UNCTAD (2001), *World Investment Report: Promoting Linkages*, UNCTAD, New York and Geneva

UNCTAD-ICTSD (2005), *Resource Book on TRIPS and Development, Cambridge*, New York, Melbourne, Madrid, Cape Town, Singapore, Sao Paulo.

United States Government Accountability Office (2008), Foreign Investment: Laws and Policies Regulating Foreign Investment in 10 Countries.

United States International Trade Commission (2010), China: Intellectual Property Infringement, Indigenous Innovation Policies, and Frameworks for Measuring the Effects on the US Economy.

United States Information Technology Office (2013), Written Comments to the U.S. Government Interagency Trade Policy Staff Committee in Response to Federal Register Notice Regarding China's Compliance with its Accession Commitments to the World Trade Organization (WTO) 20 September 2013.

Urata, S. and H. Kawai (2000a), "The Determinants of the Location of Foreign Direct Investment by Japanese Small and Medium-Sized Enterprises", *Small Business Economics*, Springer, Vol. 15(2), pages 79-103, September.

Urata, S. and H. Kawai (2000b), "Intrafirm Technology Transfer by Japanese Manufacturing Firms in Asia", in T. Ito and A. O. Krueger (eds.), *The Role of Foreign Direct Investment in East Asian Economic Development* (Chicago: The University of Chicago Press for the National Bureau of Economic Research).

Van Reenen, J. and L. Yueh (2012), Why Has China Grown So Fast? The Role of International Technology Transfer. *CEP Discussion Paper*, 1121.

Warda, J. (2001), "Measuring the Value of R&D Tax Treatment in OECD Countries", *STI Review* No. 27: Special Issue on New Science and Technology Indicators, OECD Publishing.

Wehrlé, F. and J. Pohl (2016), "Investment Policies Related to National Security: A Survey of Country Practices", OECD Working Papers on International Investment, 2016/02, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/5jlwrrf038nx-en

Wellhausen, R. L. (2013). Innovation in Tow: R&D FDI and investment incentives. Business and Politics, 15(4), 467-491.

White, J. (2011), Fostering Innovation in Developing Economies through SEZs, in Farole, T. and Gokhan Akinci, eds., *Special Economic Zones: Progress, Emerging Challenges, and Future Directions*, The World Bank.

WIPO (2016), Overview of Contractual Agreements for the Transfer of Technology" World Intellectual Property Organisation, Geneva, Switzerland. Available at http://www.wipo.int/export/sites/www/sme/en/documents/pdf/technology_transfer.pdf

WIPO (2014), Committee on Development and Intellectual Property, Fourteenth Session, Geneva, Nov. 10-14, 2014, CDIP/14/INF/11.

WIPO (2013), WIPO Survey on Technology Transfer Agreements and Antitrust, Prepared by the Secretariat (December 2013). Available at http://www.wipo.int/export/sites/www/ip-competition/en/studies/tta_survey.pdf.

WIPO (2010), Transfer of Technology, Document prepared by the Secretariat, Standing Committee on the Law of Patents, Fourteenth Session. Geneva, January 25 to 29, 2010 available at: http://www.wipo.int/edocs/mdocs/scp/en/scp_17/scp_14_4_rev_2.pdf.

WIPO (2008), Report on the International Patent System, Standing Committee on the Law of Patents, SCP/12/3.

WIPO (2004), WIPO Intellectual Property Handbook: Policy, Law and Use. Second Edition. WIPO PUBLICATION No. 489 (E)

WTO (2014), Committee on Trade-Related Investment Measures, Minutes of the Meeting held on 20 June 2014, G/TRIMS/M/36

WTO (2012) A Handbook on the WTO TRIPS Agreement, Eds. Antony Taubman, Hannu Wager & Jayashree Watal. Cambridge University Press 2012.

WTO (2005), Steps That Might Be Taken Within the Mandate of the WTO to Increase Flows of Technology to Developing Countries, Submission by India, Pakistan and the Philippines, WT/WGTTT/W/10.

WTO (2002), Trade-Related Investment Measures and Other Performance Requirements, Evidence on the Use, the Policy Objectives, and the Impact of Trade-Related Investment Measures and Other Performance Requirements, G/C/W/307/Add.1.

WTO (2001), Doha Declaration on the TRIPS Agreement and Public Health, WT/MIN(01)/DEC/2.

Yu, P.K. (2009), "The objectives and principles of the TRIPS agreement", *Houston Law Review* 979, 2009.

