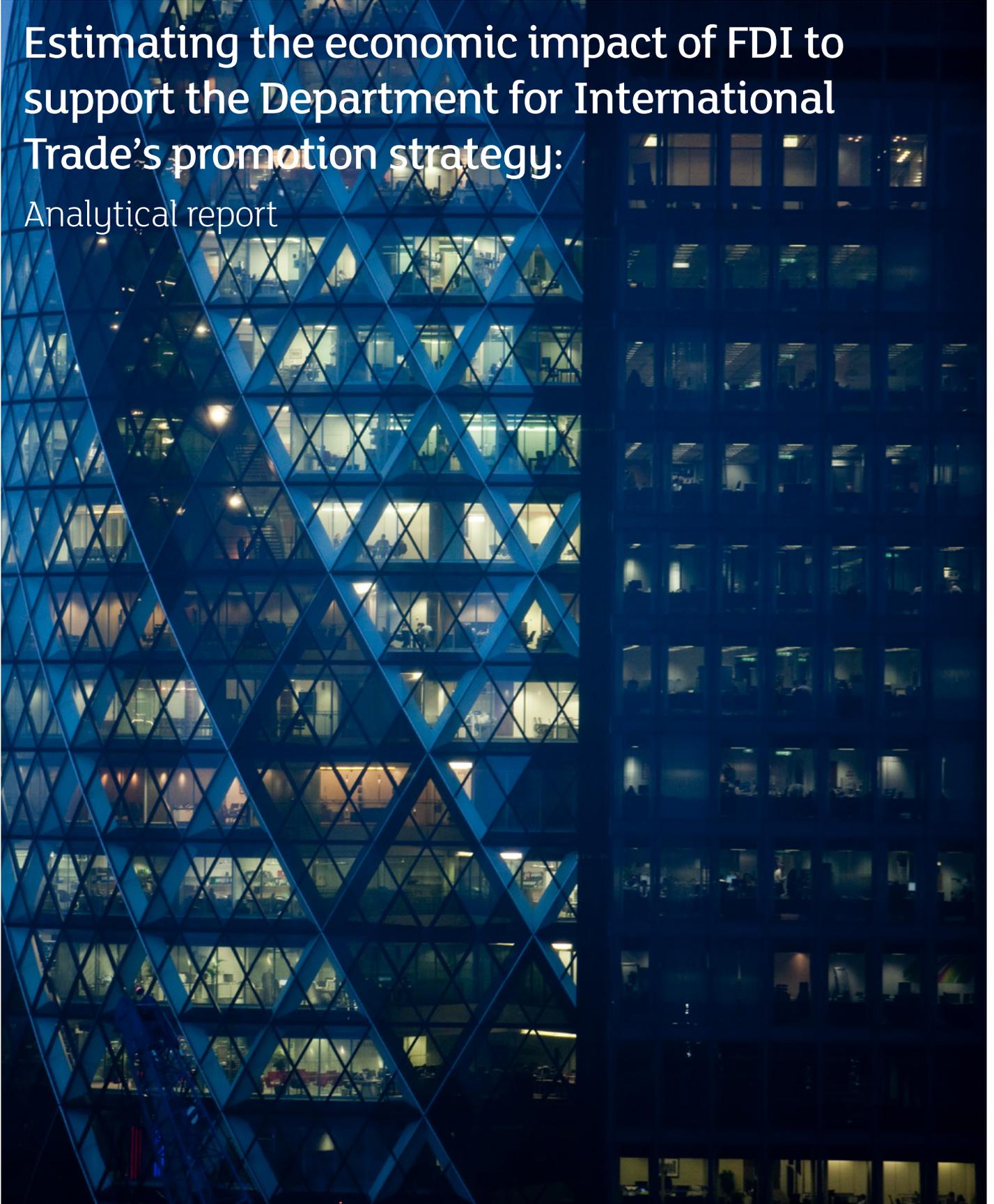




Department for  
International Trade

# Estimating the economic impact of FDI to support the Department for International Trade's promotion strategy: Analytical report





“This report, and the findings within it, will serve to guide this Department as we work to maintain Britain’s pre-eminent global reputation and deliver the benefits of international trade and investment for our businesses, our consumers, and our citizens.”

A blue ink signature of Liam Fox, written in a cursive style.

**Rt. Hon Dr  
Liam Fox MP**  
Secretary of State,  
Department for  
International Trade and  
President of the Board  
of Trade

## Rt. Hon Dr Liam Fox MP

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### Foreword

The UK is a hotbed of investment of every kind, from large multinationals expanding their operations, to venture capital hoping to benefit from the UK’s reputation for producing successful start-ups. 2017 saw more foreign direct investment projects landing in the United Kingdom than at any time in our history, and we remain the number one destination in Europe for FDI.

The United Kingdom offers investors one of the world’s most favourable regulatory and policy environments. For decades, we have maintained a legal system and legislative programme that actively supports growth and innovation, and we have an underlying commitment to maintaining and enhancing our world-leading reputation for safe investments with reliable returns.

The Department for International Trade plays a pivotal role in maintaining and improving Britain’s commercial ecosystem, promoting the United Kingdom and our businesses, as the ideal partner in future growth and prosperity, and a global repository of industry knowledge and expertise.

Investors across the world are eager to tap into this country’s vast economic potential.

The UK is a world leader in dozens of industries from Pharmaceuticals to FinTech. But, if the UK is to capitalise on the opportunities of the future and retain our global pre-eminence, it is vital that these industries continue to enjoy the proactive support of Government. This requires an economic outlook that allows us to take advantage of the substantial inward investment opportunities that Europe will continue to bring, but also does not limit our ability to adapt to the rapidly changing commercial realities of the fast-growing parts of the global economy beyond the European continent.

In order to safeguard the UK’s position as a world-leading destination for foreign investment, my Department has conducted a successful review over the last year of our FDI strategy. Its main priorities have been twofold.

Firstly, to focus our efforts across DIT on maximising wealth creation for the whole of the UK.

And secondly, to develop DIT from one of the most respected investment promotion organisations in the world, to also being the most effective.

A key pillar of the strategy is to target Government support for investors where it is most valued and impactful. This will support growth, drive productivity and create jobs that deliver wealth creation across the whole of the UK. This will be achieved through focus on those market failures that lead to underinvestment in communities, impeding their true economic potential.

The rigorous and comprehensive analysis covered in this report is the basis on which the strategy and its key pillars have been developed. As part of this,

the Department has carried out the largest review of academic research on foreign investment that the Government has undertaken in the last decade. This ground-breaking economic analysis has increased our sector-by-sector understanding of the role that FDI plays in our economy.

