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Foreign direct investment spillovers and tax havens

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Prague, July 31, 2018 _____

Signature

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Abstract

Offshore activities of multinational enterprises challenged the traditional measures of foreign direct investment. One of the consequences is that productivity spillovers from foreign direct investment likely differ for offshore and onshore investors. This heterogeneity is; however, virtually unexplored in the existing literature on productivity spillovers. The analysis in this thesis sheds light on the onshore/offshore heterogeneity and finds compelling evidence that investments from offshore jurisdictions (commonly referred to as tax havens) are associated with fewer productivity spillovers to the supplier sectors.

Abstrakt

V posledních dekádách vzrostla schopnost nadnárodních korporací využívat daňové ráje a snižovat tak svoji daňovou zátěž, případně skrývat svou skutečnou identitu. Jedním z dopadů těchto praktik je zkreslení (nadhodnocení) oficiálních statistik přímých zahraničních investic, což nevyhnutelně ovliňuje i výzkum zabývající se zahraničními investicemi. Tato práce je jednou z prvních, která výše zmíněné zkreslení explicitně zahrnuje do své analýzy, když zkoumá následné efekty přímých zahraničních investic na produktivitu domácích firem, a to zvlášť pro investice přicházející z daňových rájů a zvlášť pro investice z ostatních zemí. Hlavním poznatkem práce je, že tyto efekty jsou statisticky významně nižší u investic z daňových rájů.

Keywords: foreign direct investment, tax havens, meta-analysis, base erosion and profit shifting, offshore financial centers

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Chapter 1

Introduction

Foreign direct investment (FDI) is one of the traditional areas of economic research. It is perceived to be a source of scarce capital, and consequently a force boosting employment and economic growth. The benefits of FDI; however, do not end there. Investments of foreign firms expose local enterprises to new technologies, increase the demand for domestic firms' products, and foreign companies also frequently offer personnel training or other services to the local suppliers. Such effects potentially raise domestic firms' productivity and thus are usually referred to as FDI productivity spillovers.

The research on spillover effects has been plentiful in recent decades and identified various conditions under which the FDI spillovers are likely to materialize. Most notably, Tomáš Havránek and Zuzana Iršová performed two large meta-analyses assessing the impact of both vertical (Havránek & Iršová, 2011), i.e., inter-industry, and horizontal (Iršová & Havránek, 2013), i.e., intra-industry, productivity spillovers. One important dimension; however, seems to be virtually missing in the spillover literature: The heterogeneity of spillover effects brought

about by routing the capital through offshore financial centers (commonly referred to as tax havens).

The process of globalization rapidly increased the mobility of capital, and one of the results is that the official FDI statistics do not necessarily reflect the FDI flows as they are traditionally understood (Blanchard & Acalin, 2016), but to a big extent represent a so-called transit investment, i.e. flows through rather than to the country.

Transit investment is often a by-product of various tax avoidance schemes or other offshore activities, and therefore the motivations driving transit investment differ substantially from the incentives behind traditional FDI. Consequently, even the resulting spillover effects are likely to differ for traditional (onshore) and transit (offshore) investment.

Building on the meta-analysis by Havránek & Iršová (2011), this thesis tries to capture the heterogeneity in spillover effects with respect to onshore/offshore dynamic, and test the hypothesis posed by Ledyaeva et al. (2015) that at least some forms of offshore FDI do not generate positive productivity spillovers. The main findings of the thesis corroborate this view. The higher share of FDI from offshore jurisdictions is indeed found to be associated with fewer FDI spillovers (to the supplier sector).

The remainder of the thesis is structured as follows: Chapter 2 presents the traditional FDI theory, Chapter 3 introduces the offshore perspective and its consequences for FDI, Chapter 4 is devoted to FDI productivity spillovers, Chapter 5 presents the methodology and

describes the data set used for the analysis, Chapter 6 discusses the thesis' results, and Chapter 7 concludes.

Chapter 2

Foreign direct investment

2.1 Traditional theory

The view of foreign direct investment (FDI) has somewhat changed in the last fifty years or so. In the 1970s, many policy-makers and even some economists saw FDI as a negative force detrimental to the welfare, which displaces domestic production and contributes to the creation of monopolistic markets (Markusen & Venables, 1999). Since then, this approach has been largely abandoned, and most of the world's countries started competing in their attempts to attract FDI, often by means of some preferential (tax) treatment of foreign investors. The main benefit associated with FDI is the expansion of capital stock of the host country (i.e., country to which FDI is directed), which in turn increases demand for labour and boosts employment in the area where the investment is directed and consequently positively affects economic growth (see, e.g. Alfaro et al., 2010). In recent decades, more attention was given to benefits like raising the host country's technological level and other so-called spillover effects,

which have an impact on local companies. I will not; however, go into further detail right here, as these effects are discussed thoroughly in Chapter 4.

Let us now move to the definition of FDI. The fifth edition of the IMF's Balance of Payments Manual states that FDI concerns investment activities of a resident entity in one economy (direct investor) which are aiming to acquire a lasting interest in an enterprise in another economy. This lasting interest is defined as at least 10 percent of ordinary shares or voting power (or the equivalent for unincorporated enterprises) and implies a long-term relationship between the foreign investor and the investee. Not only the initial transaction is recorded as FDI flow, but all subsequent transactions between the company's affiliates, e.g. intra-company loans, are considered FDI as well (IMF, 1993)(IMF, 1993).

Henceforth, I will use the term multinational enterprise (MNE) to identify companies that partake in FDI activities. MNEs are business entities with usually a high share of intangible assets like patents, know-how, brands, trademarks, etc. Such assets are often subjects of FDI. The reasons being that unlike physical assets, usage of intangibles by one affiliate typically does not reduce other affiliates' ability to use the asset and that they can be transferred at very low costs (Markusen, 1995). For purposes of my analysis, it is important to realize that fees for the use of intangible assets, like royalty payments or licence fees, are also recorded as FDI.

Now, that it is clear what FDI entails and who performs it, let us

move to the incentives behind FDI. In the traditional view, MNE must possess some sort of advantage over indigenous firms in order to make a profit in the foreign market, because local firms, naturally, have superior knowledge of labour market conditions, regulations, business practices, and/or consumer preferences in their domestic market, do not have to overcome any language barriers, etc. Moreover, even if the MNE decides to sell its products in the foreign market, it does not necessarily have to establish an affiliate, but may resort to exports or licencing. The circumstances under which MNE decides to enter the foreign market directly are summarized in Dunning's OLI paradigm, which states that there are three conditions which, if all satisfied provide a necessary incentive for an MNE entry. The conditions are ownership, localization, and internalization advantage; hence, the abbreviation OLI (Dunning, 1993).

The ownership advantage typically takes the form of a superior production process (e.g. ownership of patents and trade secrets, access to cheaper resources, or more advanced technology), better marketing and management techniques, reputation for quality, etc. (Markusen, 1995), but can also be a result of MNE's better access to financing (Kinda, 2016). However, the ownership advantage by itself does not explain why MNE would not prefer exporting its products over FDI. On the contrary, FDI makes it more difficult to keep company secrets from leaking to competitors, and operating in fewer countries requires to comply with fewer sets of regulations. Therefore, even though the ownership advantage likely enables MNE to make a profit in the for-

eign market, it does not fully explain why would MNE establish a foreign affiliate.

If on top of ownership advantage FDI provides a location advantage as well, then exporting the products is no longer an ideal option. Location advantage arises when the proximity to customers is essential for the business (e.g., in a service industry), if there are sizeable transportation costs associated with exporting, or if the participation in the foreign market grants access to cheaper inputs or skilled labour. Moreover, formal trade barriers between the two countries in question.[1], or preferential treatment like FDI incentive programmes may also play an important role. However, even if ownership and location advantages are present, the enterprise considering FDI may still be better off selling a licence enabling a foreign firm to utilize the production process, and the other intangible assets. Licencing is a particularly viable option if the host country's institutions offer strong protection of intellectual property rights (Javorcik, 2004*a*).

The last condition necessary for FDI to take place (at least according to this traditional view) is the presence of internalization advantage, which makes establishing an affiliate more profitable than licencing. An internalization advantage is likely to exist when regulating and enforcing licencing contracts is too costly (Javorcik, 2004*a*), when leakage of information constituting the ownership advantage is

[1]Notice that, holding other factors fixed, more formal trade barriers (e.g., tariffs and quotas) should increase the FDI inflows. The opposite is; however, true for informal trade barriers like language barriers, or differences in business ethics. In their study of migrant networks, Javorcik et al. (2011) show, that presence of migrant groups is associated with increased FDI with migrants' country of origin, especially if the migrants achieved tertiary education.

more probable than if the investor kept full control, or if the intangible assets are difficult to transfer to another business entity, e.g., reputation, business ethics, or know-how (see, e.g. Teece, 1977).

Dunning's OLI paradigm gives us a comprehensive view of MNE's rationale for FDI; however, we have to be aware of at least two more things: Firstly, as Markusen (1995) notes, the paradigm constitutes only a necessary, not a sufficient, condition for FDI, so even if MNE enjoys the desired advantages, it does not mean that FDI actually takes place. Secondly, this traditional view of FDI does not consider other possible drivers behind international investment flows which were described in more recent literature, most notably technology-seeking FDI (see, e.g. Fosfuri & Motta, 1999; Driffield & Love, 2007) and offshore FDI (see, e.g. Haberly & Wójcik, 2014; Ledyaeva et al., 2015). These other types of FDI are further discussed in the remainder of this chapter and in Chapter 3.

For the above-described form of FDI, I henceforth interchangeably use terms traditional FDI and technology-exploiting FDI (sometimes also referred to as market-seeking FDI or horizontal FDI) as this kind of foreign investment assumes that investing firm possesses some superior technology, and exploits this technology to its advantage in order to get an edge over firms already participating in the market.

2.2 Alternative motives for FDI

Technology-exploiting FDI assumes that MNE is primarily interested in making a profit in the host country. However, since MNEs

are rather concerned with the profitability of a company as a whole, and not necessarily in every single market they participate in, this assumption may in some cases be relaxed.

The first example is technology-seeking (or technology-sourcing) FDI, which turns the initial argument of traditional FDI theory upside down. Instead of utilizing its own technology advantage, MNE may actually enter the foreign market in order to get access to the technological advantages of companies operating in the host country. Fosfuri & Motta (1999) point to the flood of foreign investment to Silicon Valley as an example of technology-seeking FDI, and Neven & Siotis (1996) found evidence of technology-seeking FDI in their analysis of US and Japanese FDI flows to Europe.

Secondly, FDI may be categorized as vertical (as opposed to traditional horizontal FDI), if MNE decides to directly enter the foreign market only to get access to cheaper inputs, to take advantage of lower taxes, or to use the host country as an export platform to third countries. Vertical FDI may, for example, enable MNE to exploit the benefits of host country's membership in a free trade area, or its preferential trade agreements (see, e.g., Ekholm et al., 2007).

Thirdly, MNEs use various FDI schemes involving offshore financial centers (OFCs), to avoid taxation (Kleibard, 2011*b*), or to disguise their true identities (Ledyaeva et al., 2015). Henceforth, I will label FDI associated with such use of OFCs as offshore FDI. The set of incentives driving offshore FDI likely differs a lot from incentives behind the types of FDI we discussed so far. To the best of my knowledge,

onshore/offshore heterogeneity of FDI has not been studied very extensively in the existing literature. Only recently, Haberly & Wójcik (2014) conducted the first analysis assessing the effects of traditional FDI determinants on offshore FDI. They found that offshore FDI is as responsive to distance between home and host country as onshore FDI, that unlike onshore FDI, lower corporate income taxes do not increase levels of offshore FDI, and that offshore FDI is not affected by the host country's level of development, and, hence, it is a global phenomenon. The next chapter should clarify what the motivations behind offshore direct investment flows are, and what are the implications for researchers tackling the issue of FDI.

Chapter 3

The offshore perspective

As the process of (economic) globalization progressed, the traditional view of FDI as a surplus of capital accumulated in one country in search for higher rates of return abroad (Ledyaeva et al., 2015), has once again been challenged. Offshore activities of MNEs and associated corporate tax base erosion and profit shifting increased rapidly in recent decades and not only enabled MNEs to pay disproportionately low taxes with respect to their economic activity but also substantially affected the flows of FDI around the world as offshore financial centers became major players in international investment.

However, before we get into that, it is necessary to properly define what do we mean by the term offshore financial center (OFC). The notion of offshore is rather an abstract one, but it can be simplified as the ability to practice regulatory arbitrage, the ability to avoid country's taxes and other regulations while still participating in that country's market. Offshore financial center (often also referred to as tax haven or in more recent literature as secrecy jurisdiction, see, e.g. Cobham et al., 2015) is then a jurisdiction that offers offshore services to in-

ternational investors, and intermediates FDI between original source of the investment and its ultimate destination. In order to be classified as OFC, jurisdiction has to not only attract non-domestic capital with low or no taxes but also has to provide a high degree of financial secrecy. OFCs play an important role in various legal tax planning schemes, but as Christensen (2012) notes, the legally enforceable secrecy makes them also susceptible to being used for criminal activities like fraud, bribery, embezzlement, or tax evasion. Other researchers stress the positive aspects of OFCs and see their existence largely as a response to weak or over-regulated onshore financial systems (see, e.g., Stal & Cuervo-Cazurra, 2011).

The importance of OFCs has been growing in recent decades. UNCTAD (2015) estimated that roughly a third of FDI is routed through OFCs before reaching its ultimate destination, approximately 20 percent of all United States' (US) corporate profits are booked in OFCs, ten times the increase since the 1980s (Zucman, 2014). Moreover, the share of US MNEs' foreign income has grown by 14 percentage points between 1996 and 2004 (Grubert, 2012), which can largely be attributed to MNEs locating their intangible assets in offshore jurisdictions and to profit shifting activities. The funds retained in OFCs are among other things used for acquisitions of foreign companies and for provision of intra-company loans; hence again, shaping the world's FDI flows. The impact of offshore activities on international investment flows seem to have emerged in the last couple of decades. In 1995, James R. Markusen analyzed behaviour of MNEs and concluded that

tax avoidance schemes have negligible, if any, effect on the location of FDI (Markusen, 1995).

3.1 Base erosion and profit shifting

In order to fully realize why offshore activities have such an impact on international investment flows, we need to understand the mechanics of a related phenomenon, corporate tax base erosion and profit shifting (BEPS).

BEPS refers to strategies that MNEs employ to avoid paying corporate taxes. Essentially, it is a process of relocating multinational's taxable income from affiliates in non-OFC countries to the ones residing in low-tax (or even no-tax) jurisdictions. Low-tax jurisdiction is typically an OFC, but it can also be a more standard jurisdiction which offers preferential tax regimes (e.g., FDI incentives) to MNEs. The ability to manipulate where the income is "taxed" gives MNEs an advantage over local firms which, by definition, do not have affiliates in multiple countries and therefore cannot avoid taxes in this manner. The ultimate consequences are that there is an unlevel playing field between MNEs and their local competition and that sovereign-states lose part of their tax revenue as they are not able to effectively tax income of multinationals generated in their country. BEPS is; therefore, an unintended consequence of economic liberalization, where the world's economy became global (i.e., high mobility of capital), whilst politics remained local (i.e., confined to nation states). To battle these adverse consequences, OECD (2013) formulated an Action Plan on BEPS with

the aim to better align taxation rights with economic activity.

We start with the argument of an unlevel playing field and its impact on FDI. Let us assume that absent profit shifting activities, the assumption of capital ownership neutrality holds (i.e., taxation does not influence who owns the capital), and normal after-tax returns on investments are the same for all investors, as it is the equilibrium price (for detailed discussion, see Kleibard, 2011*a*). Moreover, productivity advantage is the deciding factor if there are multiple companies interested in carrying out the same investment, e.g., acquire another company. In such a desirable scenario, normal pre-tax returns have to differ across jurisdictions for the equilibrium to be established. Pre-tax returns will be higher in non-OFC (higher-tax) countries and lower in low-tax countries. Once we introduce BEPS as a possible strategy for MNEs with affiliates in both higher- and lower-tax countries, the capital ownership neutrality does not hold any more, because MNEs are able to earn higher pre-tax returns in non-OFC jurisdiction, shift the income earned on the investment to low-tax jurisdiction and pay the corporate income tax there (if any). MNEs are then able to outbid local firms and undertake FDI projects even if their non-profit-shifting competitors are more productive. BEPS; therefore, leads to over-engagement in FDI and inefficient allocation of capital.