ANNEX

Annex Box 1. Types of legal contracts for the transfer of technology

The sale and purchase of the exclusive rights to a patented technology or of the permission to use a given technology or know-how, takes place through legal relationships between the owner or the supplier, called the "transferor", and the person or legal entity which acquires those rights or know-how, called the "transferee." The nature of legal relationships between them will depend on several factors including: the nature of the technology in question; the mode of its transfer (e.g. transfer of IPR or purchase of products or services); needs, capabilities and bargaining power of both sides of the transaction; other terms and conditions of the transfer (e.g. such as technical support offered by the transferor); the time horizon of the relationship; issues concerning product liability, indemnity and warranty; and other factors, including the legal environment and competitive and market contexts) (WIPO, 2016). To the extent that these legal relationships related to technology transfer are negotiated by both interested parties and are voluntary, they should be mutually beneficial to both sides (Park and Lippoldt, 2005).

The following main types of technology transfer agreements can be distinguished:

Sale or assignment of IPR: the owner transfers all the exclusive IPR to, for example, a patented invention, without any time or other restriction.

Licence contract: the owner permits another person or legal entity, in the country and for the duration of the patent, one or more of the "acts" which are covered by exclusive rights to the patented invention in that country. The "acts" are the "making or using of a product that includes the invention, the making of products by a process that includes the invention or the use of the process that includes the invention". The licensing contract usually contains a number of conditions by which the license is granted to the licensee including the conditions of payment, restrictions with respect to characteristics and marketing of products that are to be manufactured with the licence. In some jurisdictions patent law may require that a licensing contract is registered with the patent office which can have important legal implications both for the contracting and third parties.

Know-how contract: provisions concerning transfer of know-how can form a part of a licensing contract or they can be specified in a separate contract. They can regulate communication or transmission of tangible and intangible know-how. Tangible know-how or technical information and data can be transferred in the form of documents, blueprints, data for architectural plans, machinery manuals and documentation, specifications of inputs and materials, process charts or job descriptions for technical and professional personnel. Intangible know-how can be transferred through, for example, exchange of information between the licensor and licensee employers, visit to a production facility or training in the factors of the recipient. The provisions concerning know-how typically cover various measures to safeguard against its disclosure to unauthorised parties.

Franchise: franchise contracts specify legal conditions for combining reputation, technical information and expertise of one party with the investment, production or operation of another party. The outlet for marketing of such goods and services is usually based on a trademark or service mark. The license of such a mark is normally combined with the supply by owner of know-how in some form (technical information or assistance, marketing information, etc.).

Acquisition of equipment and capital goods: technology can also be transferred through a purchase of machinery or tools needed for the manufacture of products or the application of process and the associated instructions and user manuals. Legal provisions covering such transactions are sometimes associated with, or specified in, a license contract or a know-how contract.

Consultancy arrangements: technology transfer, especially of know-how, can also be effectuated through purchasing of consultancy services.

Joint venture agreements: alliances between two or more separate entities can take the form of equity joint ventures or contractual ventures. Equity joint venture requires creation of a separate legal entity with the agreement of all parties while contractual ventures are agreements stating the objectives of the venture and rights and obligations of the parties related to attainment of these objectives.

Turnkey projects: complex technological projects, such as for example construction of a factory or a power plant, which require complex business and legal arrangements are sometimes entrusted to one party who undertakes to hand over to the client an entire project according with agreed performance standards. The turnkey projects usually involve supplying to the client the design for the project and the technical information on its operation.

Technology transfer agreements

Technology transfer agreements are an important form of trade in intellectual property such as patents and trademarks, as well as in information not covered by IPR such as know-how. Their significance is likely to continue to grow with increasing complexity of products requiring ever higher numbers of IPR, expanding numbers of business partners in supply chains and the strategic role of IPR and know-how as negotiatings tools (e.g. Lugard, 2014). The wide variety of legal forms of technology transfer agreements presented above reflects the diversity of actors and contexts in which technology is traded. The review of literature and national legislation conducted for this paper suggests however that technology transfer agreements are not subject to specific regulation and are treated similarly to other contracts. Two noteworthy exceptions to this rule include requirements with respect to registration of technology licensing contracts and exceptions or special treatment of technology agreements in competition laws.

Source: This is mainly authors' abbreviation of information contained in WIPO (2016).

Annex Box 2. List of anti-competitive practices

1. *Anti-competitive price practices*

1.1. Royalty concerns

1.1.1 Excessive royalties

If the patent owner is in a dominant position sometimes competition law may consider the amount of royalties that he or she is allowed to negotiate, since excessive royalties may be deemed an abuse of the dominant position.

1.1.2 Post-expiration royalties

The question is whether it is appropriate to require a licensee of IP to pay royalties after the IP has expired, been revoked, or otherwise ceased to exist, for example if the agreement is still enforceable.