It will support and guide DIT's operations across the whole of the UK and in 177 posts overseas. This global presence represents a crucial lever through which Government can influence investment decisions by building direct relationships with new foreign investors, as well as those 27,000 foreign-owned companies already established in the UK.

Our efforts to understand the impacts of FDI in-depth, undertaken by a team of departmental economists, demonstrates how evidence and capability-building will maintain DIT's global leadership in investment promotion and facilitation. The findings will enhance the effectiveness of the Department's investment promotion efforts and form the basis of a future policy framework that will sustain the UK's position as a world-leading destination for FDI.

The United Kingdom is opening a new chapter in its history. For the first time in more than forty years, we will have an independent trade policy, and the means to shape our own economic destiny.

Fundamentally, we can decide what kind of nation we want to be. DIT's ambition is to build a truly global Britain; an open and outward-looking country that works with its international partners to trade its way to prosperity, stability and security.

Investment is a key part of this vision, and a testament to the trust of our allies, and to the UK's international reputation. This report, and the findings within it, will serve to guide this Department as we work to maintain Britain's pre-eminent global reputation and deliver the benefits of international trade and investment for our businesses, our consumers, and our citizens.



## James Zhan

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### Foreword

An array of pressing economic, social and environmental challenges confronts governments around the globe. To address these issues, demand more resources. The adoption of the UN 2030 Agenda has helped frame the formidable resource requirement to deliver on the Global Sustainable Development Goals. UNCTAD estimates that global investment needs top \$5 trillion *annually*.

These needs have foregrounded the crucial role of private investment to buttress economic growth and development, because public sector funding is far from enough. Of all external sources of financing, foreign direct investment (FDI) is arguably the most important. Such investment represents a package of tangible and intangible assets that can help build productive capacity in host countries. However, since the financial crisis the performance of FDI has been flagging. This means competition for investment is fierce and to attract substantial volumes of quality investment demands intensified and effective effort.

In most countries national, and often sub-national, investment promotion agencies (IPAs) spearhead efforts to lure foreign investors to their shores – at considerable cost to the government. These funding efforts to attract FDI are frequently contested because it is not altogether straightforward to assume a direct correlation between FDI and its development benefits. Careful and credible evaluation of the performance of investment promotion efforts is needed to motivate for – and justify – the deployment of public funds.

This study by the Department for International Trade to measure the impact of FDI on Great Britain's economy is therefore a propitious initiative. It provides an important addition to the set of tools that can be used by governments and IPAs to improve the effectiveness of their efforts in attracting quality FDI and to equally effectively report on these efforts. Through its data-based approach, the report provides a gauge on foreign direct investment effects 'on local soil', by means of which the effectiveness of government-dispensed investment services can be corroborated. This, in turn, provides material for sound investment policy-making, promotion and facilitation. A study of this nature can also serve as a crucial departure point to promote the effective allocation of resources to sectors and regions where needs – and potential – are greatest. Altogether, it provides a premise for the development of informed and rational investment promotion strategies that can target sustainable development outcomes with greater precision.

The study merits worldwide dissemination as an important tool for governments and IPAs in different countries to improve the effectiveness of their efforts in attracting quality FDI for sustainable development.

“The study merits worldwide dissemination as an important tool for governments and IPAs in different countries to improve the effectiveness of their efforts in attracting quality FDI for sustainable development.”

A handwritten signature in black ink, appearing to read 'James Zhan', with a horizontal line underneath.

**James Zhan**  
Senior Director,  
Investment and  
Enterprise and Editor-  
in-Chief of the World  
Investment Report,  
United Nations  
Conference on Trade  
and Development  
(UNCTAD)



## Richard Price

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### Foreword

The findings of DIT's analysis on the impact of FDI demonstrates the importance of foreign direct investment on our economy. The analysis, based on data since 1998, shows a positive impact on GVA, employment, productivity, wages and R&D spending in Great Britain. This is partly because foreign firms bring different approaches to technology and business management, which existing firms can benefit from through spillovers. The UK currently has the largest FDI stock of the EU 28. The UK is the top European destination for inward investment and the 3rd most popular investment destination globally, after the US and Hong Kong.

The UK has a strong track record in securing foreign direct investment, underpinned by an open and attractive business environment. However, the market for foreign investment is characterised by rising volatility in investment behaviour as investors search for higher returns in a low-interest rate environment.

This makes it all the more important that, for the future, we focus on working with investors and enhancing the aspects of the environment which make the UK an attractive place to invest. We also need to work with our trade partners across the world on investor protections, as well as with investors themselves to promote the UK abroad as a top destination for inward investment.

The findings of this report give us a better understanding of the varied impacts of FDI and will therefore help us to focus our efforts on 'what works' in policy to raise the scale and positive impacts of FDI. This will also lead to ensuring that the UK is recognised as the best place to invest, and to attract, retain and grow international investment.

"The findings of this report give us a better understanding of the varied impacts of FDI and will therefore help us to focus our efforts on 'what works' in policy to raise the scale and positive impacts of FDI."

**Richard Price**  
Chief Economist,  
Department for  
International Trade

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## Main points

1. Identifying how, when and where the positive impacts from inward FDI occur is important, as it will enable effective streamlining and targeting of DIT's activities to promote FDI in those areas or sectors where the economic impact of our services is maximised.
2. FDI is considered to be an important contributor to economic growth due to its potential to enhance productivity and innovation, create employment and lead to several other economic benefits.
3. Although most macroeconomic studies find FDI to have a positive impact on economic growth, there is also evidence in the literature that the realisation of these positive impacts depends on certain factors and characteristics of the host economy.
4. Based on a comprehensive literature review of FDI, this report identifies the various economic factors that are important to consider when assessing the impact of FDI on the economy.
5. The report discusses the analysis undertaken to understand the impact FDI has had on these economic factors.
6. We were not able to obtain the necessary data to analyse the impact on Northern Ireland, so the current analysis looks at the effect of FDI on Great Britain (GB).
7. Our analysis shows that between 1998-2014, a 1% increase in FDI stock in Great Britain has on average resulted in the following net impacts across the economy:<sup>1</sup> an increase in GVA of 0.0391%; an increase in employment of 0.0382%; an increase in average annual wages of 0.0290%; an increase in labour productivity of 0.0307% and an increase in R&D expenditure. Where earlier analysis was undertaken in a similar scope, we see that our results are broadly consistent and comparable.
8. Applying these estimates to the observed GB-wide increase of the FDI stock over the last five years of our sample period (2010-2014), equates to an approximate net increase in GVA of £19 billion and a net creation of 355,000 jobs. The FDI impact on average annual wages and labour productivity amounts to a net increase of around £280 and £510 respectively, and a net increase in overall R&D expenditure of around £448 million.
9. The analytical findings will be applied to predict the long-term impact of potential FDI projects and to be an enabling guide for DIT to target projects with the highest predicted economic impact value.
10. Further applications of the analytical findings are:
  - a. Inform the development of performance metrics with a focus on economic impact;
  - b. A tool to support up-front triaging of FDI projects;
  - c. An outcome-based performance framework for supporting internal and external reporting of DIT's FDI results.