The empirical evidence of BEPS is relatively rich (for a review of the empirical literature, see Dharmapala, 2014), and is mostly focused on the estimation of corporate tax revenue losses. Crivelli et al. (2015) estimated that OECD countries lose $207 billion and developing coun-

tries lose $105 billion as a result of profit shifting, UNCTAD (2015) focused on tax revenue losses for developing countries and found $90 billion annual loss, and Clausing (2016) found an increasing trend of US government revenue losses ranging between $77 and $111 billion in 2012. Moreover, De Mooij & Ederveen (2008) conducted a meta-analysis focusing also on the implications of BEPS on international investment and found that a ten percentage point reduction in effective corporate tax rate increases jurisdiction's FDI stock by approximately one third. There are several ways how BEPS can increase the country's FDI stock. I already mentioned the case of capital ownership neutrality violation, and before that, I alluded to the possibility of intra-company loans. An intra-company loan is a simple BEPS method, where affiliates in OFCs grant loans to affiliates residing in non-OFC countries. The associated tax-free interest payments, then channel the profits from jurisdictions where the sales or production took place to OFCs. On top of that, country's FDI stock may increase substantially, if that country is a part of treaty shopping scheme. Treaty shopping is another method of BEPS, and since the procedure is often quite complex, I devote it a separate section.

3.1.1 Treaty shopping

One of the principles of international corporate taxation is that it is administered by bilateral agreements and therefore taxation of cross-border flows is treated differently between different countries. Treaty shopping is then a practice of diverting FDI flows through jurisdic-

tions with favourable tax treaties and reaping the treaties' benefits. As a result, according to UNCTAD's bilateral FDI statistics, around 40 percent of FDI inflows to India enter the country from Mauritius, approximately 50 percent of Chinese inward FDI comes from Hong Kong, and more than a third of Russian outward FDI is directed to Cyprus. The case of Cyprus can; however, be a result of the round-tripping investment, which will be discussed in later. Moreover, Weichenrieder & Mintz (2008) describe the case of Germany where MNEs route investment through third countries in order to avoid withholding taxes, and Weyzig (2013) shows that FDI diversion increases if the countries of ultimate source and final destination of investment, both have a bilateral tax treaty with the Netherlands, because MNEs take advantage of Dutch tax treaties to reduce their tax bill. Furthermore, Blanchard & Acalin (2016) point to the high correlation of FDI inflows and outflows in Hungary. They explain the correlation by the unique attributes of the Hungarian bilateral tax treaty with the United States. The treaty, in turn, puts Hungary to the position of a conduit country for direct investment flows between European Union and the United States; hence, once again highlighting the impact of treaty shopping on FDI flows.

The bilateral nature international tax system inevitably brings about inconsistencies between individual treaties, such as a different definition of residence of a company, which can then be exploited by MNEs to reduce their tax burden. Typically, the idea behind bilateral tax treaty is to avoid double taxation of an income, and the treaties usu-

ally work well in this sense; however, the treaty shopping schemes sometimes lead to double non-taxation (OECD, 2013), where none of the jurisdictions involved taxes the income. The best-known example of this non-taxation scheme is so-called Double Irish Dutch Sandwich which was first described by Drucker (2010) on the case of Google, but similar strategies are used by other MNEs with sizeable intangible assets (see, e.g., Kleinbard, 2013; for the example of Starbucks).

Google's double Irish Dutch sandwich

In this section, I present only a brief review double Irish Dutch strategy, for detailed discussion, see, e.g., Kleibard (2011*b*). Let us start with the assumption that Czech affiliate of Google, Google Czech Republic, is making a profit that would be taxable in the Czech Republic had it not been shifted elsewhere. In order to avoid corporate income tax, Google Czech Republic pays a royalty payment to Ireland Limited (another Google's subsidiary) which is a tax resident of Ireland. The royalty payment gives Google Czech Republic the right to use Google's search and advertisement technologies, and will not be taxed because both countries involved, are members of the European Union (EU). Ireland Limited then pays a second royalty payment to Google BV, residing in the Netherlands; hence, the payment is again tax-free. Subsequently, Google BV transfers the whole sum via another royalty payment to Google Holdings. Now here is the trick: From the point of view of Dutch tax authorities Google Holdings is an Irish company, and thus the payment is not taxable as it involves two

EU members; however, from the Irish tax authorities' point of view, Google Holdings resides in Bermuda (where its "mind and management" are located), and therefore Ireland does not tax the payment. The whole amount of money could still be taxed by US tax authorities since Google is an American company, and as such, is subject to US anti-avoidance rules designed specifically to prevent avoiding taxes by means of dual-residency, i.e., so-called triangular cases. However, US tax rules also allow Google BV and Ireland limited to decide not to be treated as corporations, but as mere divisions of Google Holdings, so from US tax authorities' standpoint, they do not exist, and hence the royalty payments will not be taxed by the US. Moreover, the corporate tax rate in Bermuda is zero percent, and therefore no taxes will be paid on the profit that was originally generated by Google Czech Republic, and the so-called stateless income is created.

The fact that some MNEs are able to reduce their effective tax rate close to zero is part of the explanation why offshore FDI is not responsive to statutory tax rates (Haberly & Wójcik, 2014). Notice that corporate tax rates of the countries involved play no role in the double Irish Dutch tax-dodging strategy.

3.1.2 Round-trip investment

So far in this chapter, it was shown that offshore FDI is a result of tax avoidance schemes where capital is routed through OFCs. However, as I already mentioned, OFCs are also used for the secrecy they provide to the investors and consequently avoiding taxes is not the

only incentive that gives rise to offshore FDI.

The practice of disguising domestic investment as FDI, i.e., channeling capital through offshore jurisdiction(s) and re-investing it back in the country where the funds originally came from, is called round-trip investment (or round-tripping of capital), and since the whole procedure is done by means of direct investment flows, it is another source of offshore FDI. The primary purpose of a round-trip usually is to hide investor's identity, and thus the origin of the funds, from government officials (see, e.g., Christensen, 2012; and Ledyaeva et al., 2015). However, especially in the case of developing countries, it can also be motivated by property rights protection or efficient financial institutions that are established in OFCs (see, e.g., Sharman, 2012; and Sutherland et al., 2010).

Ledyaeva et al. (2015) examined round-tripping in Russia and concluded that it is mainly driven by onshore corruption. The more corrupt Russian regions exhibit significantly higher inward- and outward-FDI from OFCs, most notably Cyprus, whilst for onshore FDI the relationship reverses. Firstly, OFCs are used to launder proceeds of criminal activities[1] (including public sector corruption), and secondly, round-trip investment is a way for businesses to hide their identity from corrupted state officials and hence protect themselves from unfavourable state intervention or even expropriation of property. Therefore, on paper, higher corruption may not seem to discourage FDI, but

[1]In should be noted that multiple OFCs may be involved in a single round-trip. Christensen (2012) mentions a money laundering scheme where embezzled funds were routed through eleven different OFCs.

it is likely a result of the substitution of "real" (onshore) FDI with domestic funds disguised as foreign investments. Vlcek (2014) studied Chinese round-tripping patterns and confirmed the conclusion regarding property rights protection. Moreover, Sharman (2012) argues that Chinese firms channel their funds through OFCs in order to ease their financial constraints and reduce transaction costs.

Even though there are not that many findings on the extent of round-tripping activities it does not seem by any stretch of the imagination to be a marginal phenomenon (or at least in some jurisdictions it is not). Xiao (2004) and Vlcek (2014) both estimated that up to 50 percent of all inward FDI in China is a result of capital round-tripping.

3.2 What does FDI actually measure?

Statistical offices around the world should address the fact that substantial proportion of FDI they report is so-called transit investment, i.e., flows through rather than to the country[2] and hence the FDI figures tend to be inflated.

Blanchard & Acalin (2016) show that there is a high correlation between quarterly FDI inflows and outflows, something that would not be anticipated by traditional FDI theory, which does not account for transit investment and does not anticipate the emergence of conduit countries. However, a closer look at offshore practices of MNEs, like treaty shopping or round-tripping, can easily explain the strong

[2]To be fair, few of them already do that, namely statistical offices of Austria, Hungary, Luxembourg, and Netherlands.

dependency of FDI flowing in and out of the country. Therefore, the onshore/offshore dynamic should be taken into account by both researchers and statisticians as the implications of onshore and offshore FDI are likely to be very different.

Chapter 4

FDI spillovers

Let us now move to the core issue of the thesis, FDI spillovers. As I discussed in Chapter 2, FDI is a source of capital and employment, but it can also positively affect the productivity of other firms in the domestic economy as foreign investors (MNEs) introduce new technologies,[1] management or marketing practices, and other novelties to the domestic economy, or as their entry into the market intensifies competition in various sectors of the economy. This likely is the case if FDI is assumed to be technology-exploiting, meaning that a foreign firm has some sort of technological advantage over domestic producers. Such effects which boost local firms' productivity are usually called FDI productivity spillovers (or just FDI spillovers), as they spill over from foreign investors to the companies that were already present in the domestic market.[2]

[1] MNEs are a leading force in terms of R&D expenditure (Arnold & Javorcik, 2009)

[2] There is also evidence that FDI increases wages (e.g., Lipsey & Sjöholm, 2005) and productivity (e.g., Arnold & Javorcik, 2009) of acquired companies. Although my focus here is limited to firms not directly affected by FDI, as is usual in spillover literature, I would argue that assessing the impact on acquired firms with respect to investor's origin (and differentiating between offshore and onshore investors) is an interesting area for future research.

Historically, the research of FDI spillovers was centred around the issue of market imperfections and government intervention. In other words, researchers were trying to answer the question whether (or under which circumstances) is it justifiable for national governments to utilize FDI incentives, like tax holidays or tax breaks, in order to increase the productivity of domestic firms. The idea justifying government intervention is that foreign investors do not take into account the positive externalities (FDI spillovers) while considering their investments, as they are not compensated for them, and hence the sum total of investment tends to be below the socially optimal level. Certain investment opportunities are not deemed profitable for foreign investors since the costs outweigh private benefits. However, the positive effects for the economy as a whole may be higher than the costs of investment, and the government may thus decide to share the costs with a foreign investor in an attempt to attain the socially optimal level of investment. In this view, technology and knowledge are seen as public goods which once introduced into the economy can diffuse to other market participants and increase their productivity. National governments may try to maximize this public good provision by bridging the gap between social and private returns to FDI.

Another justification for FDI incentives is the imperfect flow of information. One might expect that labour mobility, competition, and contracts with MNEs are sufficient channels to diffuse technology across national borders. However, Girma & Wakelin (2007), or Crespo et al. (2009) show in their research on economic geography

that knowledge is effectively transmitted only over small distances. In other words, they find that FDI spillovers are regional. The main reasons being that skilled workers, with work experience in MNEs, are likely to prefer a job in the region they currently work in[3], MNEs prefer local suppliers and distributors to minimize transportation and communication costs, and that only a direct competition with MNEs; hence, participating in the same market, leads to knowledge transfers.

As a consequence, market imperfections such as public goods provision and imperfect flow of information, together with the promotion of local production and employment, often served as a reason for granting FDI incentives.

4.1 FDI incentives

Before I move to the specific definition of FDI spillovers and channels of spillover transmission, let me briefly summarize the issues facing governments which are trying to attain the socially optimal level of investment.

Firstly, there is an identification problem. As Blomström & Kokko (2003) point out, FDI incentivization makes sense only for marginal investors who would not invest had it not been for the incentive. Identifying these investors is; however, a challenging task. Moreover, the technology-exploiting view of FDI is essential: Foreign investor has to fundamentally differ from domestic firms otherwise it would make

[3]The fact that labour markets are relatively more narrow than country-wide product markets is the reason why wage spillovers are confined to even smaller regions than productivity spillovers (Lipsey & Sjöholm, 2005).

no sense to put him in an advantageous position vis-á-vis domestic competitors, who would not be subject to preferential tax treatment.

Secondly, even if we are positive about market failure and benefits of intervention, it is difficult to evaluate the benefits of FDI spillovers. Therefore, the favourable treatment of foreign investors (i.e., FDI incentive) may very well end up with its costs outweighing the benefits. Haskel et al. (2007) famously analyzed two FDI incentives programmes in the UK and found that in the case of Motorola in the early 1990s, the spillover benefits amounted to 18 841 £ compared to 14 356 £ per job subsidy, whilst in the case of Siemens in mid 1990s, spillover benefits were only 3 430 £, more than ten times less than the per job subsidy of 35 417 £.

Thirdly, most countries offer some sort of FDI incentives and thus are competing with each other. The result is that incentivization programmes tend to offset each other, investment decisions are not made based on market fundamentals, most benefits are transferred to MNEs (Blomström & Kokko, 2003), few spillovers are generated, and tax revenues decrease in all countries participating in this race to the bottom. Moreover, unilateral withdrawal from this system would lead to substantial decrease in FDI (see Head et al., 1999); hence, multilateral action is needed (For example, as in the EU, where investors from all member countries are treated equally, and the rules for granting investment incentives are harmonized). In this sense, FDI incentives are similar to trade debate on tariffs and quotas and the multilateral agreements in GATT/WTO. Bond & Guisinger (1985) even calculated

tariff equivalent to FDI subsidy.

Fourthly, part of the investment may end up being a transit investment which only passes through the country in order to reap the benefits of preferential treatment, and then is redirected to some other destination.

Lastly, even positive FDI spillovers may have adverse effects on some sectors of the economy. If, for example, foreign investor drives its less efficient domestic rivals out of the market and thus increases the productivity of the industry, but decides to source inputs from abroad, then the domestic supplier sector would suffer from decreased demand for its products.

All in all, profitability of FDI incentives is difficult to assess ex-ante, FDI incentives create opportunities for rent-seeking activities and discriminate local firms, which are not eligible for the preferential treatment and therefore I would advocate retiring and replacing such policies (preferably with a multilateral treaty) and luring foreign investors by other means, such as investment promotion agencies.

4.2 Definition

Early research of FDI spillovers was focused on horizontal spillovers, i.e., intra-industry spillovers, from MNE to its competitors. However, since at least Blalock & Gertler (2003) and Javorcik (2004*b*) the attention was largely turned to vertical spillovers, i.e., spillovers to the supplier (backward spillovers) and customer sectors (forward spillovers). This turn makes a lot of sense if we realize that MNEs try to preclude

leakage of information to their competitors but at the same time are likely to encourage knowledge transfers to their suppliers (Alfaro et al., 2010). Therefore, vertical (especially backward) spillovers should be more likely to materialize. I will follow this distinction and analyze horizontal and vertical spillovers separately.

The fact that research of FDI spillovers was mostly concerned with market imperfections, often led to a rather narrow definition of spillovers. Specifically, only those effects for which foreign investor was not compensated, i.e., externalities, were considered as spillovers since other effects could not justify market intervention. In my case, I am interested in any positive effects attributable to foreign investment including competition effects (increased or decreased competition in sector where MNE invests, and its supplier and customer sectors), demand shocks (e.g. increased efforts of suppliers in order to get contracts with investor), even personnel training conducted by MNEs and paid for by domestic companies, or other assistance provided by MNEs. Hence, I adopt a broad definition of spillovers. Formally, I define FDI spillovers as semi-elasticities from FDI spillover regression, which usually takes the following form:

$$ln(Productivity)_{ijt} = \beta_0 \ + \ \beta_1 * Horizontal_{jt} \ + \ \beta_2 * Backward_{jt} + \\ + \beta_3 * Forward_{jt} \ + \ \beta_4 * Controls_{ijt} \ + \ u_{ijt},$$

where subscript i denotes firm, subscript j stands for industry and t is a time subscript. Variable $Productivity$ is a measure of productivity

of domestic firms, $Horizontal$ is a share of foreign enterprises in firm i's own industry j, and $Backward$ and $Forward$ are shares of foreign enterprises in firm i's customer and supplier sector, respectively. Alternatively, $Backward$ may denote a ratio of firm i's output sold to foreign enterprises and $Forward$ a share of inputs firm i buys from foreign firms. $Controls$ is a vector of control variables (which will be discussed later on in this chapter), and u is a normal disturbance term. β_1, β_2, and β_3 are the coefficients of interest which measure the impact foreign presence on the productivity of domestic firms, i.e., measures of spillovers (interpreted as semi-elasticities, as variable $Productivity$ is in logarithmic form). For example, interpretation of positive and significant coefficient β_1 would be that one percentage point increase in the share of foreign firms in sector j is associated with an increase in productivity of host country firms in the same sector by β_1 percent.

4.3 Channels of transmission

There are several channels through which FDI spillovers can be transmitted. These channels are often interdependent, and thus it might be difficult to assess which one is responsible for a given increase in productivity. The goal of this section; however, is to provide only a general outline of possible ways of spillover transmission, for a detailed review see, e.g., Crespo & Fontoura (2007), or Javorcik (2008).

4.3.1 Imitation and reverse engineering

Imitation and reverse engineering is the first and probably the most obvious channel. Local firms may simply observe MNEs actions and products and then try to replicate or recreate them. The idea is that the introduction of new technology is associated with substantial R&D expenses which could be too high (or rather too risky) for smaller sized local companies. Contrary to that, MNEs have higher upside potential of successful R&D activities, since they need to be done only once to benefit all of MNE's affiliates. That is also why MNEs are responsible for most of the world's R&D expenditure (Arnold & Javorcik, 2009). As soon as the technology is successfully implemented, local firms can imitate management or marketing practices, or perform reverse engineering of products and thus benefit from R&D whose costs are borne solely by a foreign investor. Imitation and reverse engineering are most likely to be useful to companies operating in the same sector as the investor and thus materialize in the form of horizontal spillovers. However, management and marketing practices of a multinational may end up being beneficial to firms in other sectors as well. Successful imitation should be more prevalent if the home and the host country are similar in terms of their culture (e.g., a common language, or a similar business culture). An additional positive effect of imitation is that it reduces domestic firms' entry costs to foreign markets (at least to the ones where the MNE operates) and hence increases their ability to export.