1.1.3 Total sale royalties

When the royalty provisions in the contract require a patent licensee to pay the licensor a percentage of total sales or revenue, regardless of which products sold actually incorporated the invention of the licensed patent.

1.2. Restrictions on product prices

A technology transfer agreement may contain an obligation restricting the licensee's rights to set prices for technology-embodied products. Under such an obligation, the licensee must sell the products at a specific fixed price, or a price which is not higher than a maximum price or lower than a minimum price fixed by the licensor.

2. Anti-competitive non-price practices

2.1. Grantback

A grantback is a provision in a technology transfer agreement obligating the licensee to grant the licensor an exclusive or non-exclusive licence, or an assignment, of the licensee's improvements in the transferred technology, which are protected by IP law.

2.2. Tying and package licensing

Generally, tying (tie-in, or bundling) is defined as 'an agreement by a party to sell one product but only on the condition that the buyer also purchases a different (or tied) product, or at least agrees that he will not purchase that [tied] product from any other supplier'. Tying in technology transfer occurs when a licensor conditionally transfers her technology (the tying technology) to those who also agree to buy another product or service. If the tied product or service is another technology, the tying is package licensing. Tying in technology transfer can be 'contractual tying', in which the tying is clearly stipulated in the technology transfer agreement, and/or 'technological tying' (product integration tying), in which 'the tying and tied products are bundled together physically or produced in such a way that they are compatible only with each other'.

2.3. Non-challenge clause

No challenge clauses are inserted in patent licensing agreements to prohibit the licensee from challenging the validity of the patent for a period of time, usually the duration of the contract.

2.4. Exclusivity in technology transfer agreements

2.4.1 Exclusive licensing

Exclusive licensing refers to agreements 'which restrict the right of the licensor to license others and possibly also to use the technology itself'. When granting an exclusive license to a specific licensee, the licensor gives up her rights to practice the technology as well as the right to grant additional licenses. Generally, exclusive licensing is granted for a limited territory, field of use or customer group.

2.4.2 Exclusive dealing

Exclusive dealing (or a non-compete obligation) occurs when a technology transfer agreement prevents the licensee from using competing technologies. It prevents the so-called 'inter-technology free riding' to assure the licensor that the technology transferred to the licensee will not be used to benefit the licensor's competitors. Furthermore, it gives the licensee incentives to focus on the transferred technology with her best efforts.

3. Refusal to transfer technology

The act of refusing to license can, under certain circumstances raise antitrust concerns if there is an abuse of dominant position. This particular assessment is really fact-intensive.

4. Contractual restriction on downstream purchasers

When the right holder imposes restrictions on downstream purchasers – consumers or end-users of IPR-embodied products. Such restrictions are imposed either (i) directly through purchase agreements between the right holder (as a producer) and the purchasers, or (ii) indirectly through a combination of licensing agreements between the right holder and her licensees and purchase agreements between her licensees (as producers) and the purchasers.

Source: This is mainly authors' abbreviation of information contained in Nguyen (2010).

Annex Box 3. List of prohibited clauses by country

The Philippines

Section 87 of the IP Code covers the prohibited clauses which are adverse to competition and trade.

Prohibited Clauses (Section 87, IP Code)

1) Those which impose upon the licensee the obligation to acquire from a specific source capital goods, intermediate products, raw materials, and other technologies, or of permanently employing personnel indicated by the licensor;

2) Those pursuant to which the licensee reserves the right to fix the sale or resale prices of the products manufactured on the basis of the license;

3) Those that contain restrictions regarding the volume and structure of production;

4) Those that prohibit the use of competitive technologies in a non-exclusive technology transfer arrangement;

5) Those that establish full or partial purchase option in favor of the licensor;

6) Those that obligate the licensee to transfer for free to the licensor the inventions or improvements that may be obtained through the use of the licensed technology;

7) Those that require payment of royalties to the owners of patents for patents which are not used;

8) Those that prohibit the licensee to export the licensed product unless justified for the protection of the legitimate interest of the licensor such as exports to countries where exclusive licenses to manufacture and/or distribute the licensed product(s) have already been granted;

9) Those which restrict the use of the technology supplied after the expiration of the technology transfer arrangement, except in cases of early termination of the technology transfer arrangement due to reason(s) attributable to the licensee;

10) Those which require payments for patents and other industrial property rights after their expiration or termination of the technology transfer arrangement;

11) Those which require that the technology recipient shall not contest the validity of any of the patents of the technology supplier;

12) Those which restrict the research and development activities of the licensee designed to absorb and adapt the transferred technology to local conditions or to initiate research and development programs in connection with new products, processes or equipment;

13) Those which prevent the licensee from adapting the imported technology to local conditions, or introducing innovation to it, as long as it does not impair the standards prescribed by the licensor; and

14) Those which exempt the licensor from liability for non-fulfillment of his responsibilities under the technology transfer arrangement and/or liability arising from third party suits brought about by the use of the licensed product or the licensed technology.