<sup>1</sup>The analysis is undertaken for all 11 regions of the UK (excluding Northern Ireland).

## Executive summary

- This analytical report establishes how inward FDI affects the British economy, which is a vital step in realising DIT's vision of a value-driven investment promotion strategy. By identifying the nature of the economic value in FDI, we provide a basis to develop a coherent and value-based investment promotion strategy.
- The UK has consistently ranked in the top four economies for inward FDI stock globally, and as the largest in Europe (UNCTAD 2017b). We note that the total inward FDI stock in the UK was £1.2 billion at the end of 2016 and further draw a sectoral breakdown of this UK-wide total.
- FDI is an important contributor to economic growth due to its potential to enhance productivity and innovation, create employment and lead to several other economic benefits. FDI firms generally tend to be more productive than existing firms with access to better technology and management practices, which existing firms can benefit from through knowledge spillovers.
- Most macroeconomic studies find FDI to have a positive impact on economic growth. However, there is also evidence in the literature that shows that the realisation of these positive impacts depends on certain specific factors and characteristics of the host economy, such as the 'absorptive' capacity or supportive business environment in the host economy. Other characteristics that play a crucial role in determining the economic impact of FDI include infrastructure, skills, or supply chain networks.
- We draw a comprehensive summary of the existing literature on FDI and its economic impact on host countries with a focus on the UK. We further shift our focus to the relationships between FDI and specific economic variables, namely: GVA, employment, average annual wages, apparent labour productivity (ALP), and R&D expenditure. We also identify a trend in the literature to dissect the impact of FDI into both a direct and an indirect component.
- The *direct effect* is sourced exclusively from the incoming firm or the firm receiving FDI; once FDI occurs, it will produce output, employ workers, pay wages etc. This directly contributes to the economy.
- Concurrent with this influence, an entrant will also exert pressures and influences on existing firms (the *indirect effect*). These influences fall broadly into two categories: the competition effect and the demonstration effect.
  - Competition effect:** the FDI firm could lead to competitive pressures in the market, and thus encourage reactionary behaviour from competing firms. Crucially, this could be positive or negative: the increased competition could foster improved performance, but could also simply lead to existing firms leaving the market, if no longer competitive.
  - Demonstration effect:** Alternatively, through interaction with the wider market, certain advanced 'technologies' or processes possessed by the entrant may be attained by the competing firms. This process might occur either by observation and imitation of the foreign entrant, or through workers moving between firms and exchanging details of these productive advantages to their new employers.
- In our analysis, we choose to focus on the effect that a change in FDI stock has on existing firms in Great Britain, rather than the effect that the new entrant has on the British economy *directly*. This is synonymous with indirect effects and is also known as 'spillovers' in the economic literature.
- This choice is motivated by four principal arguments, three of which are strategic ((i)- and (iii)) and one of which is practical (iv):

i) The direct effect of an FDI project will be highly idiosyncratic and depends heavily on the specific nature of the incoming firm. By contrast, the indirect effect felt by existing firms is more stable and predictable as it is felt across many firms and so the effect is an *average effect* across many firms.

ii) Whilst an FDI firm may choose to leave the market after a certain time period, and thereby its direct contribution to the British economy would cease, effects from the spillovers are irreversible. Even if the foreign entrant leaves, the influence they had on existing firms will remain through the spillovers that already took place.

iii) Government intervention is justified in the presence of positive or negative externalities, as private agents or firms do not usually consider externalities when making investment decisions. By basing FDI promotion activities on indirect effects, we avoid targeting the profit/productivity/output of a specific firm (direct effect), and instead maximise the spillovers accruing to existing firms, and hence the positive externalities that justify government intervention to promote the UK as a destination for inward investment.

iv) The estimation of indirect effects allows us to use a larger sample as we can make use of data on both domestic and foreign firms in the ARDx, rather than just foreign firms, if we were to estimate the direct effects. This richer pool of data improves the accuracy of our estimates.

- The report further proceeds to discuss the methodology and results of the analysis on the impact of inward FDI on Great Britain's economy. The econometric analysis is carried out using the 'Annual Respondents Database X' (ARDx), which is a comprehensive database containing over 800,000 observations from a wide range of firms based in Great Britain.
- We present our findings at a national, and sectoral level across five economic impact factors: *GVA, employment, average annual wages, labour productivity (ALP), and R&D (which we evaluate across four distinct categories: in-house R&D, outsourced R&D to a Great Britain based firm, outsourced R&D to a foreign firm funded by the government, and outsourced R&D to a foreign firm funded by business)*.
- We find that, in almost all cases, inward FDI has a net positive effect on Great Britain's economy. At a national level, we find that, on average, FDI projects improve all five of our key economic impact factors such that a 1% increase in FDI leads to a sectoral increase in GVA of 0.0391%, an increase in employment of 0.0382%, an increase in average annual wages of 0.0290%, an increase in labour productivity of 0.0307% and an overall increase in R&D expenditure. Where earlier analysis was undertaken in a similar scope, we see that our results are broadly consistent and comparable.
- To put these figures into context, over the last five years of our sample period (2010-2014), the FDI stock in Great Britain has risen by around £270 billion. If we apply this figure to our estimated values, this equates to around £19 billion in GVA creation and around 355,000 additional jobs. With regards to average annual wages and ALP, the increase would have been around £280 and £510 respectively.<sup>2</sup> Applying the increase in FDI stock to the total estimated R&D impact implies a net increase in expenditure of around £448 million.<sup>3</sup>

<sup>2</sup>Both variables have slightly decreased over the specified period, suggesting that FDI has had a counteracting effect to other factors driving the decline.

<sup>3</sup>Estimates are derived using data for Great Britain. Assuming they are broadly similar for the UK and applying the estimates from the analysis similarly leads to following UK-wide results: the increase in FDI stock within the UK over the last five years of available data (2012-2016 in current prices) amounts to around £287 billion (Office for National Statistics 2017a) and resulted in approximately a net total GVA impact of around £20 billion, of 376,000 net additional jobs, an increase of £290 in average annual wages, a net increase of £540 in ALP and an estimated additional R&D expenditure of £474 million.