4.3.2 Labour mobility

The second channel is labour mobility. If the employees of MNEs have knowledge of the superior technology used by MNE or were subject to superior training, it is reasonable to assume that they utilize this knowledge once they are employed by a local firm, or once they start up their own companies (Görg & Strobl (2005) found evidence supporting this hypothesis). Local firms may thus benefit from the presence of MNEs as they increase the supply of trained workers. MNEs are; however, aware of this phenomenon and may decide to prefer exports over FDI (as we discussed in Chapter 2) if the risk of technology diffusion is too high. Moreover, labour mobility may even have an adverse effect on the productivity of domestic firms: If MNEs offer higher wages than local companies, and there is some evidence that they do so (e.g., Arnold & Javorcik, 2009), they may deprive local firms of the most talented workers. The sign of the spillover effect resulting from labour mobility is therefore ambiguous. Fosfuri et al. (2001) constructed a theoretical model where they try to identify under which circumstances do positive spillovers materialize. They find that local firms are likely to outbid MNEs and thus attract trained workers if competition is low (technology diffusion is not that harmful) and if knowledge is easily transferable and MNE can train more workers at a low cost.

4.3.3 Competition effects

Another way how the presence of foreign firms can positively affect the productivity of local ones is intensified competition brought about by the entry of a multinational. The overall impact of this channel is; however, once again unclear. On the one hand, MNE's entry may break up national monopolies, or at least restrict their market power, or simply force local firms to step up their game, i.e., engage in R&D, introduce new technologies, reduce prices, and/or use factors of production more efficiently. Such scenario not only increases the productivity of industry to which FDI is directed but also benefits firms (and households) in other sectors of the economy. On the other hand, the entry of MNE may decrease local firms' market shares to the point that they end up operating at a less efficient scale and hence become less productive. In the long-run; however, we could expect that the least productive firms will be forced out of the market, and the overall productivity will increase (unless the MNE becomes a monopoly). Markusen & Venables (1999) present some evidence supporting this claim.

4.3.4 Backward and forward linkages with domestic firms

The last channel of FDI spillover transmission I want to discuss here is the channel I already briefly touched on in the paragraphs above, that is backward and forward linkages with domestic firms. The idea behind is that more linkages with local firms, for example, a higher share of inputs that MNEs buy from local companies, cre-

ate more opportunities for spillovers to occur. The mechanics of this channel are described in one the most widely cited papers in the field: Multinationals, linkages, and economic development written by Andrés Rodriguez-Clare in 1996. According to his model, spillovers are more likely to materialize when the communication costs between the home and the host country are high, and if the two countries are similar in terms of technological development. Hence, FDI spillovers are expected to be higher when the investor is distant in terms of geographical distance, the legal system, and cultural and social norms, and if the local firms are developed enough to be reliable suppliers of the MNE. Otherwise, the MNE may decide to prefer imports over contracts with local companies, despite the fact that relying on imports increases uncertainty about the timeliness of delivery and thus incurs increased carrying costs of inventory. Let us now look on the two linkage channels separately.

Backward linkages benefit domestic firms if the investment carried out by MNE results in increased demand for local firms' products, if contacts with MNE and compliance with its rules increases domestic firm's propensity to export, or if MNE provides some sort of assistance to local firms in order assure sufficient quality of its inputs. This assistance may have a form of technical support such as leasing of machinery, or of personnel training regarding, for example, inventory management techniques. And indeed, Javorcik (2008) found that forty percent of suppliers surveyed in her study received some assistance from their MNE customer. Furthermore, according to Gorod-

nichenko et al. (2015), a direct link between foreign and domestic firms increases the innovation activity of domestic firms. Moreover, the supplier sector may increase its productivity simply by means of intensified competition: As local firms compete to become a supplier of MNE, they may, for example, increase investments or undergo technical audits and find out about their current deficiencies. Such improvements in the supplier sector may then in turn benefit also MNEs' competitors and therefore result in horizontal spillovers as well. The demand for local products can; however, also decrease due to the entry of a multinational. That could be the case if MNE had its global supplier of inputs and thus would not be likely to award contracts to local companies.

Forward linkages generate positive spillovers to the customer sector if the entry of MNE leads to decrease in price, and/or increase in quality of local firms' inputs. This effect; however, seems to be of much smaller importance than spillovers resulting from backward linkages, because MNEs mostly produce end-user goods (Damijan et al., 2003) and often export most of their production (Javorcik, 2008). Hence, there is little potential to establish forward linkages. Moreover, Rodriguez-Clare (1996) even argues that forward linkages are conditioned by the existence of backward linkages, and since there are fewer incentives for MNEs to provide assistance to companies in the customer sector, the occurrence of forward spillovers is expected to be much less prevalent.

4.4 Determinant factors

Once we have defined what are the possible channels of FDI spillover transmission, we may ask what are the circumstances under which these channels indeed serve as vehicles for knowledge transfers and competition effects. Spillovers from FDI are not uniform across countries and may change as time progresses. We may observe different results in different studies, for example Haskel et al. (2007) found positive and significant horizontal spillovers in their analysis of UK industries, Javorcik & Spatareanu (2008) obtained opposite results in their analysis of Romanian firms, and Javorcik (2004*b*) found no effect on firms operating in the same sector, but found evidence of positive and significant spillovers to the supplier sector. That; however, does not necessarily mean that some researchers correctly estimated the true effect, whilst others failed to do so. In the previous section, I already discussed how geographical distance and cultural proximity can affect whether spillovers take place through vertical linkages, but there are many other factors determining if and to what extent spillovers occur. In the following paragraphs, I present a brief rewiew of the factors that I consider to be the most important ones. For a deep inquiry into the deterninant factors of FDI spillovers see, e.g. Smeets (2008).

4.4.1 Absorptive capacity

Let us start with one of the more complex determining factors, absorptive capacity. Narula & Marin (2003, p. 23) define absorptive capacity as: *"... the ability to internalise knowledge created by others*

and modifying it to fit their own specific applications, processes, and routines." In other words, it is the ability of domestic firms to learn from foreign investors. This ability is then composed of several other factors: Theoretical model of Alfaro et al. (2010) points out to the importance of human capital and well-developed financial system, whilst technological gap between foreign investor and local companies, and domestic firm's level of R&D expenditure seem to affect absorptive capacities as well (Blalock & Gertler, 2004). Large foreign presence in an industry may indicate that domestic firms were not able to learn from their foreign competitors, it may indicate a low absorptive capacity of domestic firms.

A certain level of a technological gap between MNE and local companies is necessary in order to benefit from MNE presence; however, if the gap is too wide, domestic firms may not be able to imitate new technologies. At the same time, a too small gap could mean that domestic firms do not have a lot learn from MNE and spillovers may not occur. Therefore, we would not expect a linear effect of a technological gap on the level of FDI spillovers, but rather the optimal difference in terms of technological development is likely to be a small but significant edge of MNE over domestic firms. Moreover, if wide technological gap is also associated with high wage differential between MNE and local firms, then the labour mobility is not expected to channel many spillover effects as skilled employees of MNE are not likely to seek new job opportunities in domestic firms.

Absorptive capacity is also affected by the human capital stock

of a given industry, or by the share of skilled workers (if we were to take a microeconomic perspective). The relationship here is quite straightforward, higher human capital stock indicates more absorptive capacities and more FDI spillovers (Blalock & Gertler, 2004).

Much less obvious is the impact of the financial system on absorptive capacity, especially in the case of an underdeveloped financial system. Absorptive capacities of domestic firms are dampened if they face substantial credit constraints as they cannot react very swiftly to the new market conditions, and make adjustments according to MNE's requirements. The entry of a multinational company can ease these constraints if it brings about scarce capital, which is then distributed amongst domestic firms. On the other hand, as Harrison & McMillan (2003) found, if the MNE decides to borrow on the local market, e.g., in order to hedge against exchange rate risk, then it may even aggravate the credit constraints as MNEs are usually seen as lower-risk borrowers than local firms. The impact of underdeveloped financial system on absorptive capacity is therefore unclear; although, it does not seem that FDI would improve creditworthiness of local companies (Javorcik & Spatareanu, 2009).

Finally, international experience of domestic firms (usually approximated by trade openness of a country, or a sector of interest) may increase their absorptive capacity. If, for example, the participation of a firm in a foreign market requires some of its employees to have advanced language skills, then these employees may make it easier to establish vertical linkages or imitate MNE's products and/or practices.

On the other hand, exporting firms have less potential to learn from MNEs as they are to some extent already exposed to foreign technology. Moreover, domestic firms with international experience are less likely to be driven out of the market by MNE entry because they already face competitive pressures in the foreign market(s). Typical example of a sector with little international experience (due to low export propensity) and small absorption capacity, but with sizeable potential to learn from foreign competitors, and create many linkages, is the service sector. High potential for horizontal spillovers is one of the reasons why several authors voiced their opinion in favour of service sector liberalisation (see, e.g., Lesher & Miroudot, 2008; or Javorcik, 2008).

4.4.2 Intellectual property rights

Another factor, determining whether FDI spillovers materialize, is the protection of intellectual property rights (IPR). Strong protection encourages MNEs to transfer even high quality, cutting-edge technology and thus creates more learning potential for domestic firms, but at the same time, strong protection of IPR is an obstacle to imitation and reverse engineering. Weak IPR protection, on the other hand, is usually associated with low technology FDI and a shift of focus from manufacturing towards distribution (Javorcik, 2004*a*). Lower technology FDI; however, does not necessarily need to be undesirable. If this level of technology results in a small but significant technology gap, which as we discussed in the previous section is optimal, then there

would be more spillovers due to the weak IPR protection. However, if the protection of IPR is considered dangerously weak, then MNEs may decide to prefer cross-border trade and not invest at all.

4.4.3 Degree of foreign ownership

When an MNE decides to invest in a foreign country, it may do so by means of fully-owned foreign affiliate, or by forming a joint project with a local firm(s). The decision-making process and its implications were analyzed in detail by Javorcik & Spatareanu (2008). Which option is perceived to be more profitable may actually be closely related to the issue discussed in the previous paragraph, protection of intellectual property rights. In joint projects, MNE does not have full control over the management of the company, and the leakage of important information is; thus, more probable. Weak protection of IPR may even exacerbate this risk, disincentivise formation of joint ventures and favour fully foreign-owned projects. Analogically to the case of IPR protection, joint projects provide a smaller incentive to transfer high-quality technology, but the spillovers are more likely to occur because integration of the local partner in domestic economy may lead to a higher reliance on inputs produced by local companies.[4] Fully-owned foreign affiliates, on the other hand, encourage high-quality technology transfers (Desai et al., 2004), so there is more potential for spillovers, but fewer spillovers may materialize as the technology is not as accessible to local firms. Moreover, the complexity of inputs required

[4]Javorcik & Spatareanu (2008) note that 52 percent of joint projects in Latvia had at least one local supplier, whilst the same was the case for only 9 percent of fully-owned foreign affiliates.

by MNE may exceed the domestic firms' production capabilities in which case fewer vertical linkages emerge. The two aspects, potential, and accessibility may actually cancel each other out and result in a similar level of productivity spillovers. A research paper by Gorodnichenko et al. (2014) seems to corroborate this view, as they found no systematic difference between spillovers from high- and low-quality FDI.

4.4.4 Industry characteristics

Industry characteristics play a crucial role as well. Buckley et al. (2007) found that in labour-intensive industries, negative competition effects prevail over the positive effects of knowledge diffusion. The opposite is true for capital-intensive (especially R&D intensive) industries.

Intense competition in the industry where MNE invests may foster transfers of high-quality technology, in order for the MNE to effectively compete with its local rivals. As a consequence, there are more knowledge externalities for local firms to exploit. Therefore, competition arguably has a positive effect on spillover generation.

The level of FDI penetration may also be a determining factor (even though most studies assume that it is not). For industries already saturated with FDI, an additional investment may not be as beneficial as if there is very little foreign presence in the industry. In other words, the FDI spillover effects do not necessarily need to be linear (see, e.g., Geršl, 2008).

4.4.5 Other determinant factors

FDI spillovers may also be affected by a preferential trade agreement. Lower trade barriers make it more viable for an MNE to import intermediate inputs which in turn leads to fewer linkages with local suppliers and fewer productivity spillovers. Nonetheless, we should be aware that even though trade barriers may have a positive effect on spillovers from realized FDI, they are also likely to reduce the volume of foreign investment, and the volume effect may actually outweigh the effect of domestic sourcing of inputs, as is suggested by the so-called Bhagwati hypothesis (see, e.g., Lesher & Miroudot, 2008).

Studies examining FDI productivity spillovers usually assume that FDI is technology-exploiting, i.e., MNEs exploit their technological advantage over local firms. However, as I mentioned in Chapter 2, there are various other motivations for firms to partake in FDI. In the case of technology-seeking FDI, MNE may rather be trying to capture spillovers generated by others and therefore is not very likely to contribute to spillover generation. Results of Driffield & Love (2007), and Girma (2005) confirm this hypothesis as they found that only technology-exploiting FDI creates productivity spillovers, whilst technology-seeking FDI does not. Fosfuri & Motta (1999) even argue that MNEs are willing to establish affiliates that are unprofitable per se in order to get access to the valuable spillover channels.

4.4.6 Spillovers from offshore FDI

Let us now look at the factor that is examined in this thesis, the nationality of the investing company. Nationality usually serves as a proxy for some other variable that we do not observe directly, typically for one of the above-mentioned determinant factors. For example, Javorcik & Spatareanu (2011) controlled for the investor's resident country to analyze the effect of distance and preferential trade agreements on spillovers, and Buckley et al. (2010) used nationality to investigate the effects of technological gap. My focus here is to use investor's country of residence as a proxy for offshore activity, and test the hypothesis posed by Ledyaeva et al. (2015), that offshore investors are unlikely to generate positive FDI spillovers.

Ledyaeva et al. (2015) argue that offshore FDI in Russia is, for the most part, a result of round-tripping of capital, i.e., domestic capital disguised as FDI. Such FDI does not create new vertical linkages or introduce technologies and know-how that were not previously available to domestic firms. Even though that is likely the case, it does not necessarily have to be correct. It depends on how the proceeds of round-tripping are used. If they were, for example, invested in MNE's R&D activities, we may expect FDI spillovers to materialize. It would essentially be a question of whether domestic investment brings about productivity gains to other domestic companies. Unfortunately, the area of spillovers from the domestic investment is virtually unexplored. One exception in this regard is a study by Chang et al. (2007) who found some evidence of spillovers from more advanced domestic firms

to the less developed ones. Therefore, if round-tripping was to a large extent practiced by advanced, R&D intensive MNEs, then we could not rule out spillovers to local firms resulting from offshore FDI. These assumptions; however, seem to be very restrictive and hence this scenario is not very likely, and even though we cannot rule it out completely, we would not expect to round-tripping motivated by OFC's secrecy to give rise to FDI spillovers.

However, as was mentioned in Chapter 2, round-tripping may also be motivated by efficient institutions that were established in OFCs. In that instance, round-tripping serves to ease financing constraints and reduce transaction costs of MNEs, and as such increases productivity. More productive MNEs may then create more vertical linkages, which may give rise to spillovers. Round-trip, offshore FDI incentivized by OFC's institutions may; therefore, have a positive effect on spillover generation.

In contrast to that, if offshore FDI represents profit shifting via intra-company loans, or transit investment arising from treaty shopping, there may hardly be any positive effect on domestic firms since the funds are only registered in the host country in order to reap the benefits of preferential treatment and are moved to different location afterward. In this case, it is reasonable to expect no effect of offshore FDI on productivity spillovers, not positive, nor negative.

Naturally, every treaty shopping, tax avoidance scheme has its ultimate destination, and this destination does not necessarily have to be the same as the starting point of the scheme. In other words, it

does not have to be a round-trip, as countries of the original source and final destination may differ. The impact on productivity in the country of final destination is; however, ambiguous. On the one hand, if the investment comes from a technologically advanced company, it may bring forth new technologies and know-how which may lead to productivity spillovers. Basically, most of the arguments regarding spillovers from onshore FDI would apply here, probably with the exception of distance and technological gap since tax avoidance schemes alter the original location. The determinant factors would then assess the impact on domestic firms, and it could very well be positive. On the other hand, even if the onshore perspective would suggest the occurrence of positive spillovers, there would be a countervailing effect stemming from the advantage the investing firm would have over its non-tax-avoiding competitors. It would create market distortions and would lead to inefficient allocation of capital (due to violation of capital ownership neutrality, as was explained in Chapter 3). The overall impact of offshore FDI on the final destinations of tax avoidance schemes is thus unclear.