China

The requirements are found in several sources, including the Technology Regulations, Article 329 of China's Contract Law, a Supreme Court interpretation of Article 329, the Anti-Monopoly Law ("AML") and regulations implementing the AML with respect to intellectual property rights.

Those authorities provide that any agreement that illegally monopolizes a technology, impedes technological progress, or infringes another's technology shall be void; no party with a dominant market position may abuse its position to restrict or eliminate competition; dominant position is defined as capacity to control price, quantity or other trading conditions in the relevant market, or deter others from entering the market; and ownership of IPR, by itself, does not create a presumption of dominant position, but may be a factor.

A contract potentially violates Article 329 when it:

a) Restricts the transferee's right to further develop the technology;

b) Restricts the transferee's procurement of similar or competing technology;

c) Unreasonably restricts the transferee's use of the technology in the market, including with respect to quantity, variety, prices, or distribution channels;

d) Unreasonably requires purchase of goods, or services that are not necessary for the technology;

e) Unreasonably restricts the transferee's channels for procuring parts, materials, or equipment; or

f) Restricts the right to challenge the validity of the transferor's intellectual property rights.

A party in a dominant position has potentially abused its position unlawfully when it:

a) Sells goods at unreasonably high prices or buys at unreasonably low prices;

b) Refuses to trade with another party without justifiable cause;

c) Requires a party to trade exclusively with a designated party without justifiable cause;

d) Ties products or imposes unreasonable trading conditions without justifiable cause;

e) Applies dissimilar prices or terms to different parties with equal standing;

f) Sends an obviously false notice of infringement; or

g) Requires an exclusive grant-back of intellectual property rights.

European Union

COMMISSION REGULATION (EU) No 316/2014 of 21 March 2014 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of technology transfer agreements

Article 4

Hardcore restrictions

1. Where the undertakings party to the agreement are competing undertakings, the exemption provided for in Article 2 shall not apply to agreements which, directly or indirectly, in isolation or in combination with other factors under the control of the parties, have as their object any of the following:

a) the restriction of a party's ability to determine its prices when selling products to third parties;

b) the limitation of output, except limitations on the output of contract products imposed on the licensee in a nonreciprocal agreement or imposed on only one of the licensees in a reciprocal agreement;

c) the allocation of markets or customers except:

(i) the obligation on the licensor and/or the licensee, in a non-reciprocal agreement, not to produce with the licensed technology rights within the exclusive territory reserved for the other party and/or not to sell actively and/or passively into the exclusive territory or to the exclusive customer group reserved for the other party,

(ii) the restriction, in a non-reciprocal agreement, of active sales by the licensee into the exclusive territory or to the exclusive customer group allocated by the licensor to another licensee provided the latter was not a competing undertaking of the licensor at the time of the conclusion of its own license,

(iii) the obligation on the licensee to produce the contract products only for its own use provided that the licensee is not restricted in selling the contract products actively and passively as spare parts for its own products,

(iv) the obligation on the licensee, in a non-reciprocal agreement, to produce the contract products only for a particular customer, where the license was granted in order to create an alternative source of supply for that customer;

(d) the restriction of the licensee's ability to exploit its own technology rights or the restriction of the ability of any of the parties to the agreement to carry out research and development, unless such latter restriction is indispensable to prevent the disclosure of the licensed know-how to third parties.

2. Where the undertakings party to the agreement are not competing undertakings, the exemption provided for in Article 2 shall not apply to agreements which, directly or indirectly, in isolation or in combination with other factors under the control of the parties, have as their object any of the following:

a) the restriction of a party's ability to determine its prices when selling products to third parties, without prejudice to the possibility of imposing a maximum sale price or recommending a sale price, provided that it does not amount to a fixed or minimum sale price as a result of pressure from, or incentives offered by, any of the parties;

b) the restriction of the territory into which, or of the customers to whom, the licensee may passively sell the contract products, except:

(i) the restriction of passive sales into an exclusive territory or to an exclusive customer group reserved for the licensor,

(ii) the obligation to produce the contract products only for its own use provided that the licensee is not restricted in selling the contract products actively and passively as spare parts for its own products,

(iii) the obligation to produce the contract products only for a particular customer, where the licence was granted in order to create an alternative source of supply for that customer,

(iv) the restriction of sales to end-users by a licensee operating at the wholesale level of trade,

(v) the restriction of sales to unauthorized distributors by the members of a selective distribution system;

c) the restriction of active or passive sales to end-users by a licensee which is a member of a selective distribution system and which operates at the retail level, without prejudice to the possibility of prohibiting a member of the system from operating out of an unauthorised place of establishment.