- The analysis described in this report provides justification for the department's commitment to the value-driven investment promotion strategy, by establishing in specific terms the value-adding properties of FDI. The estimates of the impact across regions and sectors allows for directed policymaking, designed to maximise the impact of investment promotion through identification of high-value areas or industries.
- Although our analysis offers a comprehensive overview of how changes in inward FDI stock affect the British economy, there are still some limitations and possible future extensions worth noting:
  - i) We analyse the impact resulting from a change in the FDI stock. A more complete picture would involve analysis to estimate the impact through operating costs of the businesses. This would be especially valuable in the case of new modes of economic production such as *the digital economy*, where capital investment size may not always be a good indicator of the size/scope of the FDI project.
  - ii) Our analysis does not distinguish between greenfield and brownfield investments. Our definition of FDI captures greenfield, expansions, mergers and acquisitions and joint venture investment projects. As a result, our analysis is unable to identify varying impacts of FDI based on the type of investment.
  - iii) Our main variable of interest is the normalised FDI stock. It is important to note that in addition to the various forms of investment listed above, stock values can also be impacted by non-transactional effects such as revaluations (exchange rate movements, revaluation of assets etc.) and corporate restructures. Our estimation results therefore not only incorporate the impact of all types of FDI, but also impacts of other non-transactional effects.
  - iv) Our analysis captures the indirect effect only on an intra-sectoral basis. If there are significant, positive inter-sectoral indirect effects, the estimates provided may be lower than the true magnitude of expected total spillovers. This limitation is particularly relevant in the case of sectors such as 'financial services' where there is a higher possibility of interaction with other sectors.
  - v) Although we had initially planned to consider the effect of FDI on the UK, we were not able to obtain the necessary data to analyse the impact on Northern Ireland, so the current analysis examines the effect of FDI on Great Britain.
  - vi) This report focuses on five key economic measures and their relationship with FDI. In the long run, it would be valuable to expand the analysis to incorporate a wider range of factors. Some of these factors, such as the impact of FDI on environmental and socio-economic factors, will be in line with the UN Sustainable Development Goals, which the Government is committed to delivering (Cabinet Office 2017).
- We intend to address some of these issues in the second phase of the analysis.

# Section 1: Introduction

## 1.1 Foreign direct investment

Foreign direct investment (FDI) refers to cross-border investments from one country into another, with the aim of establishing a lasting interest in an enterprise where the investor’s purpose is to have an effective voice in the management of the enterprise. For the purposes of FDI statistics, an effective voice means an ownership of at least 10% of the equity share capital. From a UK perspective, inward FDI is an investment from foreign investors who add to, deduct from, or acquire equity share capital in a UK resident affiliate enterprise (subsidiary or associate) or branch by a non-UK parent company or head office.

FDI transactions take three main forms:

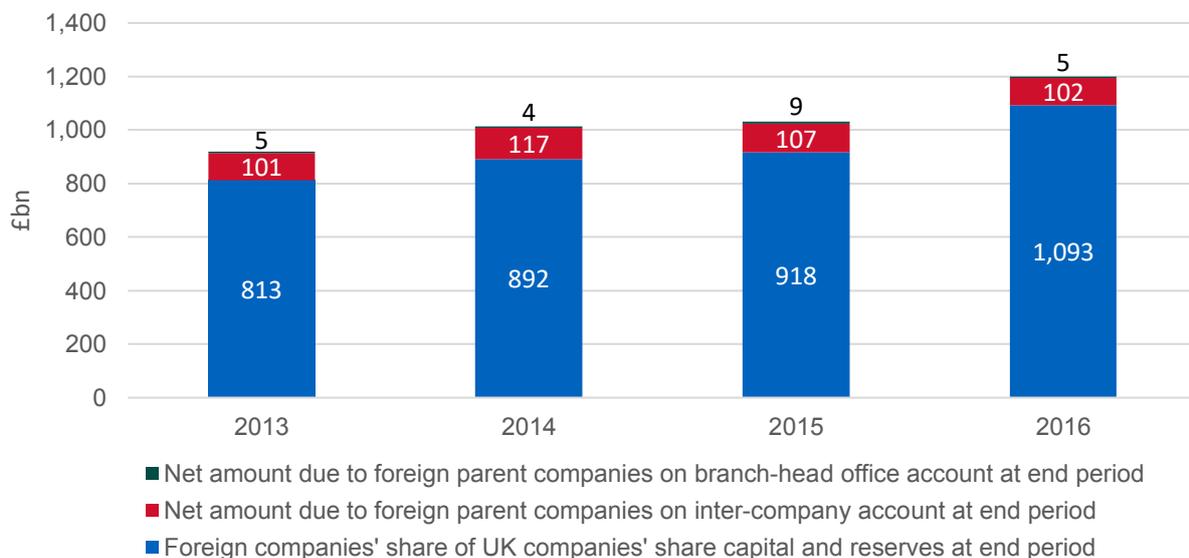
- New (‘Greenfield’)
- Expansions
- Merger and Acquisitions (M&As)

## 1.2 Measuring FDI in the UK

The UK inward **FDI stock** (International Investment position) measures the total financial value of FDI in the UK at a point in time (normally end of calendar year). The stock has the following main components:

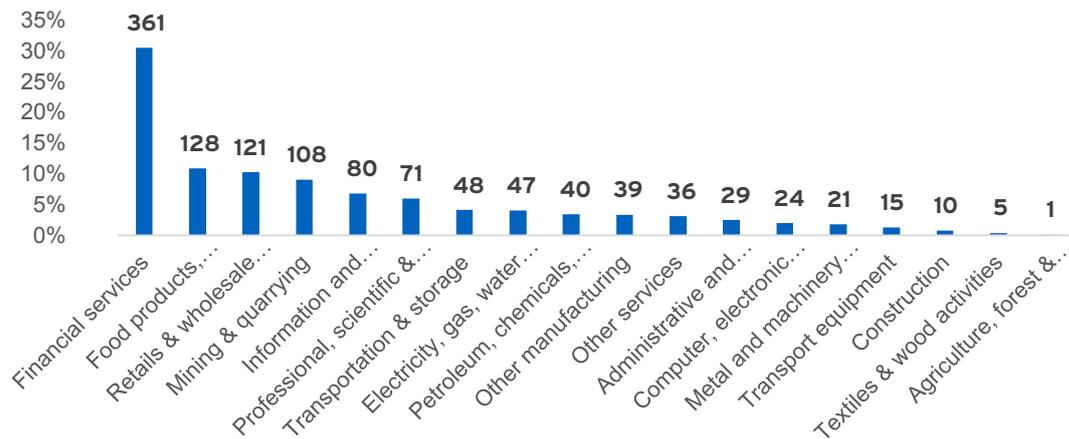
- Foreign companies’ share capital and reserves
- Net amount due to foreign parents on the inter-company account
- Net amount due to foreign parents on the branch head-office account

Figure 1 shows a breakdown of inward FDI stock by component in the UK. The total FDI stock value was £1,199 billion at the end of 2016. 91% of the stock (£1,093 billion) is made up of the share capital of foreign companies in the UK companies (Office for National Statistics 2017a).