As this section demonstrates, the central research question of this thesis, whether offshore FDI generates positive productivity spillovers, is not easy to answer and the answers likely differ for different offshore financial centers.

Chapter 5

Methodology and data set description

The analysis in this thesis builds on work by Havránek & Iršová (2011) (henceforth H&I) who conducted an extensive meta-analysis comprising of 57 distinct studies and 3 626 estimates of productivity spillover effects in countries all around the world (see Table A1 in the Appendix for the list of host countries represented in the dataset). The meta-analytical approach allows evaluating the overall spillover effects beyond publication bias, which appears to be especially important for backward spillovers where the authors found significant upward bias of estimates among studies published in peer-reviewed journals. To filter out the publication bias, I largely follow their methodology.

5.1 Methodology of Havránek & Iršová

The analysis of H&I is primarily focused on vertical spillovers; however, as horizontal and vertical spillovers are often estimated simultaneously, H&I report results for horizontal spillovers as well. They;

however, acknowledge the limitations of such partial meta-analysis of horizontal spillovers. For analysis conducted solely for the purpose of evaluating horizontal spillover effects, see their more recent work, i.e., Iršová & Havránek (2013). Once again, I follow their approach and concentrate mainly on vertical FDI spillover effects, but I also report estimates for horizontal spillovers.

The estimates of spillovers collected by H&I, which are mostly semi-elasticities from FDI spillover regression described in the previous chapter, are then further analyzed by means of meta-regression (separately for horizontal, backward and forward spillovers). Meta-regression is a transformation of the following equation:

$$e_{ij} \;=\; e_0 \;+\; \beta_0 * se(e_{ij}) \;+\; \beta_1 * Controls_{ij} \;+\; u_{ij},$$

where e_{ij} denotes semi-elasticity estimate i from study j, e_0 is the true spillover effect implied by the literature, $se(e_{ij})$ is the standard error of spillover estimate, $Controls$ is a vector of determinant factors of FDI spillovers, and u_{ij} is a normal disturbance term. Coefficient β_0 captures the dependence between spillover estimate and its standard error; hence, it is a measure of publication bias. For example, if higher semi-elasticity estimates were associated with higher standard errors, it could be a result of researchers running different model specifications until the estimate is large enough to exhibit significance or until it has the expected sign predicted by economic theory (see, e.g., Card & Krueger, 1995).

The equation above is; however, heteroscedastic by definition because $se(e_{ij})$ is the sample estimate of standard deviation of the spillover

estimate, which is the dependent variable. Therefore, it has to be transformed and estimated in the following specification, called meta-regression:

$$\frac{e_{ij}}{se(e_{ij})} \;=\; \beta_0 \;+\; e_0 * \frac{1}{se(e_{ij})} \;+\; \beta_1 * \frac{Controls_{ij}}{se(e_{ij})} \;+\; a_j \;+\; \epsilon_{ij}.$$

Notice that the disturbance term now consists of study level (a_j) and estimate level (ϵ_{ij}) component. It is reasonable to assume such form of disturbance term since there are multiple estimates from the same study in the data set. As a consequence, the meta-regression has to be estimated with a method allowing for within-study dependence of estimates. Following the methodology of H&I, I estimate the equation using mixed-effects multilevel linear regression, and employ OLS with standard errors clustered at the study and country levels as robustness checks.

5.2 Data set description

The original data set analyzed by H&I does not contain only estimated spillover effects, but also variables explaining heterogeneity across FDI spillover estimates. These variables are then divided into two categories: controls for method heterogeneity, and structural heterogeneity variables. Method heterogeneity variables assess the impact of model specification, and data, estimation and publication characteristics. Structural heterogeneity then evaluates the effects of deter-

minant factors which were discussed in the previous chapter. Let us now further discuss the variables which H&I found to have a systematic effect on backward FDI spillovers and hence are included in my analysis as well.

Data characteristics include controls for aggregation of the data at the sector level, the average year of the data period, accounting for the possible time trend, and the use of the Amadeus database employed in many studies on European countries. Specification characteristics encompass a dummy for studies utilizing foreign share in employment to control for foreign presence, as opposed to share in output which is used in most studies, a variable marking whether competition in the sector where FDI is directed was controlled for, and another variable indicating whether the study took cyclicality into consideration, in other words, if there were controls for demand in downstream sectors. Moving on to estimation characteristics, H&I found that it is of significance if FDI spillovers were estimated in one step, e.g., using output as dependent variable and not computing total factor productivity, what method was used to compute productivity, or to estimate the spillovers (pooled OLS, fixed effects), and if the regression was estimated in differences. The last set of variables controlling for method heterogeneity is confined publication characteristics, which are trying to capture the differences among studies regarding their quality. They include a variable indicating whether the study was published in a peer-reviewed journal, another one for how many times was the study cited, a dummy signalling if at least one of the authors is native

to the country examined in the study, the number of citations of the most cited author, and the publication date, which should account for eventual improvements in methodology. These variables were selected from the pool of method heterogeneity controls due to their significant impact on backward FDI spillovers. The remaining method heterogeneity controls were excluded based on their joint insignificance at the 10 percent level. I use the same procedure to select the optimal set of method controls for the analysis forward and horizontal spillovers.

Concerning the host country's determinant factors, a significant systematic impact on backward FDI spillovers was found for the geographical and technological distance between the home and the host country, for the degree of trade openness, and for the development of the financial system. As expected, backward spillovers increase with geographical distance because increased communication and transportation costs favour the contracts with local suppliers. Higher technology gap seems to dampen the spillover effects which again supports the theoretical predictions made in Chapter 4. The gap must be reasonably small in order for domestic firms to be able to absorb and apply the knowledge brought about by foreign investors. Higher trade openness fosters positive backward spillovers, suggesting that international experience is important for firms' absorptive capacity. Moreover, host countries with underdeveloped financial systems generate more backward productivity spillovers, which supports the idea that foreign capital helps to ease the financing constraints of domestic suppliers. Important firms' characteristics appear to be if the foreign firm

is fully-owned by the investor and if only domestic firms from service sector are included in the analysis. Fully foreign-owned subsidiaries are associated with fewer spillovers to the supplier sector. The plausible explanation is that such subsidiaries do more often rely on their worldwide supply chains and thus are less likely to engage with local suppliers. Firms in the service sector also appear to receive fewer backward spillovers, which is presumably caused by the lower export propensity of services and hence their lower international experience compared to firms in manufacturing. Finally, the level of protection of intellectual property rights is not significant, which may imply that the countervailing factors discussed in the previous chapter (i.e., more technology transfers vs. easier technology diffusion) cancel each other out. Similarly, estimates based exclusively on joint domestic and foreign projects do not differ from the rest.

In my analysis, I always select the optimal set of method heterogeneity variables for a given type of spillovers and include all of the structural heterogeneity controls even if their average effect is found to be insignificant, since the importance of determinant factors is backed by economic theory and the significance may emerge once the origin of investment is controlled for. Descriptive statistics of all variables capturing method and structural heterogeneity are included in the Appendix (Tables A2 – A5).

My contribution to the original data set is the information about the geographical composition of inward FDI of the host country derived from UNCTAD's Bilateral FDI Statistics. In practice, it means

that every spillover estimate is accompanied with information about the share of the host country's FDI attributable to each foreign country. For example, it tells us what percentage of FDI comes to the host country from China. As this percentage likely varies across the data set, we may observe whether a higher share of Chinese investment is associated with higher or lower productivity spillovers, or whether there is no impact at all. In my case, the focus is on investments originating in OFCs; hence, I concentrate on whether FDI from offshore financial centers has a significant effect on the generation of FDI spillovers. The use of bilateral investment data overcomes the usual difficulty of tracking the offshore investment at firm-level.

There were several possibilities of how to enrich the original data set with UNCTAD's data. First of all, either FDI flows or FDI stocks could theoretically be used. However, the UNCTAD's data is mostly available from the year 2001 onwards and since the median year of the estimates in the original data set is 1999, the choice of FDI stocks is clearly the better option.[1] For example, productivity spillovers in the year 1998 can hardly be affected by inflows of FDI that took place in 2001. On the other hand, the host country's inward FDI stock from 2001 still gives us valuable information as it represents overtime accumulation of foreign capital. The FDI inflows from 1998 and preceding years are a part of the 2001 FDI stock and thus only the inflows that took place after 1998 create a distortion in the data. Moreover, even if the two data sets overlapped perfectly the inward FDI stock would

[1]Descriptive statistics for shares of inward FDI stocks for all countries in the data set are included in the Appendix (Tables A6 – A8).

still be the preferred option, because it is not clear how much time has to elapse until spillovers start to materialize and hence it is not clear what year's FDI inflows should be used. Some delay between investment and spillover generation is expected because it takes time to establish vertical linkages, and imitation or reverse engineering also presumably do not happen instantly; however, it is not apparent how long the delay is. Furthermore, the delay is likely different for different investments, so there probably is not an optimal lag of FDI inflows that could be used for the purpose of spillover analysis. In future research, if FDI spillovers were analyzed, for example, between 2010 and 2015 and hence the data on FDI composition were available for the whole period, then the sum of FDI inflows to the country of interest from, let us say, 2005 to 2015 could be used as a robustness check. FDI stock would; however, still be preferred as even the foreign investments that took place many years ago may potentially contribute to positive spillover effects.

Once the decision to prefer stocks over flows is made, it is necessary to decide which inward FDI stock should be used, since the composition of the stock; naturally, changes over time as new foreign investments enter the host country. As I already suggested, if the time period for which FDI spillovers were studies does not overlap with UNCTAD's data, the oldest available inward FDI stock is used (usually it is the 2001 FDI stock). If there is, on the other hand, perfect overlap, e.g., spillovers were analyzed in France between 2005 and 2008, then the weighted average of French inward FDI stocks for

years 2005 to 2008 would be used (with FDI penetration for each year as weights). Finally, if the overlap is only partial, e.g., the paper focuses on productivity spillovers in Poland from 1996 to 2002, then the inward FDI stock plugged into the data set would be the weighted average of Polish 2001 and 2002 inward FDI stocks.

The fact that some of the studies used in the original meta-analysis already account for the nationality of the investors is a potential issue for my analysis. Therefore, estimates from such studies were assigned an "artificial inward FDI stock." If the nationality of investors is specified for a group of countries as, for example, in the article by Tong & Hu (2007) where the investments from Hong Kong, Macao, and Taiwan were grouped together and analyzed separately, then the "artificial inward FDI stock" is divided between the three countries according to the share by which each country contributed to the sum total of investments to the host country. In this specific instance, Hong Kong is assigned a value of 84,83 percent as it is by far the biggest investor of the three, Macao's share amounts to 1,95 percent, and Taiwan's is 13,22 percent. Other countries are assigned a value of zero as their investments presumably did not affect the resulting productivity spillovers. Another possibility is that the spillover estimate can be ascribed to a specific jurisdiction, e.g., FDI from Japan is analyzed separately as in the case of Girma & Wakelin (2007). In this case, an "artificial inward FDI stock" is composed solely of investments from the investor's home country and hence assigns 100 percent share to the source country (i.e., Japan, in our example) and zero percent

to all other jurisdictions. It is debatable whether this is the optimal approach because even if we look at the investments performed by a single country, it is not apparent if the spillover generation is independent of the host country's inward FDI stock (as we assume if the artificial FDI stock is used). Therefore, I test the robustness of my results to the relaxation of this assumption. The main findings of this thesis; however, are not altered by the exclusion of the source country-specific spillover estimates from the data set.

Chapter 6

Discussion of results

Before we start the discussion, it should be mentioned that the most important are considered the results for backward FDI spillovers, since they were found to be economically significant, unlike forward spillovers, and were a primary focus of the original meta-analysis by Havránek & Iršová (2011), unlike horizontal spillovers.

6.1 Backward spillovers

In the previous chapter, I already discussed the impact of determinant factors on backward FDI spillovers as was found by H&I. Therefore, let me not repeat the whole discussion here and just note that none of the model specifications that I ran throughout the analysis of backward spillovers alter the results of H&I. The coefficients for the selected method and structural heterogeneity controls are presented in Table 6.1 below. In the first column of the table are the original results of H&I and the next columns show the robustness checks. In the second column is a mixed-effects multilevel model which al-

lows for within-country dependence of spillover estimates (instead of within-study dependence which is controlled for in the main model). Estimates in the in the third column also represent a mixed-effects multilevel model, but this time calculated on a reduced data set, which excludes observations where less than 40 percent of inward FDI stock was specified (i.e., excludes observations if 60 or more percent of inward FDI stock comes from unspecified locations), and observations with data gap of five or more years. Data gap is defined as the difference between the first year for which the inward FDI stock of the country of interest is available and the last year of a time period relevant to the spillover estimate. For example, if the estimate represents spillovers that took place between 1990 and 1995, and the inward FDI stock is available from the year 2001 onwards, then the data gap is six years, and such observation would not be included in the robustness check in column three. The fourth column is another mixed-effects multilevel model, but in this case the underlying data set is expanded with outlying observations. Finally, column five presents the results obtained by OLS estimation with standard errors clustered at the study level.

Assessing the impact of investor's origin on productivity spillovers appeared to be somewhat complicated, most notably due to collinearity issues. Collinearity of explanatory variables did not allow to plug in inward FDI shares for all countries at once, and hence the effects had to be analyzed for each country separately.

Out of the 83 jurisdictions included in the data set, none of them

Table 6.1: Backward spillovers, method and structural heterogeneity

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	2.773*	2.866*	-1.096	1.536	0.181
Distance	0.248***	0.196***	0.151**	0.339***	0.228***
Technology gap	-0.512***	-0.482***	-0.0935	-0.571***	-0.260
Openness	0.435***	0.366***	0.329**	0.558***	0.238
Financial dev.	-0.344***	-0.285**	-0.00138	-0.208*	-0.198
Patent rights	-0.0653	-0.0448	0.00483	0.0296	0.0540
Fully owned	-0.205***	-0.276***	-0.223***	-0.173**	-0.297***
Joint ventures	0.0186	-0.0392	0.00927	-0.00154	-0.0577
Services	-0.223***	-0.338***	-0.0803	-0.256**	-0.388
Aggregated	1.205***	1.202***	1.159***	1.095***	1.167***
Average year	0.0349***	0.0306***	0.0106	0.0169***	0.0272***
Amadeus	-0.684***	-0.693***	-0.571***	-0.392***	-0.593***
Employment	-0.171*	-0.227***	-0.136	-0.472***	-0.312*
Competition	-0.314***	-0.303***	-0.348***	-0.260***	-0.308***
Cyclicality	0.574***	0.689***	0.549***	0.569***	0.647***
One step	-0.349***	-0.457***	-0.404***	-0.431***	-0.443***
Olley-Pakes	-0.324***	-0.491***	-0.457***	-0.436***	-0.496***
OLS	-0.392***	-0.585***	-0.465***	-0.442***	-0.592***
Pooled OLS	0.156***	0.205***	0.197***	0.111***	0.217***
Sector fixed	0.120***	0.144***	0.133***	0.0984**	0.127**
Differences	0.104*	0.0652	0.136**	0.0431	0.0547
Published	0.278***	0.372***	0.346***	-0.0274	0.400***
Study citations	0.0775**	0.0398*	0.176**	0.0999***	0.0454
Native	0.450***	0.424***	0.274***	0.342***	0.464***
Author citations	-0.0664***	-0.0458***	-0.0701**	-0.0790***	-0.0313
Publication date	0.0661**	0.0677***	0.0780*	0.176***	0.0569
Constant	0.416	0.710**	0.801**	0.710*	0.672**
R^2					0.462
AIC	7026.2	7141.4	6157.6	8592.9	7164.4
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

exhibit a robustly positive effect on backward spillovers, whilst six jurisdictions were consistently found to have a significant negative effect. However, two of the jurisdictions, namely Gibraltar and Turkey, likely do not represent a real effect, but only noise in the data, as their average and maximum inward FDI shares are very small. It is difficult to imagine that increase in Gibraltar's share in the host country's inward FDI stock by 0.4 percent (which is the maximum value in the data set for backward spillovers) would significantly undermine the productivity of domestic firms, as the results suggest. From this point onwards I; therefore, report only the results for countries with an average inward FDI share of at least 0.5 percent and maximum share exceeding 5 percent (see Table 6.3 or Table A9 for the individual countries' results). The four countries that satisfy the criteria are Cyprus, Greece, Italy, and the Netherlands Antilles, and two of them (Cyprus and Netherlands Antilles) are usually considered to be offshore financial centers. The results for Cyprus may be seen as a support for the hypothesis by Ledyaeva et al. (2015) that round-trip investment does not generate positive productivity spillovers. An alternative explanation would be that FDI from OFCs often represents transit investment which also would not benefit domestic firms as the funds would only pass through the country, or that the FDI is a result of profit shifting activities; hence, rather depriving the economy of capital. Negative effects for the other two countries, Greece and Italy, most likely cannot be attributed to offshore FDI but could be a result of stronger reliance on home country suppliers. In that case,

Greek and Italian MNEs would not create as many vertical linkages with local firms. Research of Putnam et al. (1994) on social capital and resulting networks among (northern) Italian firms, provides some support for this claim. Moreover, as Javorcik & Spatareanu (2011) suggest, preferential trade agreements which were not controlled for in the analysis may also play an important role.