3. Where the undertakings party to the agreement are not competing undertakings at the time of the conclusion of the agreement but become competing undertakings afterwards, paragraph 2 and not paragraph 1 shall apply for the full life of the agreement unless the agreement is subsequently amended in any material respect. Such an amendment includes the conclusion of a new technology transfer agreement between the parties concerning competing technology rights.

Andean Community

Decision No. 291 Establishing the Regime for the Common Treatment of Foreign Capital and Trademarks, Patents, Licenses Agreements and Royalties

14. In order to register transfer of technology, trademark or patent contracts, Member Countries may bear in mind that those contracts not contain the following:

a. Clauses by virtue of which the supply of technology or the use of a trademark bears with it the obligation of the recipient country or enterprise to acquire, from a given source, capital equipment, intermediate products, raw materials or other technologies, or to use on a permanent basis personnel indicated by the enterprise supplying the technology;

b. Clauses by virtue of which the enterprise selling the technology or enterprise granting use of a trademark reserves the right to set sale or resale prices for the products that are manufactured using that technology;

c. Clauses that contain restrictions on the volume and structure of production;

d. Clauses that prohibit use of competing technologies;

e. Clauses that establish a total or partial purchase option in favor of the technology supplier;

f. Clauses that compel the technology buyer to transfer to the supplier all such inventions or improvements as may be obtained through use of that technology;

g. Clauses that require the payment of royalties to the holders of patents or trademarks for patents or trademarks that are

not used or have expired; and

h. Other Clauses having an equivalent effect

Except in special cases that have been duly judged by the competent national agency of the recipient country, clauses prohibiting or limiting in any way the export of the products manufactured using the respective technology, shall not be accepted. In no case shall clauses of this kind be allowed with respect to Subregional trade or to the export of similar products to third countries.

Thailand

According to Patent Act Article 41 and Ministerial Regulation No. 25 clause 4, the licensing agreement for patent that has the following clauses shall be regarded as being unjustifiably anti-competitive:

1) a requirement that the licensee shall use other invention or design of the patentee or the owner of the petty patent with remuneration for such use, unless it is proved that the requirement is necessary for the effective working of the patent or petty patent or the invention or design cannot be obtained from any other source in the country and the remuneration is suitable with the benefits from such invention or design;

2) a prohibition that the licensee shall not challenge or raise a defense that the patent is invalid pursuant to Section 54 or 64 or the petty patent is invalid pursuant to Section 65 novies or Section 77 octies;

3) a requirement that the licensee shall disclosed to the licensor any improvement of the licensed invention or design or allow the patentee to exclusively exploit such improved invention or design without providing for appropriate compensation for such exploitation;

4) a requirement that the licensee shall pay remuneration for the use of the licensed invention or design after the expiry of the patent or petty patent;

5) a requirement that the licensee shall be subject to such a condition, restriction or remuneration regarded as being unjustifiably anti-competitive by the court, the Board of Patents or the committees appointed under the law on competition.

The Copyright Act, Article 15, and Ministerial Regulation (B.E. 2540) Issued under Copyright Act, provide in clause 1 that the following licensing conditions shall be deemed to unfairly restrict competition:

1) A condition binding the licensee to obtain materials used in the production of the licensed work in whole or in part from the copyright owner or from the seller specified by the copyright owner either with or without remuneration, unless the condition is necessary to make the copies fulfill the standard as set by the copyright owner, or the materials are not available from other sources within the territory and the remuneration is not higher than the price of materials of equal quality which are obtainable from other persons.

2) A condition prohibiting the licensee to obtain materials used in the manufacture of the licensed work in whole or in part from one or several sellers specified by the copyright owner, unless the omission of the condition would make the produced copies fail to fulfill the standards set by the copyright owner, or the materials are not obtainable from other sources in the territory.

3) A condition or restriction binding the licensee concerning the employment of persons to produce the copies of work under the license, unless it is necessary to make the copies fulfill the standard as set by the copyright owner or to keep the trade secret of the copyright owner or to render necessary technical service.

4) A condition stipulating a royalty rate for the copyright license which is unfair when compared to the rate stipulated by the copyright owner in another license for the same copyright work in which the said licensee has similar relationship or status and the license takes place at the same period of time.