Source: Office for National Statistics (2017a)

The Office for National Statistics (ONS) also reports the value of FDI positions held in various sectors of the economy, which varies considerably (see Figure 2). The ‘financial services’ sector accounts for around 30% of the total stock, followed by ‘food products, beverages and tobacco products’ (11%), ‘retail and wholesale trade, repair of motor vehicles and motor cycles’ (10%), and ‘mining and quarrying’ (9%). ‘Agriculture, forestry and fishing’ is the sector grouping with the lowest FDI stock in the UK.<sup>4</sup>



Source: Office for National Statistics (2017a)

Inward **FDI flows** (or transactions) show the net inward direct investments made during any reference period (quarterly and annually). FDI flows comprise of:

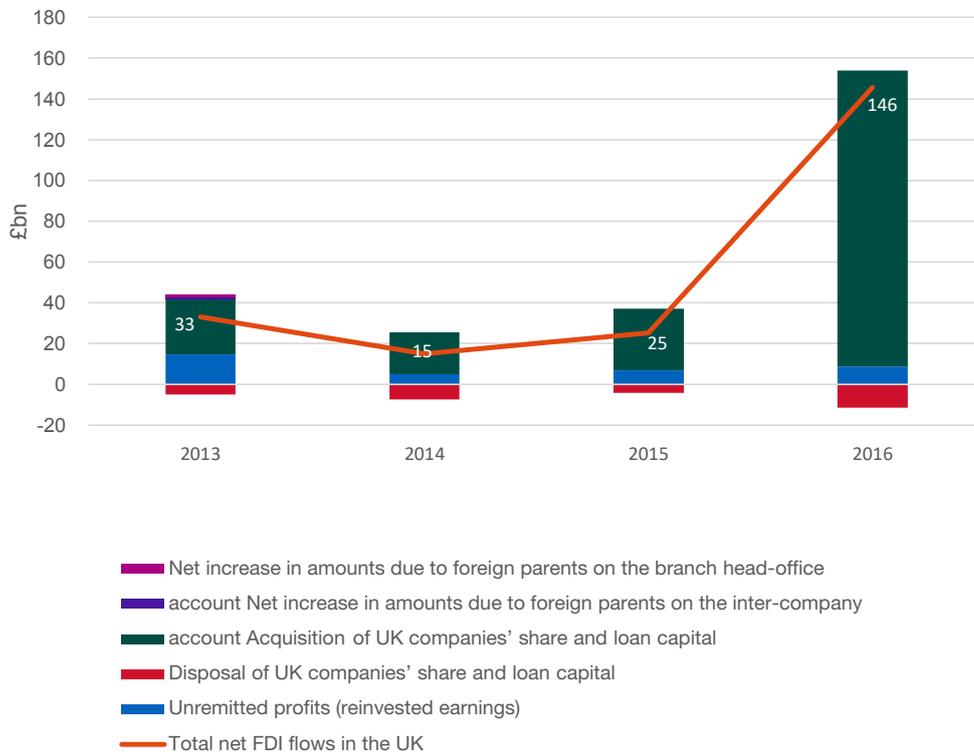
- Acquisitions or disposals of equity capital;
- Reinvested earnings;
- Inter-company debt and other capital.

The total net FDI flow into the UK rose dramatically between 2015 and 2016, as shown in Figure 3. A detailed breakdown by component reveals that this can be explained by a substantial increase in acquisitions.<sup>5</sup>

<sup>4</sup>A full list of sectors can be found in Annex IV.

<sup>5</sup>FDI flows are particularly sensitive to M&As. The FDI stock measure is more stable over time, and therefore better suited as the main variable of interest for estimating the impact of FDI on the economy.

**Figure 3 – UK FDI inflows by component, 2013-2016 (£ billion)**



Source: Office for National Statistics (2017a)

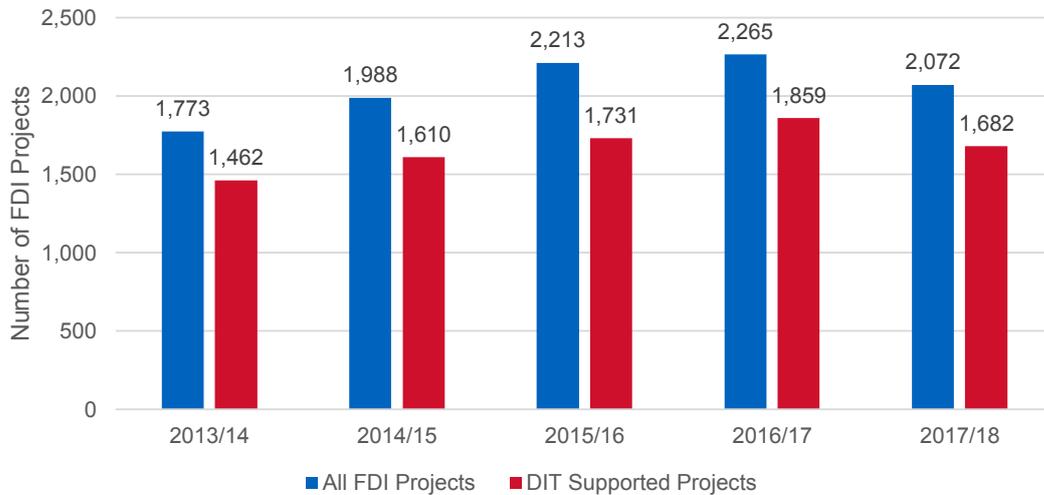
The ONS also measures and reports the estimated value of **FDI earnings** foreign investors generate from their investments. The official statistics on FDI flow and FDI earnings form part of the Balance of Payments, while the FDI stock figures are reflected in the international investment positions.

The UK has consistently ranked in the top four for inward FDI stock globally, and as the largest in Europe (UNCTAD 2017b). According to UNCTAD (2017b), the UK’s inward FDI stock in 2016 amounted to 4.5% of the global inward FDI capital stock. Europe and the Americas continued to be the dominant sources for FDI positions in the UK, accounting for 56.3% and 34.4% respectively of total UK inward FDI positions in 2016 (Office for National Statistics 2017a).

### 1.3 DIT and FDI in the UK

DIT seeks to attract new FDI and helps existing foreign-owned businesses to expand in the UK. The teams, both in the UK and in the overseas offices, focus on generating leads through a range of activities including identifying targets through business and financial media and analyst networks, networking events, referrals from DIT and commercial partners, and strengthening the UK’s reputation as a place for business with prospective investors. In the financial year of 2017/18, an estimated 2,072 FDI projects landed in the UK, of which 1,682 were supported by DIT (see Figure 4). This includes greenfield investment, expansions and M&As.