To analyze the effects of FDI from offshore financial centers even further, two additional variables representing the combined share of inward FDI for offshore jurisdictions were generated. The first one contains only small, mostly island, economies with large financial sectors devoted to the provision of offshore services and a high ratio of FDI stock to GDP, and is based on the OECD's (2000) list of tax havens. The second variable includes also larger economies that help to facilitate transit investment and are at least sometimes referred to as tax havens, or secrecy jurisdictions. Both variables are further described in Table 6.2 below.

Table 6.2

Variable	Jurisdictions included	Mean	SD
OFC 1	Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cyprus, Gibraltar, Guernsey, Isle of Man, Jersey, Liechtenstein, Liberia, Malta, Mauritius, Netherlands Antilles, Panama, Samoa, Seychelles, US Virgin Islands	4.46%	4.60%
OFC 2	all jurisdictions included in OFC 1, Hong Kong, Hungary, Ireland, Luxembourg, Macao, Netherlands, Singapore, Switzerland, Taiwan	36.00%	25.15%

Coefficients for both variables representing OFCs are negative and highly significant and hence provide more support for the claim that inward FDI from offshore jurisdictions undermines backward productivity spillovers. Specifically, for the broader definition of offshore financial centers (OFC 2), a ceteris paribus effect of 10 percentage point increase in the OFCs' share of host country's inward FDI stock is associated with a 6.7 percent decrease in the productivity of domestic firms in the supplier sector.

Table 6.3: Significant countries, backward spillovers

	$\beta_{backward}$	std. error	p-value	95% confidence interval
Cyprus	-10.317***	2.697	0.000	(-15.604 , -5.031)
Greece	-4.198***	1.298	0.001	(-6.742 , -1.654)
Italy	-7.582***	1.849	0.000	(-11.205 , -3.958)
Netherlands Antilles	-6.016***	2.165	0.005	(-10.259 -1.772)
OFCs 1	-2.419***	0.616	0.000	(-3.626 , -1.211)
OFCs 2	-0.669***	0.198	0.001	(-1.057 , -0.280)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Tables with robustness checks for all significant countries and both OFC variables are included in the Appendix (Tables A10 – A15).

6.2 Forward spillovers

Let us once again start with the determinant factors and their impact on forward FDI spillovers. Coefficients resulting from various data set specifications and estimation methods can be seen in Ta-

ble 6.4. At first glance, it is apparent that most determinant factors do not have a systematic effect on forward spillovers. The two exceptions are the joint ownership and service industry. Joint projects of foreign and domestic firms appear to generate more positive forward spillovers. The likely explanation is that since the local firms are entrenched in the domestic economy, they possess the necessary knowledge of other market participants, which in turn facilitates the dissipation of knowledge brought about by foreign firms. In particular, domestic firm's participation in an FDI project helps to overcome language and cultural barriers, and enables to choose the distributors most likely to absorb the knowledge, and thus meet the MNEs requirements. The second important determinant factor is a variable indicating whether the spillover estimate was calculated for firms in the service sectors only. The effect is positive and significant meaning that firms in services benefit more from the foreign presence in the upstream sector than manufacturing firms. This finding is consistent with the low tradability of services; hence, the positive forward spillovers to service sector are likely a consequence of increased demand resulting from MNEs' need for the provision of services. Both factors, joint ventures, and service industry; however, become substantially less significant when the spillovers are estimated by OLS (see Table 6.4).

Concerning the effects of individual countries, we can observe both negative and positive effects on forward FDI spillovers. Increase in forward spillovers is associated with FDI originating in Greece, Ko-

Table 6.4: Forward spillovers, method and structural heterogeneity

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	3.022*	2.508	7.094***	-1.588	-0.616
Cross-sectional	0.257*	0.161	0.329**	0.274*	0.443
Aggregated	-1.190***	-1.391***	-1.135***	-0.496**	-1.130**
Time span	0.0727***	0.0708***	0.0112	0.0452**	0.0221
Average year	0.172***	0.183***	0.0287	0.134***	0.0681
GMM	-0.584***	-0.558***	-0.623***	-0.215**	-0.500***
Olley-Pakes	-0.155***	-0.153***	-0.0719	-0.128**	-0.237
Pooled OLS	-0.976***	-0.970***	-0.944***	-1.012***	-0.906***
Random	-0.744***	-0.683***	-0.525**	-0.475*	-0.674
Sector fixed	-0.295***	-0.288***	-0.220***	-0.417***	-0.262
Log-log	0.802*	0.921**	0.316	0.0587	0.274
Differences	-0.886***	-0.845***	-0.850***	-0.676***	-0.765***
Employment	-0.526***	-0.669***	-0.773***	-0.158	-0.647**
Competition	0.411***	0.533***	0.313***	0.452***	0.548*
Cyclicality	-0.392**	-0.403**	-0.547***	-0.591**	-0.991**
Regional	2.643***	3.303***	2.729***	2.837***	2.137**
More	-0.197***	-0.202***	-0.180***	-0.303***	-0.159*
Combination	-0.306***	-0.317***	-0.264***	-0.453***	-0.274*
Impact	-0.323***	-0.266***	-0.241***	-0.418***	-0.236*
Study citations	-0.426***	-0.531***	-0.627***	-0.221*	-0.364**
Native	-0.469***	-0.588***	-0.561***	-0.422*	-0.734**
Author citations	0.177***	0.173***	0.237***	0.0873*	0.158**
Publication date	-0.401***	-0.354***	-0.268***	-0.363***	-0.269**
Distance	-0.0880	-0.195*	-0.159	-0.140	-0.479*
Technology gap	0.238	0.355*	-0.0692	0.727***	0.777**
Openness	0.000415	-0.366	-0.526**	0.131	-0.516
Financial dev.	-0.297	-0.510***	-0.463*	-0.604***	0.434
Patent rights	-0.101	0.0159	-0.245	-0.0296	0.0968
Fully owned	0.145	0.158*	0.0967	0.223*	0.154
Joint ventures	0.286***	0.313***	0.228**	0.407***	0.292
Services	0.766***	0.760***	0.881***	0.976***	0.732*
Constant	-0.235	-0.929	-0.398	-2.634*	-0.246
R^2					0.379
AIC	6348.4	6389.6	5583.6	7350.4	6532.5
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

rea, and Singapore, whilst fewer forward spillovers result from Belgian, Luxembourgian, and British investments (see Table 6.5). The interpretation of results; however, is not as straightforward as for backward spillovers. The negative coefficient ascribed to a country's share of inward FDI may simply mean that the investors (MNEs) from that country do more often participate in end-user goods production and hence do not have as many opportunities to create forward linkages. Alternatively, MNEs from such countries may be more reliant on their own distribution networks, which may then crowd-out domestic firms, or force them to operate at a less efficient scale; thus, undermining their productivity.

As was the case for backward spillovers, offshore jurisdiction again seem to play an important role. However, this time the effect on productivity spillovers can be both positive, as in the case of Singapore, and negative, as for Luxembourg.

Table 6.5: Significant countries, forward spillovers

	$\beta_{forward}$	std. error	p-value	95% confidence interval
Belgium	-22.561***	3.297	0.000	(-29.023 , -16.099)
Greece	16.185***	2.465	0.000	(11.355 , 21.016)
Korea	22.098***	3.266	0.000	(15.696 , 28.500)
Luxembourg	-16.553***	2.480	0.000	(-21.413 , -11.693)
Singapore	18.046***	2.884	0.000	(12.392 , 23.699)
United Kingdom	-14.385***	1.686	0.000	(-17.690 , -11.080)
OFCs 1	4.748***	1.038	0.000	(2.713 , 6.783)
OFCs 2	-1.547***	0.372	0.000	(-2.275 , -0.818)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Apart from the above-mentioned reasons, negative coefficients for offshore jurisdictions may be attributed to the usual suspects like round-tripping and treaty shopping. A robustly significant and positive effect that we observe for Singapore is; however, something that was not found for backward spillovers. There are two possible explanations for this effect. Firstly, if the incentive for routing the investment through OFC is to take advantage of the OFC's quality institutions and financial services, then the investment may improve MNE's efficiency, which could, in turn, benefit domestic firms in the customer sector in the form of higher quality and/or lower prices of their inputs. The fact that otherwise insignificant variable controlling for financial development of the host country becomes, at least in some specifications, significant and negative after controlling for investments from tax havens (OFC 1) provides some additional support for this claim (for details, see Table A16 in the Appendix). Secondly, interaction with OFC may be driven by tax avoidance efforts. If the MNE successfully avoids the taxes and then uses the proceeds to improve its efficiency, it may once again benefit domestic firms in the customer sector with cheaper or higher quality products.

As you can see in Table 6.5, variables assessing the impact of OFCs as a whole do not provide such unequivocal evidence as in the case of backward spillovers. For the first group of OFCs, there is a robust positive effect of FDI on forward spillovers which corroborates the efficient institutions hypothesis of Sharman (2012) who shows that capital is often routed through small tax haven economies because of

the quality services they provide. However, the results for the second group of OFCs (which also includes all of the jurisdictions from the first group) provides some evidence, albeit weak, for the opposite effect. Therefore, we cannot draw a general conclusion about the impact of FDI from offshore jurisdictions on forward spillovers, as there are countervailing factors and different ones come out on top in different OFCs. Consequently, it seems important to examine the impact of OFCs on forward spillovers on the country-by-country basis.

6.3 Horizontal spillovers

Before we move on to the discussion of results for horizontal spillovers, I would like to once again point out that that the original meta-analysis, which provides the basis for my thesis, was primarily conducted to analyze vertical FDI spillovers and therefore the results in this section are not as reliable as the ones in the previous parts of this chapter.

The determinant factors with systematic effect on horizontal spillovers appear to be host country's financial system development and joint collaboration of foreign and domestic firms on FDI projects, i.e., joint ownership (see Table 6.6 for the results). As the theoretical model by Alfaro et al. (2010) implies, host countries with developed financial system benefit more from international presence which indicates that absorptive capacity matters for horizontal spillovers. In other words, the ability to learn from foreign competitors is directly connected to the ability to borrow funds. Moreover, in line with the results of Javor-

cik & Spatareanu (2008), it is found that joint domestics and foreign projects also have a favourable effect on horizontal spillovers. Joint ownership makes it harder for MNEs to, for example, protect their trade secrets, and thus the knowledge diffuses to local competitors more easily, and more spillovers materialize.

Table 6.6: Horizontal spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	-0.531***	-0.947***	-1.502***	-0.234	-0.632
Cross-sectional	-0.0625***	-0.0556***	-0.0974***	-0.151***	-0.0552***
Aggregated	0.606***	0.476***	0.676***	0.420***	0.400**
One step	0.0480***	0.0376***	0.0564***	0.0359***	0.0285
Pooled OLS	-0.0456**	-0.0275	0.00966	0.134***	-0.0305
Log-log	-0.779**	-0.626**	-0.126	-0.738*	-0.465***
Differences	0.117***	0.0987***	0.0320*	0.0937***	0.0909***
Employment	0.343***	0.274***	0.266***	0.261***	0.231***
Regional	-0.405***	-0.301***	-0.580***	-0.236***	-0.229
Lagged	0.0828**	0.0910***	0.0531	0.0642	0.0894**
More	-0.0722***	-0.0727***	-0.0556***	-0.0714***	-0.0644*
Impact	0.0242**	0.00432	-0.0107	0.0153	0.00954
Author citations	0.0366***	0.0238***	0.0175***	0.0274***	0.0213**
Distance	0.0298**	0.0301**	0.0231	0.00154	0.0290
Technology gap	0.00470	0.0503**	0.127**	0.00694	0.0279
Openness	-0.0670**	-0.0188	-0.00626	-0.0820**	-0.0493
Financial dev.	0.148***	0.172***	0.0481	0.0945***	0.0964*
Patent rights	0.000971	0.00324	-0.00361	-0.00398	0.00240
Fully owned	0.0323*	0.0478***	0.0205	0.0370*	0.0422
Joint ventures	0.0637***	0.0784***	0.0532***	0.0660***	0.0642*
Services	0.0301	0.0324	-0.0337	0.0166	0.0266
Constant	0.636*	0.127	-0.165	0.710*	-0.412
R^2					0.178
AIC	5663.9	5761.1	4540.2	6401.8	5821.5
Observations	1151	1151	954	1201	1151

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

When it comes to individual countries or even groups of countries (i.e., OFCs 1 and OFCs 2), none of them was found to have a robustly significant effect on horizontal spillovers. To save space, I do not report the results for individual countries here, they are; however, available upon request.

In order to obtain more reliable results regarding horizontal spillovers, I would recommend applying the same methodological approach as in this thesis on the meta-analysis by Iršová & Havránek (2013), which focuses solely on horizontal spillovers.

6.4 Data limitations and future research

There are several limitations of my analysis worth singling out. The fact that the time periods for which the spillover effects were analyzed in the primary studies do not always overlap with the availability of decomposed inward FDI stocks is far from ideal and potentially distorts the results presented in this thesis. Moreover, as I already noted in Chapter 3, provision of offshore services became much more plentiful in recent decades; therefore, the thesis' findings are not necessarily representative of the current market conditions and FDI flow patterns. Both of these issues could be addressed if a new meta-analysis enriching the original data set with more recent FDI spillover studies was conducted. Therefore, such an analysis would be much appreciated.

This thesis shows that OFCs play an important role with respect to FDI spillovers. The future research should; therefore, pay close attention to this phenomenon or even analyze the spillovers from offshore

and onshore FDI separately. Furthermore, it would be of interest to investigate whether the onshore/offshore heterogeneity alters the spillover effects of geographical distance and the technology gap between the home and the host country. It may very well be the case since offshore practices often disguise the true identity and hence the true origin of the investor.

Lastly, in his study of 30 African countries, Kinda (2016) finds that FDI is not responsive to the corporate income tax rate. Once again, it could be a result of MNEs using offshore jurisdictions and effectively avoiding nominal corporate tax rates. In other words, onshore FDI may actually be affected by statutory tax rates, whilst offshore FDI may respond only to substantially lower effective corporate tax rates paid by MNEs with affiliates located offshore. A study differentiating between the two types of FDI may confirm or deny this hypothesis.

Chapter 7

Conclusion

One of the consequences of economic globalization is that the traditional view of foreign direct investment became to a certain extent outdated, and as such cannot explain all of the FDI flows that take place in the world's economy. That being the case inevitably challenges most, if not all, of the current research concerning international investment flows, including the literature on productivity spillovers from FDI. Jurisdictions providing offshore financial services proved themselves to be important players in international investment, and as a result, a large portion of official FDI statistics reflects offshore FDI, which is generated by various tax avoidance, or identity hiding schemes. To the best of my knowledge, this thesis presents the first analysis of FDI productivity spillovers explicitly accounting for onshore/offshore heterogeneity of foreign direct investment. The analysis in this thesis builds on a large meta-analysis by Havránek & Iršová (2011) and examines FDI spillover estimates from countries all around the world. The focus is then given to the declared origin of investors, and especially to investors from offshore financial centers. The main finding

of this thesis is that backward FDI spillovers, which are considered to be the economically most important spillover effect, are adversely affected by the investments originating in offshore jurisdictions. Moreover, the analysis of forward spillovers provides some support for the hypothesis that setting up subsidiaries in tax havens is, among other things driven by the efficient institutions established in offshore jurisdictions. Undoubtedly, more research is needed to further differentiate between various incentives driving offshore FDI and between the effects of offshore FDI originating in different offshore financial centers. The main message of this thesis; however, remains clear: Both statisticians tracking the international investment flows, and researchers assessing the effects of FDI should pay close attention to the different incentives and implications of offshore and onshore FDI.

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Appendix

Table A1: List of host countries and the number of studies examining them

country	number of studies	country	number of studies
China	12	Colombia	1
Czech Republic	7	Croatia	1
Romania	7	Estonia	1
Hungary	5	Finland	1
Poland	5	France	1
Bulgaria	3	Georgia	1
Vietnam	3	Germany	1
Indonesia	2	India	1
Italy	2	Ireland	1
Lithuania	2	Kazakhstan	1
Portugal	2	Kenya	1
Russian Federation	2	Latvia	1
Slovakia	2	Luxembourg	1
Slovenia	2	Mexico	1
Spain	2	Netherlands	1
United Kingdom	2	Norway	1
Albania	1	Serbia	1
Austria	1	Sweden	1
Belgium	1	Turkey	1
Bosnia and Herzegovina	1	Ukraine	1
Brazil	1	Venezuela	1
Canada	1	Zambia	1
Chile	1		

Note: Some of the studies examined multiple countries; hence, the grand total exceeds the total number of studies in the meta-analysis (57).