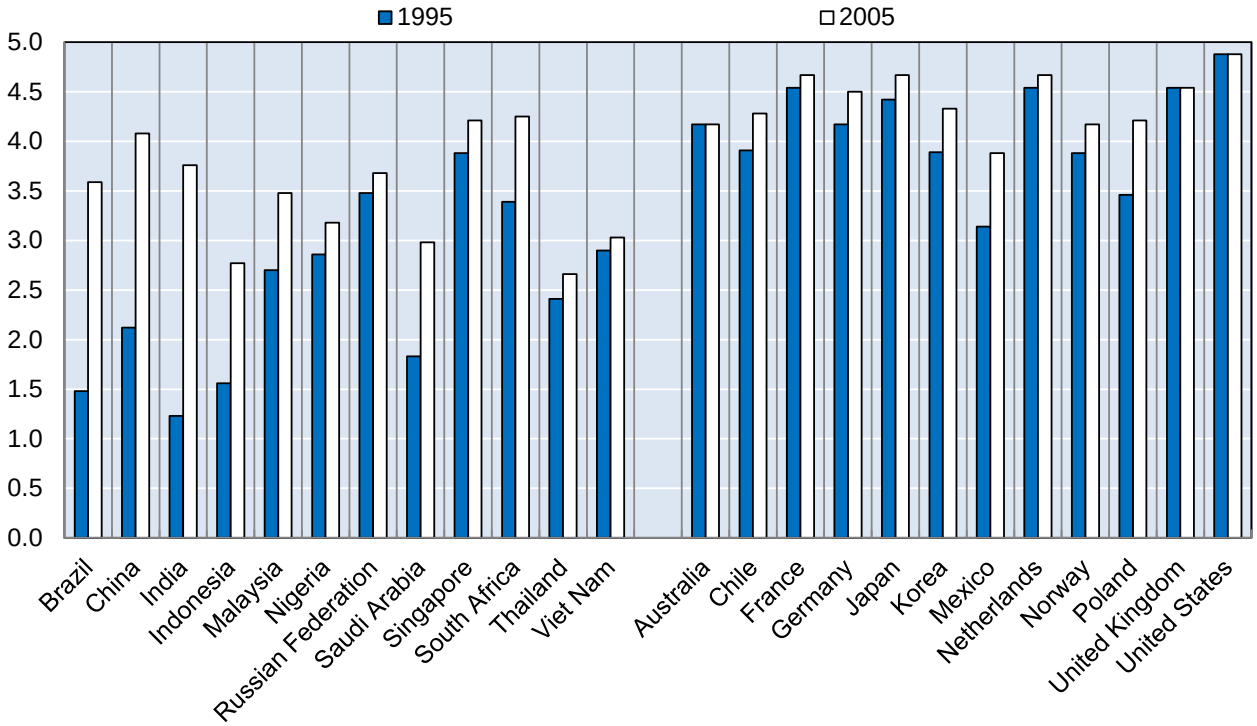
5) A condition or restriction binding the licensee concerning the research or study of the licensed copyright work.

6) A condition binding the licensee to assign the copyright in the work adapted or developed from the licensed copyright work to the copyright owner or to any other person, or to authorize the copyright owner or another person to hold exclusively the right with respect to the adapted or developed work unless the copyright owner or the said person shall pay reasonable remuneration to the licensee.

7) A condition in favour of the licensor to terminate the license arbitrarily and without reasonable cause.

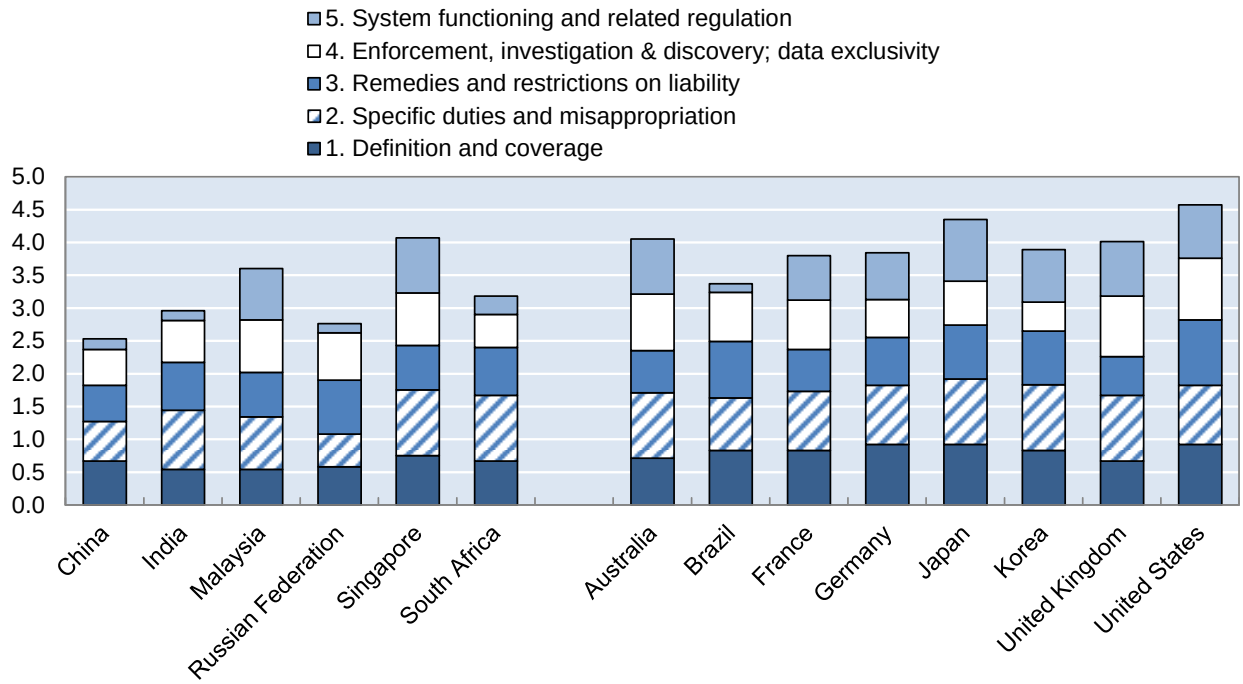
Source: authors' own elaboration.