**Figure 4 – Number of FDI projects in the UK, 2013/14 - 2017/18**



Source: Department for International Trade (2018), UK Trade & Investment (2014, 2015)<sup>6</sup>

Officials work with firms considering a number of locations in the UK or worldwide for their investment. Services are objective, client led and bespoke depending on client needs with the aim of helping potential investors understand how the UK can play a role in their global operations.

In addition to services offered to new inward investors, DIT also provides similar services to foreign-owned businesses planning to expand their UK operations. This support is particularly targeted to strategically important businesses to ensure they create new jobs and safeguard existing ones. DIT aims to increase the overall number of projects investing in the UK, and to prioritise support for those with the greatest quality using a framework made up of quantitative and qualitative indicators.

However, the quality and suitability of investment projects initiated by foreign investors is important in assessing its contribution to the host economy. The impact and benefits of FDI depend on many factors, such as the motives and quality of the investor, nature of business operation, the host and source country characteristics, and sector in which the investment lands.

Therefore, when considering the impact of FDI, it is important to consider not only the financial size of investment or pure FDI project numbers but also their economic impacts by looking into the business nature, quality and other characteristics and suitability of the FDI project in generating positive impact. We explore some of these in the current analysis and report.

<sup>6</sup>‘All FDI Projects’ and ‘DIT Supported Projects’ for 2015/16, 2016/17 and 2017/18 are based on Department for International Trade (2018). ‘DIT Supported Projects’ for remaining years can be found in the UK Trade & Investment publication corresponding to the respective financial year.

## 1.4 Economic impact of FDI

FDI is considered to be an important contributor to economic growth due to its potential to enhance productivity and innovation, create employment and lead to several other benefits. FDI firms or firms receiving FDI generally tend to be more productive with access to better technology and management practices, which existing firms can benefit from through knowledge spillovers.

Although most macroeconomic studies support the positive impact FDI has on economic growth, linkage is identified on the basis of specific factors such as the 'absorptive' capacity or supportive business environment in the host country. Studies indicate that FDI can generate overall economic growth when certain conditions such as infrastructural capacity, skill base, cluster strengths, supply chain networks etc. are in place.

Besides, there is also a strand of studies arguing that the effect of FDI on economic growth tends to be weak (Rodrik 1999) and (Carkovic and Levine 2002). Some firm level studies fail to find significant positive effects in the industry (Aitken and Harrison 1999), (Djankov and Hoekman 2000) and (Konings 2001).

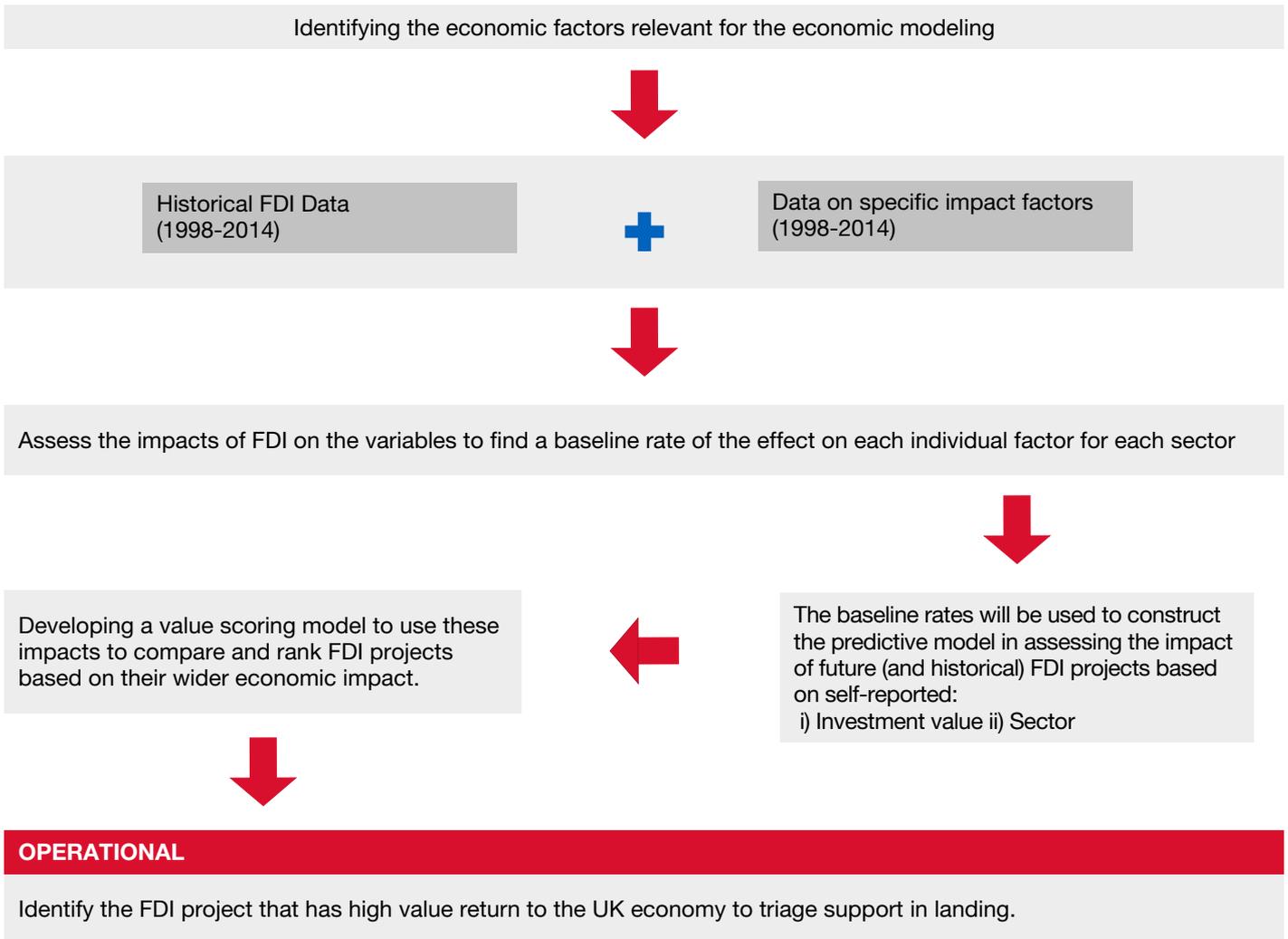
Thus, although FDI can generate positive spillovers and result in economic growth, the empirical literature suggests that the positive impact of FDI is not immediate and depends on specific conditions in the host economy, the sector and the time period during which the FDI takes place.<sup>7</sup>

Identifying how, when and where the positive impacts from FDI occur is important as it will enable effective streamlining and targeting of DIT's services to promote FDI in those areas, regions, or sectors where the best value for money is attained.