Table A2: Summary statistics of regression variables, backward spillovers

Variable	Description	Mean	SD
t-statistic	The t-statistic of the spillover estimate.	0.803	4.997
1/Se	The precision of the spillover estimate.	5.465	6.640
Method heterogeneity			
Data characteristics			
Cross-sectional data	=1 if cross-sectional data are used.	0.079	0.269
Aggregated data	=1 if sector-level data for productivity are used.	0.033	0.178
Time span	The number of years of the data used.	7.090	3.788
Firms	The logarithm of [(the number of observations used)/(time span)].	7.598	2.040
Average year of data	The average year of the data used (2000 as a base).	-1.053	3.798
Amadeus database	=1 if the Amadeus database by Bureau van Dijk Electronic Publishing is used.	0.223	0.416
Specification characteristics			
Forward	=1 if forward spillovers are included in the regression.	0.655	0.475
Horizontal	=1 if horizontal spillovers are included in the regression.	0.866	0.341
Employment	=1 if employment is the proxy for foreign presence.	0.142	0.349
Equity	=1 if equity is the proxy for foreign presence.	0.060	0.238
All firms	=1 if both domestic and foreign firms are included in the regression.	0.252	0.435

Source: Havránek & Iršová (2011).

Table A3: Summary statistics of regression variables, backward spillovers (continued)

Variable	Description	Mean	SD
Absorption	=1 if the specification controls for absorption capacity using technology gap or R&D spending.	0.070	0.256
Competition	=1 if the specification controls for sector competition.	0.272	0.445
Cyclicality	=1 if the specification controls for demand in downstream sectors.	0.075	0.263
Regional	=1 if vertical spillovers are measured using the ratio of foreign firms in the region as a proxy for foreign presence.	0.037	0.188
Lagged	=1 if the coefficient represents lagged foreign presence.	0.127	0.334
More	=1 if the coefficient is not the only spillover estimate in the regression.	0.459	0.499
Combination	=1 if the coefficient is a marginal effect computed using a combination of reported estimates.	0.072	0.259
Estimation characteristics			
One step	=1 if spillovers are estimated in one step using output, value added, or labor productivity as the dependent variable.	0.429	0.495
Olley-Pakes	=1 if the Olley-Pakes method is used for TFP estimation.	0.187	0.390
OLS	=1 if OLS is used for the estimation of TFP.	0.107	0.309
GMM	=1 if the system GMM estimator is used for the estimation of spillovers.	0.089	0.285
Random	=1 if the random-effects estimator is used for the estimation of spillovers.	0.031	0.174

Source: Havránek & Iršová (2011).

Table A4: Summary statistics of regression variables, backward spillovers (continued)

Variable	Description	Mean	SD
Pooled OLS	=1 if pooled OLS is used for the estimation of spillovers.	0.157	0.364
Year fixed	=1 if year fixed effects are included.	0.854	0.353
Sector fixed	=1 if sector fixed effects are included.	0.494	0.500
Differences	=1 if the regression is estimated in differences.	0.456	0.498
Translog	=1 if the translog production function is used.	0.076	0.266
Log-log	=1 if the coefficient is taken from a specification different from log-level.	0.017	0.128
Publication characteristics			
Published	=1 if the study was published in a peer–reviewed journal.	0.288	0.453
Impact	The recursive RePEc impact factor of the outlet.	0.238	0.453
Study citations	The logarithm of [(Study's Google Scholar citations)/(age of the study)+1].	1.160	1.110
Native	=1 if at least one co-author is native to the investigated country.	0.712	0.453
Author citations	The logarithm of (the number of RePEc citations of the most-cited co-author+1).	3.114	2.480
US–based	=1 if at least one co-author is affiliated with a US-based institution.	0.397	0.489
Publication date	The year and month of publication.	7.865	1.637

Source: Havránek & Iršová (2011).

Table A5: Summary statistics of regression variables, backward spillovers (finished)

Variable	Description	Mean	SD
Structural heterogeneity			
Host-country characteristics			
Distance	The logarithm of the country's FDI-stock-weighted distance from its source countries of FDI (kilometers).	7.769	0.621
Technology gap	The logarithm of the country's FDI-stock-weighted gap in GDP per capita with respect to its source countries of FDI.	9.816	0.419
Openness	The trade openness of the country: [(exports+imports)/GDP].	0.704	0.330
Financial development	The development of the financial system of the country: [(domestic credit to private sector)/GDP].	0.614	0.428
Patent rights	The Ginarte-Park index of patent rights of the country.	2.993	0.800
Foreign-firm characteristics			
Fully owned	=1 if only fully owned foreign investments are considered for linkages.	0.069	0.253
Joint ventures	=1 if only investments with joint domestic and foreign ownership are considered for linkages.	0.070	0.256
Local-firm characteristics			
Services	=1 if only firms from service sectors are included in the regression.	0.046	0.209

Source: Havránek & Iršová (2011).

Table A6: Shares of inward FDI stocks, backward spillovers

	mean	standard dev.	min	max
Argentina	0,18%	0,74%	0,00%	3,37%
Australia	0,20%	0,62%	0,00%	3,15%
Austria	3,32%	5,45%	0,00%	34,07%
Bahamas	0,05%	0,25%	0,00%	5,22%
Barbados	0,01%	0,04%	0,00%	0,45%
Belgium	1,09%	1,58%	0,00%	4,73%
Belize	0,01%	0,05%	0,00%	0,86%
Bermuda	0,07%	0,19%	0,00%	2,39%
Bosnia and Herzegovina	0,01%	0,07%	0,00%	0,73%
Brazil	0,03%	0,14%	0,00%	1,49%
British Virgin Islands	1,72%	3,07%	0,00%	12,8%
Canada	0,75%	1,00%	0,00%	12,97%
Cayman Islands	0,33%	0,50%	0,00%	3,78%
Chile	0,05%	0,19%	0,00%	0,84%
China	0,56%	4,04%	0,00%	56,58%
Croatia	0,12%	1,17%	0,00%	20,34%
Cyprus	0,80%	1,56%	0,00%	11,54%
Czech Republic	0,13%	0,61%	0,00%	6,71%
Denmark	1,04%	3,18%	0,00%	18,60%
Egypt	0,01%	0,03%	0,00%	0,14%
Estonia	0,37%	1,79%	0,00%	10,05%
Finland	0,76%	2,46%	0,00%	25,79%
France	4,34%	3,88%	0,00%	15,39%
Germany	7,46%	7,81%	0,00%	27,62%
Ghana	0,00%	0,12%	0,00%	4,39%
Gibraltar	0,04%	0,09%	0,00%	0,40%
Greece	0,98%	3,04%	0,00%	14,58%
Guernsey	0,02%	0,08%	0,00%	0,80%
Hong Kong	13,24%	24,35%	0,00%	84,83%
Hungary	0,14%	0,51%	0,00%	5,38%
Iceland	0,05%	0,15%	0,00%	0,98%
India	0,02%	0,08%	0,00%	0,67%
Indonesia	0,08%	0,14%	0,00%	0,57%

Continued on the next page.

Table A7: Shares of inward FDI stocks, backward spillovers (continued)

	mean	standard dev.	min	max
Ireland	0,27%	0,46%	0,00%	2,08%
Isle Of Man	0,06%	0,23%	0,00%	1,25%
Israel	0,02%	0,05%	0,00%	0,49%
Italy	1,72%	2,32%	0,00%	10,88%
Japan	3,35%	4,57%	0,00%	18,40%
Jersey	0,03%	0,09%	0,00%	0,42%
Kenya	0,00%	0,11%	0,00%	4,02%
Korea	1,60%	2,56%	0,00%	20,80%
Kuwait	0,04%	0,31%	0,00%	5,15%
Latvia	0,05%	0,22%	0,00%	1,33%
Lebanon	0,01%	0,03%	0,00%	0,35%
Liberia	0,01%	0,06%	0,00%	0,65%
Liechtenstein	0,19%	0,33%	0,00%	3,82%
Lithuania	0,01%	0,09%	0,00%	1,00%
Luxembourg	1,24%	2,45%	0,00%	14,24%
Macao	0,31%	0,57%	0,00%	2,00%
Malaysia	0,30%	0,76%	0,00%	5,10%
Malta	0,04%	0,08%	0,00%	0,41%
Mauritius	0,22%	1,62%	0,00%	26,76%
Mexico	0,02%	0,35%	0,00%	9,24%
Netherlands	10,40%	10,88%	0,00%	37,04%
Netherlands Antilles	0,56%	1,87%	0,00%	7,50%
New Zealand	0,01%	0,04%	0,00%	0,43%
Norway	0,38%	0,80%	0,00%	6,92%
Panama	0,11%	0,32%	0,00%	1,86%
Philippines	0,10%	0,18%	0,00%	0,71%
Poland	0,11%	0,37%	0,00%	2,15%
Portugal	0,08%	0,29%	0,00%	2,94%
Qatar	0,05%	0,36%	0,00%	2,64%
Russian Federation	0,32%	1,09%	0,00%	9,91%
Samoa	0,14%	0,29%	0,00%	1,28%
Saudi Arabia	0,02%	0,09%	0,00%	0,76%
Serbia	0,01%	0,12%	0,00%	2,15%

Continued on the next page.

Table A8: Shares of inward FDI stocks, backward spillovers (finished)

	mean	standard dev.	min	max
Seychelles	0,04%	0,27%	0,00%	1,99%
Singapore	2,19%	4,15%	0,00%	24,39%
Slovakia	0,11%	0,29%	0,00%	1,24%
Slovenia	0,09%	0,70%	0,00%	12,02%
South Africa	0,11%	0,99%	0,00%	14,50%
Spain	0,87%	2,23%	0,00%	18,56%
Sweden	1,70%	4,59%	0,00%	43,37%
Switzerland	1,65%	2,13%	0,00%	14,77%
Syrian Arab Republic	0,08%	0,72%	0,00%	10,22%
Taiwan	2,10%	3,86%	0,00%	13,60%
Thailand	0,23%	0,37%	0,00%	1,25%
Turkey	0,20%	0,49%	0,00%	2,30%
Ukraine	0,01%	0,03%	0,00%	0,32%
United Arab Emirates	0,02%	0,06%	0,00%	0,62%
United Kingdom	3,78%	4,94%	0,00%	46,45%
United States	14,49%	21,07%	0,00%	100,00%
Uruguay	0,00%	0,05%	0,00%	1,16%
US Virgin Islands	0,01%	0,06%	0,00%	0,51%