Annex Figure 1. Ginarte-Park index of patent protection, 1960–2005



Source: Park, W.G., International patent protection: 1960–2005, Res Policy (2008).

Annex Figure 2. Trade Secrets Protection Index, by country and index component, 2010



Note: the range for scores in each sub-category is 0-1 and all sub-categories are equally weighted.
Source: Schultz, M. F. and D. Lippoldt (2014).

Annex Figure 3. Equity restrictions by sector

	Australia	Brazil	Canada	Chile	China	France	Germany	India	Indonesia	Japan	Korea	Malaysia	Mexico	Netherlands	Norway	Poland	Russia	Saudi Arabia	South Africa	United Kingdom	United States	Average
Primary	0	0	0.138	0.125	0.322	0.113	0.056	0.269	0.334	0.000	0.250	0.208	0.094	0.056	0.125	0	0	0.521	0	0.125	0.125	0.1362
Agriculture & Forestry	0	0	0	0	0.075	0.225	0	0.263	0.148	0	0.250	0.415	0	0	0	0	0	0.042	0	0	0	0.0675
Agriculture	0	0	0	0	0.150	0.450	0	0.525	0.247	0	0.500	0	0	0	0	0	0	0.042	0	0	0	0.0911
Forestry	0	0	0	0	0	0	0	0	0.05	0	0	0.830	0	0	0	0	0	0.042	0	0	0	0.0439
Fisheries	0	0	0.500	0.500	1	0	0.225	0.500	0.500	0	0.500	0	0.375	0.225	0.500	0	0	1	0	0.500	0.500	0.3250
Mining & Quarrying (incl. Oil extr.)	0	0	0.050	0	0.138	0	0	0.050	0.538	0	0	0	0	0	0	0	0	1	0	0	0	0.085
Secondary	0	0	0	0	0.098	0	0	0.032	0.032	0	0.060	0.107	0	0	0	0	0.024	0.042	0	0	0.027	0.020
Manufacturing	0	0	0	0	0.047	0	0	0.032	0.007	0	0	0	0	0	0	0	0.033	0.042	0	0	0	0.008
Food and other	0	0	0	0	0.013	0	0	0.1	0	0	0	0	0	0	0	0	0	0.042	0	0	0	0.007
Oil ref. & Chemicals	0	0	0	0	0.010	0	0	0.058	0.033	0	0	0	0	0	0	0	0	0.042	0	0	0	0.007
Metals, machinery and other minerals	0	0	0	0	0.035	0	0	0	0	0	0	0	0	0	0	0	0	0.042	0	0	0	0.004
Electric, Electronics and other instruments	0	0	0	0	0.013	0	0	0	0	0	0	0	0	0	0	0	0	0.042	0	0	0	0.003
Transport equipment	0	0	0	0	0.163	0	0	0	0	0	0	0	0	0	0	0	0.167	0.042	0	0	0	0.018
Electricity	0	0	0	0	0.325	0	0	0.063	0.04	0	0.417	0.500	0	0	0	0	0	0.042	0	0	0.192	0.075
Electricity generation	0	0	0	0	0.15	0	0	0.125	0.04	0	0.333	0.500	0	0	0	0	0	0.042	0	0	0.383	0.075
Electricity distribution	0	0	0	0	0.500	0	0	0	0.04	0	0.500	0.500	0	0	0	0	0	0.042	0	0	0	0.075
Construction	0	0	0	0	0.125	0	0	0	0.15	0	0	0.250	0	0	0	0	0	0.042	0	0	0	0.027
Tertiary	0.042	0.057	0.097	0.044	0.257	0.014	0.014	0.244	0.398	0.050	0.130	0.196	0.102	0.007	0.102	0.111	0.177	0.223	0.072	0.027	0.068	0.116
Distribution	0	0	0	0	0.038	0	0	0.090	0.500	0	0	0.167	0.075	0	0	0	0	0.083	0	0	0	0.045