This report discusses the econometric analysis undertaken to assess the impact FDI has on the identified economic impact factors on the basis of historical data on FDI in Great Britain between 1998 and 2014. The findings from the analysis will be used to form baseline impact rates for each of these economic impact factors to assess the impact or value addition of future FDI projects. Figure 5 illustrates the high-level analytical process and how the findings will be applied.

<sup>7</sup>According to UNCTAD (2001), the linkage potential differs across primary, manufacturing and services sectors.

**Figure 5 – Analytical process leading to operational aspects**



When estimating the impact on any given economic impact factor, it is important to differentiate between the direct and the indirect effect.<sup>8</sup> The direct effect describes the immediate impact of FDI occurring; for example, the number of employees hired for the functioning of the business, the wages the foreign company pays to their own employees, the amount spent on R&D etc. The indirect effect captures the impact FDI’s occurrence has had on all other firms in the sector, either through the competition or the demonstration effect.

The competition effect applies to scenarios where either existing firms innovate and/or improve their productivity to retain market share or are forced out of the market if they are no longer competitive. On the other hand, existing firms might learn from the FDI firms and adopt the management or production techniques, either through observation, or through movements in the labour market when employees previously employed by the foreign firm are subsequently hired by an existing firm (Girma and Wakelin 2002). This can be described as the demonstration effect. Where relevant within this report, we will refer to these effects.

<sup>8</sup>The terms direct impact and direct effect, and indirect impact and indirect effect are used interchangeably.

## 1.5 Indirect effects as the principal focus of the report

The report retains a higher focus on the indirect effects of foreign direct investment. By explicitly emphasising the role of indirect effects, we focus on the spillover generating qualities of FDI, rather than the direct effect of an inward investment. This preference for indirect effects, and hence spillovers, is rooted in four principal arguments, three of which are strategic from a government intervention perspective, whereas one of which is practical.

- **Certainty:** the indirect effect is more certain as it is mostly driven by the market forces that act on a large group of heterogeneous organisations. As such, the impact of a foreign investment is aggregated across a wide cross-section of firms, meaning that an estimated indirect effect is an average across a large and varied group. In such a situation, an average effect is likely more insightful than in the case of the direct effect. This is because the direct effects are mostly driven by individual firm's decisions and firm-specific characteristics. Given that these can vary significantly, the use of an *average* for a single firm's direct impact on the economy could be misleading due to the idiosyncratic nature of the single firm performing the investment.
- **Irreversible:** as established in previous paragraphs, one of the main drivers of FDI benefits is through spillovers. Once FDI occurs in Great Britain, the project will begin contributing towards the British economy directly (through its output, employment of workers, etc.), but will also influence the composition and behaviour of existing firms in ways that are often relatively more irreversible. For example, a domestic competitor may invest heavily in advanced manufacturing capabilities to meet the competitive challenge of the new FDI firm. The incoming foreign firm could then decide to disinvest from Great Britain, and hence its direct contribution to the economy could cease. The influence that the occurrence of FDI has on existing firms will remain through the spillovers that have already taken place. Hence, if we want to focus on economic impact, the more lasting impacts are the indirect effects.
- **Rationale:** government intervention is justified in the presence of positive or negative externalities. Spillovers clearly fit the description of an externality; their emergence (positive or negative) affects third parties not involved in the economic transaction of FDI. Given that private firms do not tend to consider externalities when making investment decisions, but rather focus exclusively on the impacts relevant to the investing firm itself, there is a case for government intervention to attempt to foster or encourage positive spillovers where possible. This is an aspect of market failure where the market will not operate efficiently in maximising these positive externalities. By basing the promotion strategy on the indirect impacts, rather than just boosting the profit/productivity/output of a specific firm (direct effects), we will be able to target maximising the spillovers that are at the root of the justification for government intervention to promote FDI.
- **Accuracy:** the indirect effect is estimated using a larger sample of all the firms (including domestic firms) in the sector as opposed to the direct effect, which is estimated from a smaller population of foreign firms only. With a larger population, the effect of outliers is likely to be reduced. Further, given the subjectivity of direct effects mentioned above, it would be less accurate to apply the average effects estimated to all firms alike.

The report is structured as follows: Section 2 introduces the economic impact factors that are scoped to be relevant in the context of FDI in the UK followed by Section 3 which details the analytical approach and methodology. Section 4 details the data sources that are used for the analysis, and Section 5 details the main results and their respective intuitions. Section 6 summarises the report and analytical findings with the limitations and recommendations for future research.

## Section 2: Economic impact factors

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Based on an extensive literature review, several economic impact factors were identified to be part of the analysis to draw a holistic picture of the effect of FDI in the UK. This section introduces these economic impact factors, followed by drawing in some key insights from the literature on the effect of FDI on each of the measures. Where possible we will refer to competition and demonstration effects separately to provide an understanding on both potential channels of FDI impact. As previously mentioned, our analysis focuses on the indirect effect of FDI and although this section may include literature on the direct effect of FDI, we will be concentrating on the indirect effects in the analysis and results sections.

### 2.1 Gross value added (GVA)

#### ***What is GVA?***

GVA, or Gross value added, is a measure of economic output, much like GDP. Indeed, GVA and GDP only differ in their treatment of taxation and subsidies when measuring output. For a given institutional unit, such as a business, household, or charity, GVA is a measure of the economic value generated by that unit.

It is estimated as the £ output of a unit (i.e. the goods/services produced: e.g. chairs, books, financial advice etc.) minus the purchases required to produce that output. By 'purchases', we refer to intermediate consumption; this constitutes of all the purchases a unit makes in the supply chain in order to produce their output.<sup>9</sup> Examples of purchases could be: raw material inputs, like wood or metal; machinery used in production such as sewing machines or printing presses; or accountancy services purchased to maintain company accounts.

GVA in a sector/industry is calculated by summing together the GVA of each of the institutional units belonging to that sector/industry. We then have a sector-specific picture on how an industry is performing, whether or not the production of economic value is growing or shrinking within a sector, and how this performance might compare to other sectors.

When discussing the GVA of Great Britain as a whole, we refer to the sum of all sector-specific GVA totals. This gives us a measure of total output and income in the economy and provides the monetary value of the goods and services produced after deducting the cost of inputs and raw materials that have gone into the production of those goods and services.