Table A9: Significant countries, backward spillovers

	$\beta_{backward}$	std. error	p-value	95% confidence interval
Cyprus	-10.317***	2.697	0.000	(-15.604 , -5.031)
Gibraltar	-132.871***	42.267	0.002	(-215.714 , -50.028)
Greece	-4.198***	1.298	0.001	(-6.742 , -1.654)
Italy	-7.582***	1.849	0.000	(-11.205 , -3.958)
Netherlands Antilles	-6.016***	2.165	0.005	(-10.259 -1.772)
Turkey	-31.581***	8.680	0.000	(-48.594 , -14.567)
OFCs 1	-2.419***	0.616	0.000	(-3.626 , -1.211)
OFCs 2	-0.669***	0.198	0.001	(-1.057 , -0.280)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A10: OFCs 1, backward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	2.205	2.816*	-1.415	0.774	-0.0253
Distance	0.359***	0.260***	0.289***	0.443***	0.289***
Technology gap	-0.488***	-0.470***	-0.118	-0.516***	-0.242
Openness	0.419***	0.325***	0.373**	0.580***	0.217
Financial dev.	-0.259**	-0.222*	-0.0750	-0.0652	-0.138
Patent rights	-0.137**	-0.116**	-0.129	-0.0519	-0.00357
Fully owned	-0.194***	-0.255***	-0.214***	-0.155*	-0.272***
Joint ventures	0.0274	-0.0199	0.0179	0.00989	-0.0344
Services	-0.226***	-0.339***	-0.0843	-0.259**	-0.397
Aggregated	0.991***	1.025***	0.999***	0.902***	0.999***
Average year	0.0429***	0.0376***	-0.00229	0.0247***	0.0322***
Amadeus	-0.502***	-0.568***	-0.474***	-0.214*	-0.480***
Employment	-0.147	-0.215***	-0.107	-0.475***	-0.298*
Competition	-0.287***	-0.271***	-0.312***	-0.220***	-0.279***
Cyclicality	0.493***	0.585***	0.516***	0.476***	0.557***
One step	-0.375***	-0.475***	-0.464***	-0.469***	-0.476***
Olley-Pakes	-0.364***	-0.514***	-0.544***	-0.475***	-0.537***
OLS	-0.418***	-0.602***	-0.532***	-0.479***	-0.621***
Pooled OLS	0.160***	0.206***	0.207***	0.112***	0.223***
Sector fixed	0.0920**	0.109***	0.128***	0.0697	0.0951
Differences	0.155***	0.0869**	0.136**	0.0610	0.0839
Published	0.387***	0.452***	0.311**	0.0708	0.467***
Study citations	0.0567*	0.0256	0.198***	0.0865***	0.0350
Native	0.458***	0.401***	0.292***	0.326***	0.446***
Author citations	-0.0563***	-0.0347**	-0.0689**	-0.0648***	-0.0229
Publication date	0.0276	0.0344	0.0848**	0.130***	0.0303
OFCs 1	-2.419***	-2.276***	-2.610***	-2.507***	-1.970**
Constant	0.407	0.713***	0.757**	0.701*	0.646**
R^2					0.468
AIC	7012.9	7129.4	6151.5	8586.5	7153.4
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A11: OFCs 2, backward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	4.403***	3.959**	0.560	3.869*	1.232
Distance	0.0819	0.0639	0.0144	0.104	0.107
Technology gap	-0.491***	-0.433***	-0.109	-0.534***	-0.223
Openness	0.172	0.165	0.181	0.0605	0.0908
Financial dev.	-0.217*	-0.114	0.120	-0.0794	-0.0543
Patent rights	-0.156***	-0.131**	-0.0421	-0.0770	-0.0205
Fully owned	-0.196***	-0.255***	-0.216***	-0.165**	-0.270***
Joint ventures	0.0361	-0.0145	0.0216	0.0119	-0.0279
Services	-0.214***	-0.332***	-0.0725	-0.236**	-0.384
Aggregated	1.205***	1.205***	1.165***	1.043***	1.164***
Average year	0.0322***	0.0278***	0.0270	0.0153**	0.0252***
Amadeus	-0.703***	-0.697***	-0.615***	-0.426***	-0.590***
Employment	-0.212**	-0.270***	-0.172	-0.453***	-0.358**
Competition	-0.296***	-0.290***	-0.307***	-0.267***	-0.306***
Cyclicality	0.491***	0.587***	0.496***	0.486***	0.532***
One step	-0.332***	-0.456***	-0.397***	-0.364***	-0.454***
Olley-Pakes	-0.273***	-0.443***	-0.424***	-0.362***	-0.449***
OLS	-0.370***	-0.581***	-0.453***	-0.404***	-0.595***
Pooled OLS	0.147***	0.191***	0.175**	0.109***	0.210***
Sector fixed	0.121***	0.141***	0.135***	0.127**	0.119*
Differences	0.0707	0.0409	0.102	0.0459	0.0321
Published	0.326***	0.412***	0.370***	0.110	0.445***
Study citations	0.0761**	0.0384	0.173**	0.0828***	0.0423
Native	0.329***	0.317***	0.207**	0.201**	0.364***
Author citations	-0.0511***	-0.0348**	-0.0666**	-0.0665***	-0.0218
Publication date	0.0804***	0.0732***	0.0768*	0.188***	0.0610*
OFCs 2	-0.669***	-0.651***	-0.578**	-0.959***	-0.540*
Constant	0.485	0.643**	0.872**	0.626	0.636**
R^2					0.466
AIC	7016.9	7133.3	6153.4	8580.1	7156.9
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A12: Cyprus, backward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	2.878*	3.106*	-0.0256	1.332	0.441
Distance	0.224***	0.160***	0.161**	0.301***	0.187**
Technology gap	-0.465***	-0.442***	-0.141	-0.482***	-0.218
Openness	0.330***	0.261**	0.284*	0.488***	0.162
Financial dev.	-0.394***	-0.320***	-0.334	-0.210*	-0.232
Patent rights	-0.0401	-0.0239	-0.104	0.0556	0.0721
Fully owned	-0.194***	-0.258***	-0.209***	-0.153*	-0.261***
Joint ventures	0.0341	-0.0192	0.0260	0.0197	-0.0196
Services	-0.224***	-0.339***	-0.0818	-0.261**	-0.395
Aggregated	1.051***	1.096***	1.020***	0.969***	1.034***
Average year	0.0450***	0.0385***	-0.00426	0.0247***	0.0342***
Amadeus	-0.646***	-0.674***	-0.585***	-0.364***	-0.568***
Employment	-0.175*	-0.247***	-0.140	-0.509***	-0.329*
Competition	-0.258***	-0.257***	-0.313***	-0.184**	-0.259**
Cyclicality	0.461***	0.578***	0.474***	0.446***	0.508**
One step	-0.357***	-0.466***	-0.438***	-0.450***	-0.475***
Olley-Pakes	-0.336***	-0.499***	-0.524***	-0.458***	-0.523***
OLS	-0.403***	-0.598***	-0.502***	-0.457***	-0.621***
Pooled OLS	0.166***	0.215***	0.210***	0.113***	0.235***
Sector fixed	0.114***	0.134***	0.130***	0.0854*	0.116*
Differences	0.154***	0.0913**	0.147**	0.0569	0.0967
Published	0.342***	0.416***	0.312**	0.00738	0.445***
Study citations	0.0602*	0.0279	0.201***	0.0879***	0.0343
Native	0.396***	0.374***	0.174*	0.274***	0.406***
Author citations	-0.0406**	-0.0211	-0.0671**	-0.0454*	-0.00739
Publication date	0.0268	0.0340	0.0865**	0.132***	0.0233
Cyprus	-10.32***	-8.780***	-10.17***	-10.84***	-9.315**
Constant	0.439	0.682***	0.782**	0.764*	0.630**
R^2					0.469
AIC	7013.6	7133.1	6149.6	8586.3	7150.4
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A13: Greece, backward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	3.513**	4.083**	1.244	2.619	1.061
Distance	0.211***	0.132**	0.135**	0.289***	0.183***
Technology gap	-0.520***	-0.502***	-0.213	-0.579***	-0.274
Openness	0.339***	0.241*	0.125	0.452***	0.144
Financial dev.	-0.428***	-0.370***	-0.447*	-0.281**	-0.268
Patent rights	-0.0794	-0.0698	-0.185	-0.0000510	0.0341
Fully owned	-0.193***	-0.251***	-0.197***	-0.138*	-0.265***
Joint ventures	0.0379	-0.00619	0.0421	0.0271	-0.0197
Services	-0.224***	-0.334***	-0.0783	-0.259**	-0.395
Aggregated	1.038***	1.044***	0.912***	0.861***	1.025***
Average year	0.0370***	0.0337***	-0.0237	0.0210***	0.0280***
Amadeus	-0.599***	-0.600***	-0.467***	-0.294***	-0.508***
Employment	-0.163*	-0.239***	-0.131	-0.490***	-0.327*
Competition	-0.227***	-0.203***	-0.275***	-0.114	-0.211*
Cyclicality	0.465***	0.557***	0.396***	0.429***	0.537***
One step	-0.383***	-0.491***	-0.452***	-0.495***	-0.488***
Olley-Pakes	-0.365***	-0.527***	-0.526***	-0.501***	-0.552***
OLS	-0.434***	-0.631***	-0.521***	-0.523***	-0.645***
Pooled OLS	0.158***	0.204***	0.188**	0.107***	0.217***
Sector fixed	0.124***	0.153***	0.131***	0.108**	0.137**
Differences	0.0943*	0.0338	0.0950	0.0357	0.0315
Published	0.307***	0.408***	0.341***	0.0189	0.425***
Study citations	0.0706**	0.0275	0.190**	0.0836***	0.0400
Native	0.451***	0.416***	0.205**	0.331***	0.466***
Author citations	-0.0544***	-0.0270*	-0.0623**	-0.0579***	-0.0173
Publication date	0.0414	0.0323	0.0878**	0.129***	0.0312
Greece	-4.198***	-5.095***	-6.022***	-6.172***	-4.062**
Constant	0.422	0.652**	0.769**	0.694*	0.647**
R^2					0.468
AIC	7017.8	7128.3	6144.6	8583.0	7152.7
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A14: Italy, backward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	4.334***	5.294***	3.047	1.980	2.222
Distance	0.170***	0.0498	0.136**	0.285***	0.114**
Technology gap	-0.566***	-0.544***	-0.419*	-0.549***	-0.323*
Openness	0.137	-0.0230	0.130	0.393**	-0.0600
Financial dev.	-0.530***	-0.520***	-0.350	-0.250**	-0.398**
Patent rights	-0.0358	-0.00904	-0.0500	0.0493	0.0802
Fully owned	-0.202***	-0.249***	-0.219***	-0.158*	-0.263***
Joint ventures	0.0236	-0.0109	0.0135	-0.00111	-0.0235
Services	-0.221***	-0.333***	-0.0833	-0.253**	-0.390
Aggregated	1.109***	1.107***	1.092***	1.080***	1.067***
Average year	0.0375***	0.0334***	0.0215	0.0152**	0.0291***
Amadeus	-0.531***	-0.578***	-0.509***	-0.292**	-0.492***
Employment	-0.200**	-0.268***	-0.124	-0.555***	-0.346**
Competition	-0.242***	-0.224***	-0.281***	-0.174*	-0.239**
Cyclicality	0.582***	0.636***	0.580***	0.603***	0.607***
One step	-0.393***	-0.513***	-0.453***	-0.478***	-0.519***
Olley-Pakes	-0.351***	-0.506***	-0.482***	-0.481***	-0.529***
OLS	-0.435***	-0.640***	-0.508***	-0.502***	-0.654***
Pooled OLS	0.155***	0.195***	0.198***	0.109***	0.215***
Sector fixed	0.111***	0.128***	0.121***	0.103**	0.110*
Differences	0.126**	0.0600	0.144**	0.0446	0.0632
Published	0.329***	0.422***	0.393***	-0.0312	0.445***
Study citations	0.0624**	0.0238	0.167**	0.0953***	0.0331
Native	0.507***	0.438***	0.377***	0.369***	0.477***
Author citations	-0.0373*	-0.0165	-0.0555**	-0.0529**	-0.00911
Publication date	0.0440*	0.0361	0.0470	0.159***	0.0358
Italy	-7.582***	-9.062***	-6.961***	-5.435**	-7.448***
Constant	0.485	0.680***	0.805**	0.740*	0.570*
R^2					0.471
AIC	7011.5	7121.8	6149.8	8589.8	7146.4
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A15: Netherlands Antilles, backward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	3.161*	3.814**	0.350	2.146	0.661
Distance	0.224***	0.145**	0.144**	0.312***	0.200***
Technology gap	-0.506***	-0.494***	-0.156	-0.567***	-0.261
Openness	0.362***	0.267**	0.170	0.480***	0.169
Financial dev.	-0.420***	-0.362***	-0.374	-0.272**	-0.252
Patent rights	-0.0692	-0.0638	-0.141	0.0152	0.0446
Fully owned	-0.195***	-0.250***	-0.200***	-0.148*	-0.269***
Joint ventures	0.0360	-0.00562	0.0394	0.0224	-0.0252
Services	-0.222***	-0.330***	-0.0756	-0.256**	-0.391
Aggregated	1.017***	1.017***	0.870***	0.840***	1.022***
Average year	0.0354***	0.0321***	-0.0213	0.0194***	0.0267***
Amadeus	-0.594***	-0.592***	-0.452***	-0.290**	-0.512***
Employment	-0.159*	-0.232***	-0.126	-0.480***	-0.322*
Competition	-0.231***	-0.202***	-0.267***	-0.133	-0.224*
Cyclicality	0.477***	0.565***	0.410***	0.449***	0.558***
One step	-0.395***	-0.503***	-0.479***	-0.507***	-0.492***
Olley-Pakes	-0.376***	-0.539***	-0.557***	-0.513***	-0.557***
OLS	-0.444***	-0.641***	-0.548***	-0.533***	-0.647***
Pooled OLS	0.158***	0.204***	0.190***	0.108***	0.217***
Sector fixed	0.129***	0.161***	0.141***	0.115**	0.141**
Differences	0.0967*	0.0312	0.104	0.0400	0.0352
Published	0.299***	0.399***	0.331***	0.00856	0.414***
Study citations	0.0744**	0.0296	0.197***	0.0867***	0.0429
Native	0.453***	0.416***	0.211**	0.338***	0.467***
Author citations	-0.0613***	-0.0336**	-0.0713**	-0.0678***	-0.0236
Publication date	0.0510*	0.0405*	0.0964**	0.145***	0.0414
Netherlands Antilles	-6.016***	-7.603***	-8.915***	-8.355***	-5.181*
Constant	0.407	0.600**	0.749**	0.700*	0.649**
R^2					0.466
AIC	7020.5	7130.3	6147.4	8587.0	7157.5
Observations	1308	1308	1137	1398	1308