Wholesale	0	0	0	0	0.025	0	0	0	0.375	0	0	0	0	0	0	0	0	0.042	0	0	0	0.021
Retail	0	0	0	0	0.05	0	0	0.180	0.625	0	0	0.333	0.15	0	0	0	0	0.125	0	0	0	0.070
Transport	0.060	0.250	0.167	0.354	0.354	0.150	0.150	0.125	0.352	0.167	0.492	0.083	0.428	0.075	0.333	0.075	0.267	0.278	0.167	0.075	0.500	0.233
Surface	0	0.250	0	0.063	0.125	0	0	0	0.150	0	0	0	0.333	0	0	0	0.300	0.750	0	0	0	0.094
Maritime	0	0	0	0.500	0.438	0.225	0.225	0	0.405	0	0.975	0.250	0.450	0	0.500	0	0	0.042	0	0	1	0.239
Air	0.180	0.500	0.500	0.500	0.5	0.225	0.225	0.375	0.500	0.500	0.500	0	0.500	0.225	0.500	0.225	0.500	0.042	0.500	0.225	0.500	0.368
Hotels & restaurants	0	0	0	0	0	0	0	0	0.063	0	0	0.05	0	0	0	0	0.05	0.042	0.1	0	0	0.015
Media	0	0.375	0.500	0.125	0.925	0	0	0.200	0.825	0.188	0.563	0.625	0.375	0	0.125	0.25	0.25	0.521	0.25	0.225	0.25	0.313
Radio & TV broadcasting	0	0.250	0.500	0.250	0.950	0	0	0.150	0.750	0.375	0.750	0.750	0.500	0	0.250	0.500	0.500	0.042	0.500	0.450	0.500	0.379
Other media	0	0.500	0.500	0	0.900	0	0	0.250	0.900	0	0.375	0.500	0.25	0	0	0	0	1	0	0	0	0.246
Communications	0.200	0	0.400	0	0.500	0	0	0	0.230	0.2	0.275	0.250	0	0	0	0	0	0.125	0	0	0	0.104
Fixed telecoms	0.200	0	0.400	0	0.500	0	0	0	0.200	0.4	0.275	0.250	0	0	0	0	0	0.125	0	0	0	0.112
Mobile telecoms	0.200	0	0.400	0	0.500	0	0	0	0.260	0	0.275	0.250	0	0	0	0	0	0.125	0	0	0	0.096
Financial services	0	0	0	0	0.283	0	0	0.204	0.146	0	0.033	0.150	0	0	0.033	0	0.308	0.097	0.008	0	0	0.060
Banking	0	0	0	0	0.250	0	0	0.188	0.050	0	0	0.188	0	0	0	0	0.25	0.125	0	0	0	0.050
Insurance	0	0	0	0	0.375	0	0	0.4	0.100	0	0	0.250	0	0	0	0	0.625	0.125	0	0	0	0.089
Other finance	0	0	0	0	0.225	0	0	0.025	0.288	0	0.100	0.013	0	0	0.100	0	0.05	0.042	0.025	0	0	0.041
Business services	0	0	0	0	0.125	0.003	0	0.563	0.469	0	0	0.063	0	0	0.313	0	0.125	0.125	0.250	0	0	0.097
Legal	0	0	0	0	0.500	0.01	0	1	0.500	0	0	0.250	0	0	1	0	0.5	0.125	0.500	0	0	0.209
Accounting & audit	0	0	0	0	0	0	0	1	0.500	0	0	0	0	0	0.250	0	0	0.125	0.500	0	0	0.113
Architectural	0	0	0	0	0	0	0	0	0.438	0	0	0	0	0	0	0	0	0.125	0	0	0	0.027
Engineering	0	0	0	0	0	0	0	0.25	0.438	0	0	0	0	0	0	0	0	0.125	0	0	0	0.039
Real estate investment	0.200	0	0	0	0	0	0	1	1	0	0	0.300	0.167	0	0.250	0.900	0.333	0.900	0	0	0	0.240
Total FDI Index	0.021	0.028	0.073	0.045	0.218	0.027	0.017	0.181	0.270	0.025	0.129	0.170	0.068	0.014	0.074	0.056	0.096	0.219	0.036	0.036	0.066	0.089

Note: Indicative scale: domestic minority holding 0.25; domestic majority holding 0.5.