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A16: OFCs 1, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	10.17***	12.83***	11.76***	6.369*	11.03**
Cross-sectional	0.523***	0.507***	0.642***	0.445**	0.957*
Aggregated	-1.085***	-1.243***	-1.009***	-0.522**	-0.857***
Time span	0.0529***	0.0466***	0.00680	0.0415**	-0.00317
Average year	0.137***	0.136***	0.0278	0.124***	0.0305
GMM	-0.584***	-0.559***	-0.605***	-0.191*	-0.494***
Olley-Pakes	-0.124***	-0.105**	-0.0466	-0.0928	-0.141
Pooled OLS	-0.952***	-0.935***	-0.909***	-0.966***	-0.839***
Random	-0.741***	-0.689***	-0.540**	-0.446*	-0.669
Sector fixed	-0.307***	-0.320***	-0.259***	-0.432***	-0.298**
Log-log	0.617	0.670*	0.240	0.108	0.0157
Differences	-0.870***	-0.797***	-0.891***	-0.649***	-0.754***
Employment	-0.448***	-0.538***	-0.650***	-0.199	-0.493*
Competition	0.345***	0.445***	0.281**	0.439***	0.424**
Cyclicality	-0.318*	-0.248	-0.511***	-0.500**	-0.713**
Regional	2.404***	2.807***	2.541***	2.906***	1.480
More	-0.193***	-0.198***	-0.164***	-0.295***	-0.141*
Combination	-0.325***	-0.376***	-0.311***	-0.468***	-0.328**
Impact	-0.317***	-0.282***	-0.263***	-0.348***	-0.256**
Study citations	-0.322***	-0.376***	-0.470***	-0.251**	-0.195
Native	-0.227	-0.244	-0.297*	-0.215	-0.195
Author citations	0.0998**	0.0816**	0.147***	0.0437	0.0604
Publication date	-0.285***	-0.215***	-0.202***	-0.299***	-0.145
Distance	-0.324***	-0.445***	-0.461***	-0.309**	-0.708***
Technology gap	-0.330	-0.521**	-0.365	0.0701	-0.248
Openness	-0.335	-0.684***	-0.898***	-0.123	-0.961***
Financial dev.	-0.931***	-1.317***	-0.912***	-1.262***	-0.522
Patent rights	-0.161	-0.135	-0.163	-0.142	-0.00697
Fully owned	0.166*	0.166*	0.107	0.259**	0.152
Joint ventures	0.274***	0.283***	0.208**	0.387***	0.262
Services	0.745***	0.717***	0.847***	0.952***	0.708*
OFCs 1	4.748***	6.204***	4.852***	4.177***	6.845**
Constant	-0.417	-1.001*	-0.470	-2.330*	-0.344
R^2					0.412
AIC	6330.3	6358.2	5565.1	7344.2	6477.4
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A17: OFCs 2, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	2.315	1.959	5.061*	-2.352	-1.071
Cross-sectional	0.103	0.0127	0.248*	0.124	0.172
Aggregated	-1.330***	-1.532***	-1.215***	-0.630**	-1.331***
Time span	0.0672***	0.0666***	0.0205	0.0400**	0.0177
Average year	0.160***	0.171***	0.0481	0.121***	0.0655
GMM	-0.634***	-0.614***	-0.645***	-0.232**	-0.601***
Olley-Pakes	-0.129***	-0.124***	-0.0637	-0.107*	-0.188
Pooled OLS	-1.017***	-1.019***	-0.968***	-1.016***	-0.992***
Random	-0.778***	-0.735***	-0.551**	-0.483*	-0.750*
Sector fixed	-0.254***	-0.253***	-0.210***	-0.378***	-0.230
Log-log	0.710*	0.803**	0.441	-0.131	0.0952
Differences	-0.880***	-0.848***	-0.876***	-0.651***	-0.778***
Employment	-0.736***	-0.852***	-0.881***	-0.374	-0.960***
Competition	0.419***	0.567***	0.339***	0.477***	0.596**
Cyclicality	-0.399**	-0.437***	-0.545***	-0.585**	-1.007***
Regional	3.334***	3.848***	3.002***	3.557***	3.051***
More	-0.216***	-0.225***	-0.185***	-0.309***	-0.214**
Combination	-0.273***	-0.292***	-0.252***	-0.422***	-0.244
Impact	-0.306***	-0.256***	-0.249***	-0.403***	-0.222*
Study citations	-0.485***	-0.597***	-0.637***	-0.292**	-0.490***
Native	-0.888***	-0.989***	-0.823***	-0.856***	-1.282***
Author citations	0.198***	0.197***	0.239***	0.106**	0.209***
Publication date	-0.309***	-0.277***	-0.240***	-0.281***	-0.163
Distance	-0.593***	-0.657***	-0.490***	-0.590***	-1.087***
Technology gap	0.764***	0.845***	0.415	1.219***	1.397***
Openness	-0.451*	-0.748***	-0.776***	-0.262	-1.000***
Financial dev.	0.174	0.0538	-0.112	-0.173	1.164***
Patent rights	-0.186	-0.101	-0.226	-0.129	-0.0542
Fully owned	0.163*	0.180**	0.104	0.224*	0.217
Joint ventures	0.306***	0.334***	0.238**	0.414***	0.349
Services	0.800***	0.784***	0.894***	1.010***	0.750*
OFCs 2	-1.547***	-1.700***	-0.899**	-1.386**	-2.226***
Constant	-0.430	-1.289**	-0.411	-2.687*	-0.702
R^2					0.404
AIC	6333.3	6374.1	5581.1	7345.9	6491.7
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A18: Belgium, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	8.350***	9.116***	9.642***	4.720**	4.316**
Cross-sectional	0.235*	0.0839	0.257*	0.199	0.341
Aggregated	-1.283***	-1.492***	-1.217***	-0.741***	-1.185***
Time span	0.0449***	0.0333**	0.00599	0.0273	-0.00187
Average year	0.129***	0.116***	0.0335	0.112***	0.0288
GMM	-0.515***	-0.474***	-0.574***	-0.165	-0.428**
Olley-Pakes	-0.148***	-0.155***	-0.0914*	-0.110*	-0.224
Pooled OLS	-0.873***	-0.834***	-0.881***	-0.933***	-0.782***
Random	-0.817***	-0.753***	-0.546**	-0.580**	-0.836*
Sector fixed	-0.241***	-0.247***	-0.188***	-0.355***	-0.265*
Log-log	0.619	0.788**	0.442	0.0485	0.0464
Differences	-0.884***	-0.835***	-0.846***	-0.715***	-0.784***
Employment	-0.529***	-0.679***	-0.626***	-0.184	-0.675***
Competition	0.352***	0.350***	0.245**	0.282**	0.389*
Cyclicality	-0.306*	-0.266*	-0.453***	-0.429*	-0.824***
Regional	2.141***	2.733***	2.939***	2.576***	1.790**
More	-0.168***	-0.167***	-0.163***	-0.285***	-0.139*
Combination	-0.187**	-0.186**	-0.176*	-0.305**	-0.173
Impact	-0.325***	-0.277***	-0.252***	-0.385***	-0.258**
Study citations	-0.536***	-0.623***	-0.588***	-0.377***	-0.468***
Native	-0.759***	-1.017***	-0.735***	-0.639***	-1.037***
Author citations	0.0735*	0.0351	0.130***	-0.0261	0.0680
Publication date	-0.238***	-0.143***	-0.179***	-0.196***	-0.117
Distance	-0.132	-0.351***	-0.159	-0.216*	-0.576*
Technology gap	-0.271	-0.190	-0.344	0.152	0.363
Openness	0.0634	-0.310	-0.332	-0.0146	-0.417
Financial dev.	-0.922***	-1.318***	-0.917***	-1.518***	-0.173
Patent rights	-0.0267	0.105	-0.179	0.117	0.152
Fully owned	0.127	0.119	0.108	0.246**	0.140
Joint ventures	0.248***	0.240**	0.226**	0.386***	0.245
Services	0.814***	0.797***	0.900***	1.028***	0.729*
Belgium	-22.56***	-28.12***	-15.26***	-25.13***	-21.31***
Constant	-0.350	-1.363**	-0.375	-2.316*	-0.499
R^2					0.422
AIC	6304.6	6307.5	5571.5	7325.5	6460.9
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A19: Greece, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	-1.172	-1.641	-0.761	-4.829***	-5.274**
Cross-sectional	0.459***	0.377***	0.544***	0.394**	0.691**
Aggregated	-0.875***	-1.041***	-0.852***	-0.466**	-0.678***
Time span	0.0534***	0.0459***	0.0246	0.0377**	0.00520
Average year	0.143***	0.136***	0.0759**	0.124***	0.0340
GMM	-0.529***	-0.467***	-0.554***	-0.0952	-0.407**
Olley-Pakes	-0.140***	-0.138***	-0.0824*	-0.0973	-0.186
Pooled OLS	-0.881***	-0.829***	-0.850***	-0.833***	-0.735**
Random	-0.677***	-0.560***	-0.476*	-0.346	-0.579
Sector fixed	-0.249***	-0.263***	-0.208***	-0.365***	-0.211
Log-log	0.599	0.654*	0.190	0.214	0.0577
Differences	-0.726***	-0.602***	-0.770***	-0.491***	-0.541***
Employment	-0.379**	-0.447***	-0.485***	-0.313	-0.322
Competition	0.0961	0.121	0.110	0.176	0.0506
Cyclicality	-0.197	-0.117	-0.413**	-0.307	-0.511**
Regional	2.015***	2.504***	2.656***	2.588***	1.206
More	-0.191***	-0.189***	-0.169***	-0.292***	-0.140*
Combination	-0.261***	-0.288***	-0.236**	-0.391***	-0.225
Impact	-0.258***	-0.208***	-0.207***	-0.204**	-0.166
Study citations	-0.321***	-0.349***	-0.437***	-0.310***	-0.162
Native	0.0207	-0.0841	-0.0251	0.0495	-0.0824
Author citations	0.0887**	0.0517	0.144***	0.0404	0.0327
Publication date	-0.240***	-0.149***	-0.237***	-0.233***	-0.0791
Distance	-0.0254	-0.0866	-0.159	0.00452	-0.304*
Technology gap	0.348*	0.397**	0.424	0.689***	0.807***
Openness	-0.158	-0.412*	-0.596**	0.0363	-0.573**
Financial dev.	-0.157	-0.398**	0.0664	-0.342*	0.446**
Patent rights	0.241*	0.303**	0.326	0.267	0.422*
Fully owned	0.140	0.119	0.100	0.266**	0.0931
Joint ventures	0.245***	0.231**	0.200**	0.363***	0.191
Services	0.776***	0.753***	0.869***	0.971***	0.754*
Greece	16.19***	19.66***	14.57***	18.41***	20.07***
Constant	-0.272	-0.691	-0.211	-1.246	-0.203
R^2					0.434
AIC	6308.8	6324.0	5556.6	7327.4	6438.2
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A20: Korea, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	-2.073	-3.145*	1.180	-7.315***	-5.584**
Cross-sectional	0.168	0.0917	0.222	0.180	0.318
Aggregated	-1.329***	-1.506***	-1.254***	-0.690***	-1.182***
Time span	0.0614***	0.0541***	0.0120	0.0355*	0.0148
Average year	0.123***	0.119***	0.00326	0.0770***	0.0295
GMM	-0.614***	-0.577***	-0.628***	-0.229**	-0.545***
Olley-Pakes	-0.148***	-0.151***	-0.0774*	-0.118*	-0.223
Pooled OLS	-0.977***	-0.949***	-0.942***	-1.000***	-0.894***
Random	-0.790***	-0.725***	-0.558**	-0.504*	-0.762
Sector fixed	-0.246***	-0.247***	-0.191***	-0.361***	-0.244
Log-log	1.297***	1.417***	1.293***	0.354	0.643
Differences	-0.899***	-0.848***	-0.876***	-0.687***	-0.791***
Employment	-0.784***	-0.858***	-0.986***	-0.586**	-0.892***
Competition	0.150	0.219**	0.0384	0.288**	0.267
Cyclicality	-0.425**	-0.469***	-0.531***	-0.617**	-1.010***
Regional	3.494***	3.914***	3.151***	4.043***	2.726***
More	-0.222***	-0.229***	-0.190***	-0.320***	-0.207***
Combination	-0.270***	-0.279***	-0.240**	-0.436***	-0.239
Impact	-0.309***	-0.255***	-0.257***	-0.388***	-0.219*
Study citations	-0.543***	-0.623***	-0.666***	-0.452***	-0.504***
Native	-0.878***	-0.975***	-1.034***	-1.104***	-1.034***
Author citations	0.186***	0.168***	0.201***	0.123**	0.192***
Publication date	-0.310***	-0.262***	-0.167**	-0.278***	-0.220**
Distance	-0.946***	-1.045***	-0.938***	-1.065***	-1.193***
Technology gap	1.236***	1.375***	0.981***	1.850***	1.655***
Openness	-0.840***	-1.186***	-1.231***	-0.521*	-1.167***
Financial dev.	-0.587***	-0.816***	-0.874***	-0.741***	0.249
Patent rights	0.621***	0.816***	0.355*	0.664***	0.811***
Fully owned	0.144	0.147	0.0868	0.199	0.170
Joint ventures	0.277***	0.286***	0.214**	0.379***	0.280
Services	0.795***	0.776***	0.904***	1.016***	0.722*
Korea	22.10***	25.57***	19.41***	24.75***	22.30***
Constant	-0.398	-1.082*	-0.389	-2.562*	-0.427
R^2					0.420
AIC	6305.6	6335.2	5556.6	7324.9	6463.3
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A21: Luxembourg, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	13.86***	15.03***	14.60***	12.66***	12.07***
Cross-sectional	0.480***	0.427***	0.547***	0.300*	0.787**
Aggregated	-1.439***	-1.642***	-1.395***	-0.871***	-1.372***
Time span	0.0365**	0.0348**	-0.00235	0.0384*	-0.00433
Average year	0.112***	0.118***	0.0267	0.122***	0.0298
GMM	-0.546***	-0.529***	-0.605***	-0.184*	-0.463***
Olley-Pakes	-0.106**	-0.0910**	-0.0436	-0.0525	-0.123
Pooled OLS	-0.936***	-0.930***	-0.919***	-0.983***	-0.836***
Random	-0.849***	-0.831***	-0.621**	-0.574**	-0.907**
Sector fixed	-0.310***	-0.330***	-0.249***	-0.433***	-0.316**
Log-log	1.145***	1.410***	0.806**	0.848	0.741***
Differences	-0.994***	-0.968***	-0.998***	-0.774***	-0.964***
Employment	-0.529***	-0.767***	-0.553***	-0.232	-0.695***
Competition	0.462***	0.561***	0.370***	0.473***	0.570***
Cyclicality	0.124	0.284	-0.0578	-0.0192	-0.0416
Regional	1.310***	1.997***	2.924***	1.812***	0.760
More	-0.187***	-0.192***	-0.173***	-0.288***	-0.144*
Combination	-0.316***	-0.371***	-0.288***	-0.434***	-0.335**
Impact	-0.401***	-0.367***	-0.324***	-0.392***	-0.353***
Study citations	-0.343***	-0.458***	-0.415***	-0.282**	-0.329***
Native	-0.988***	-1.222***	-0.948***	-0.855***	-1.195***
Author citations	0.0317	0.0134	0.0687	-0.0323	0.00815
Publication date	-0.177***	-0.0875*	-0.128*	-0.191***	-0.0447
Distance	-0.0179	-0.184*	-0.103	-0.0203	-0.389
Technology gap	-0.906***	-0.914***	-0.915***	-0.743**	-0.557
Openness	-0.274	-0.701***	-0.696***	-0.238	-0.958***
Financial dev.	-0.682***	-0.972***	-0.614**	-1.401***	-0.149
Patent rights	-0.166	-0.0573	-0.129	-0.114	0.0918
Fully owned	0.158*	0.160*	0.134	0.285**	0.143
Joint ventures	0.255***	0.264***	0.227**	0.362***	0.245
Services	0.756***	0.733***	0.849***	0.967***	0.704*
Luxembourg	-16.55***	-19.36***	-15.67***	-17.98***	-19.66***
Constant	-0.282	-0.943*	-0.426	-2.305	-0.447
R^2					0.440
AIC	6307.2	6320.2	5555.1	7326.8	6427.9
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A22: Singapore, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
main					
1/SE	-0.484	-1.328	1.127	-4.955**	-4.533*
Cross-sectional	0.150	0.0802	0.235*	0.102	0.285
Aggregated	-1.382***	-1.558***	-1.301***	-0.766***	-1.262***
Time span	0.0552***	0.0519***	0.0136	0.0369*	0.0101
Average year	0.132***	0.135***	0.0265	0.101***	0.0366
GMM	-0.631***	-0.593***	-0.639***	-0.230**	-0.573***
Olley-Pakes	-0.139***	-0.140***	-0.0687	-0.101	-0.209
Pooled OLS	-1.003***	-0.984***	-0.961***	-1.008***	-0.935***
Random	-0.774***	-0.705***	-0.563**	-0.462*	-0.716
Sector fixed	-0.253***	-0.256***	-0.208***	-0.374***	-0.239
Log-log	1.277***	1.411***	1.260***	0.446	0.730*
Differences	-0.885***	-0.852***	-0.897***	-0.641***	-0.790***
Employment	-0.797***	-0.882***	-1.019***	-0.623**	-0.938***
Competition	0.169	0.258**	0.0876	0.340**	0.251
Cyclicality	-0.405**	-0.423***	-0.539***	-0.571**	-0.960***
Regional	3.415***	3.850***	3.073***	4.059***	2.760***
More	-0.230***	-0.238***	-0.194***	-0.320***	-0.223***
Combination	-0.293***	-0.309***	-0.270***	-0.458***	-0.265
Impact	-0.305***	-0.252***	-0.262***	-0.353***	-0.212*
Study citations	-0.571***	-0.666***	-0.707***	-0.535***	-0.555***
Native	-0.833***	-0.910***	-0.990***	-1.026***	-1.022***
Author citations	0.189***	0.179***	0.213***	0.136**	0.200***
Publication date	-0.304***	-0.263***	-0.193***	-0.293***	-0.206**
Distance	-0.861***	-0.929***	-0.937***	-0.917***	-1.209***
Technology gap	1.034***	1.132***	0.982***	1.542***	1.560***
Openness	-0.732***	-1.058***	-1.211***	-0.358	-1.171***
Financial dev.	-0.710***	-0.978***	-0.842***	-0.933***	0.0206
Patent rights	0.556***	0.737***	0.422*	0.560***	0.853***
Fully owned	0.152*	0.158*	0.0870	0.208*	0.179
Joint ventures	0.287***	0.301***	0.217**	0.381***	0.293
Services	0.788***	0.769***	0.895***	1.004***	0.726*
Singapore	18.05***	21.24***	16.57***	19.41***	21.28***
Constant	-0.459	-1.082*	-0.403	-2.612*	-0.490
R^2					0.421
AIC	6312.1	6347.0	5558.7	7329.0	6461.7
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A23: United Kingdom, forward spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	16.33***	15.60***	22.26***	17.98***	9.365***
Cross-sectional	0.419***	0.276**	0.379***	0.277*	0.538*
Aggregated	-1.248***	-1.404***	-1.280***	-0.791***	-1.107***
Time span	0.0308*	0.0302**	-0.0124	0.0297	-0.00301
Average year	0.0785***	0.0807***	-0.00927	0.0806***	-0.00235
GMM	-0.449***	-0.390***	-0.486***	-0.0993	-0.350*
Olley-Pakes	-0.130***	-0.133***	-0.0965**	-0.0650	-0.209
Pooled OLS	-0.871***	-0.833***	-0.844***	-0.925***	-0.766**
Random	-0.870***	-0.792***	-0.585**	-0.633**	-0.886*
Sector fixed	-0.313***	-0.342***	-0.251***	-0.438***	-0.319**
Log-log	2.069***	2.267***	2.309***	2.141***	1.138***
Differences	-0.997***	-0.908***	-0.942***	-0.831***	-0.816***
Employment	-0.621***	-0.881***	-0.421**	-0.431*	-0.799***
Competition	0.224**	0.305***	-0.00647	0.212	0.385*
Cyclicality	-0.0862	-0.0390	-0.0806	-0.0816	-0.668***
Regional	0.382	1.509***	2.977***	0.639	0.694
More	-0.163***	-0.159***	-0.152***	-0.280***	-0.125*
Combination	-0.291***	-0.339***	-0.254***	-0.411***	-0.288*
Impact	-0.402***	-0.329***	-0.331***	-0.360***	-0.279**
Study citations	-0.497***	-0.569***	-0.412***	-0.550***	-0.424***
Native	-0.767***	-1.005***	-0.742***	-0.730***	-0.988***
Author citations	0.0713*	0.0523	0.0246	0.00621	0.0904*
Publication date	-0.245***	-0.158***	-0.138**	-0.250***	-0.139
Distance	0.391***	0.175	0.582***	0.503***	-0.186
Technology gap	-1.262***	-1.038***	-1.947***	-1.412***	-0.296
Openness	-0.360	-0.776***	-0.528**	-0.405	-0.758**
Financial dev.	-1.245***	-1.549***	-1.722***	-2.117***	-0.284
Patent rights	-0.464***	-0.398***	-0.674***	-0.493***	-0.229
Fully owned	0.0747	0.0610	0.0776	0.218*	0.0682
Joint ventures	0.191**	0.185*	0.177*	0.309**	0.175
Services	0.788***	0.762***	0.861***	0.976***	0.716*
United Kingdom	-14.38***	-14.27***	-17.37***	-17.91***	-10.44***
Constant	-0.214	-1.068*	-0.406	-1.879	-0.453
R^2					0.417
AIC	6280.6	6305.8	5539.9	7294.0	6468.6
Observations	1030	1030	912	1067	1030

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A24: OFCs 1, horizontal spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	-0.550***	-1.051***	-2.122***	-0.174	-0.647
Cross-sectional	-0.0592**	-0.0540***	-0.0924***	-0.139***	-0.0544***
Aggregated	0.573***	0.442***	0.671***	0.346***	0.389**
One step	0.0525***	0.0448***	0.0595***	0.0415***	0.0302
Pooled OLS	-0.0411**	-0.0225	0.0153	0.138***	-0.0295
Log-log	-0.785**	-0.645**	-0.175	-0.747*	-0.464***
Differences	0.108***	0.0898***	0.0316*	0.0804***	0.0884***
Employment	0.343***	0.277***	0.272***	0.256***	0.231***
Regional	-0.382***	-0.279***	-0.578***	-0.180*	-0.222
Lagged	0.0821**	0.0905***	0.0569*	0.0627	0.0892**
More	-0.0732***	-0.0720***	-0.0574***	-0.0728***	-0.0636*
Impact	0.0204*	-0.000484	-0.0116	0.00839	0.00828
Author citations	0.0375***	0.0245***	0.0187***	0.0252***	0.0213**
Distance	0.0135	0.0139	-0.00661	-0.0218	0.0255
Technology gap	0.0136	0.0650***	0.194***	0.0178	0.0306
Openness	-0.0519*	0.00237	-0.0183	-0.0880***	-0.0461
Financial dev.	0.163***	0.193***	0.109**	0.0919***	0.0991
Patent rights	0.00771	0.0140	0.0406	0.000493	0.00448
Fully owned	0.0318*	0.0451**	0.0211	0.0364*	0.0407
Joint ventures	0.0622***	0.0752***	0.0536***	0.0655***	0.0625*
Services	0.0284	0.0312	-0.0343	0.0145	0.0266
OFCs 1	0.389**	0.491***	0.365	0.336**	0.111
Constant	0.679*	0.194	-0.144	0.768*	-0.407
R^2					0.179
AIC	5661.0	5756.4	4539.8	6399.4	5823.0
Observations	1151	1151	954	1201	1151

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A25: OFCs 2, horizontal spillovers

	1–ME	2–ME	3–ME	4–ME	5–OLS
1/SE	-1.259***	-2.048***	-1.672***	-0.466**	-1.245**
Cross-sectional	-0.0565**	-0.0487***	-0.0946***	-0.161***	-0.0525***
Aggregated	0.568***	0.449***	0.674***	0.461***	0.376**
One step	0.0458***	0.0396***	0.0570***	0.0324**	0.0305
Pooled OLS	-0.0457**	-0.0310*	0.00400	0.131***	-0.0362
Log-log	-0.766**	-0.684**	-0.121	-0.725*	-0.490***
Differences	0.126***	0.114***	0.0401**	0.106***	0.102***
Employment	0.349***	0.301***	0.276***	0.268***	0.247***
Regional	-0.364***	-0.260***	-0.575***	-0.260***	-0.197
Lagged	0.0777**	0.0822***	0.0465	0.0628	0.0789*
More	-0.0643***	-0.0674***	-0.0513***	-0.0722***	-0.0574**
Impact	0.0235**	0.00804	-0.0103	0.0196*	0.0128
Author citations	0.0305***	0.0195***	0.0149***	0.0296***	0.0182**
Distance	0.0712***	0.0837***	0.0575***	0.0193	0.0591*
Technology gap	0.0229	0.0814***	0.108**	0.00667	0.0441
Openness	0.0118	0.101***	0.0509	-0.0361	0.0198
Financial dev.	0.122***	0.133***	0.0116	0.105***	0.0723
Patent rights	0.0367***	0.0601***	-0.000269	0.00543	0.0355
Fully owned	0.0238	0.0394**	0.0150	0.0377*	0.0322
Joint ventures	0.0573***	0.0708***	0.0486***	0.0661***	0.0544*
Services	0.0260	0.0323	-0.0336	0.0167	0.0300
OFCs 2	0.221***	0.357***	0.140***	0.0574**	0.204
Constant	0.649*	0.301	-0.115	0.665*	-0.304
R^2					0.191
AIC	5647.8	5725.2	4535.1	6399.9	5805.3
Observations	1151	1151	954	1201	1151

Meta-response variable: t-statistic

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$