#### ***What are the channels through which FDI affects GVA?***

Various studies such as Graham and Krugman (1993) and Girma, et al. (2001) show that firms undertaking FDI tend to be more productive than domestic firms. It is argued that they must be more productive to be able to overcome the sunk costs of moving to the new market and compete with domestic firms. This is empirically justified by studies from Girma, et al. (2001) and Lipsey and Sjöholm (2004). Upon entering the host economy, these highly productive foreign competitors exert two distinct influences on existing firms: a competitive pressure, and a demonstrative effect (Girma, et al. 2001).

When a firm undertakes FDI, it creates further competition within the sector. Domestic firms respond to this increased competitive pressure, either by leaving the market, or by improving their own competitiveness. The former case could lead to an overall contraction in output as firms will leave the market and thereby lower the GVA from the sector. However, in the latter case existing firms may increase their output to meet the competitive challenge, for instance by lowering their price to regain market share from the foreign entrant. Furthermore, existing firms which respond with improved efficiency may also be

<sup>9</sup>This does not include labour costs.

able to increase production and thus increase the GVA from the sector.

Bengoa and Sanchez-Robles (2003) show that if there exists sufficient 'absorptive capacity' in the host market, existing firms respond to new entrants by increasing output. Similarly, Girma and Wakelin (2002) in their analysis of FDI spillovers in the UK economy, describe the expectation that firms in less competitive sectors will benefit less from spillovers, an argument consistent with the 'absorptive capacity' hypothesis. Their analysis confirms that FDI leads to an expansion in output, with greater expansions occurring in sectors where firms are more able to compete with foreign entrants.

Local firms could also improve their operations by 'imitating' the FDI firms. Imitation, however, is only possible if a firm is sufficiently well equipped to implement the productive technology that the foreign entrant possesses. In much the same way that firms must be sufficiently advanced to be capable of competing seriously with foreign entrants, so too must they be in possession of the requisite capabilities to imitate productive advantages. Bengoa and Sanchez-Robles (2003) note that human capital, economic stability, and liberalised markets are vital to ensure that the productivity advantages of firms are converted effectively into expansions in output.

To summarise, the inherent productivity advantage of foreign entrants, established in the literature (Graham and Krugman (1993) and Girma, et al. (2001)) induces two effects on domestic firms: an amplification of competitive pressure, and an opportunity to appropriate advanced or more productive technologies. Depending upon the absorptive capacity of the host region, these effects can either lead to a contraction or expansion of output. This conclusion is consistent with findings from Girma and Wakelin (2002) and Bengoa and Sanchez-Robles (2003).

Our analysis estimating the indirect effect of FDI, explained in detail in the subsequent sections, suggests that a 1% increase in FDI leads on average to a 0.0391% increase in GVA, which corresponds to a net creation of GVA of around £69,000 for every £1 million of FDI. This suggests that the market in Great Britain possesses sufficient absorptive capacity for the effects of FDI on GVA to be expansionary as opposed to contractionary.

## 2.2 Employment

Globally, the increase in FDI is also reflected by an increase in the number of jobs in the foreign affiliates of MNEs. Around 80 million workers were employed in foreign affiliates of multinational companies in 2010, nearly triple the number in 1990 (UNCTAD 2010). FDI into the UK in 2017/18 created around 75,000 new jobs, of which roughly 67,000 were created as a result of DIT involvement (Department for International Trade 2018).<sup>10</sup>

### *What are the channels through which FDI affects employment?*

The direct effect of FDI on employment could be neutral or positive, depending on whether the investment moves people from unemployment to employment, or simply sees employees switch firms (in the case of mergers & acquisitions (M&As) or displacement effects). In both cases, the hiring firm will consider skills and human capital of potential employees. Additionally, in the case of M&As, the firm may adopt rationalisation processes, which could result in a reduction in the size of the existing workforce. There is significant evidence in the literature that supports the positive effects of FDI on employment in a host country; (Braunstein and Epstein 2002) and (Spiezia 2004). Vacaflares (2011) identifies a significant effect of FDI on employment generation for a large group of South American host countries, driven largely by its effect on the male labour force.

As mentioned before, MNEs tend to be more productive than domestic firms (Graham and Krugman (1993) and Girma, et al. (2001)). FDI can therefore lead to increased competitive pressure in the market. On the other hand, it may allow existing firms to observe and adopt new and improved technologies. Both competition and demonstration effects therefore have the potential to lead to an increase in productivity in the market, depending on firms' ability to compete and the absorptive capacity in the host economy or country (see sections on GVA and ALP).

The improved productivity could result in a reduction of employment, if it means that less workers are required to produce the same output. Hale and Xu (2016) describes a negative impact on workers due to the adoption of advanced technologies. However, it is equally likely that output is increased following the productivity improvement and the impact on workers could be neutral or positive. Hale and Long (2012) refer to the positive employment outcomes stemming from competitive pressures. Out of the two channels, the demonstration effect seems less likely to have explanatory power in understanding the impact of FDI on employment, a sentiment echoed by Driffield (2001) and Girma, et al. (2001).

In addition, and in line with the competition effect, non-competitive firms may be forced out of the market, which would result in job losses. There is little evidence in the literature supporting this argument, although Jude and Silaghi (2016) have found that FDI caused creative job destruction due to competitive pressures.

To summarise, most of the literature suggests a positive direct effect of FDI on employment, although the extent of the effect varies, and in some instances can also result in negative impacts. The competition and demonstration effects of FDI on employment could be positive or negative depending on the characteristics of the entrant and the competing existing firms within the sector, mainly their 'absorptive capacity' and ultimate response in terms of output generation.

Our analysis, explained in detail in the subsequent sections, suggests a positive impact of FDI in Great Britain. Specifically, we found that a 1% increase in FDI leads on average to a 0.0382% increase in employment across all firms, which corresponds to a net creation of around 1.3 jobs for every £1 million of FDI occurring in Great Britain.

<sup>10</sup>The job figures are estimates over three years as reported by investors.

## 2.3 Average wages

### ***What are the channels through which FDI affects the average wage rate?***

Girma, et al. (2001) suggest that employees working for foreign firms tend to be more productive and have a higher marginal product, and as a result, are paid higher wages. An increase in wages as a result of FDI could also be due to the presence of market failures such as worker turnover and search frictions, and MNEs paying higher than average wages to attract the best workers from domestic firms Girma, et al. (2001).

Driffield (1996) found evidence in the UK to suggest that a high foreign presence in a sector causes wages to rise for domestic firms, and that the higher wages causes domestic firms to reduce employment. Additionally, Girma, et al. (2001) finds that the overall impact of FDI on wages disappears when considering the productivity of domestic workers, and that any positive effects can be explained by domestic firms becoming more efficient as a result of foreign competition, rather than a shift in labour demand in the industry, where domestic firms have to increase wages in order to attract the best workers. Girma and Gorg (2007) find that international takeovers in the UK manufacturing sector between 1980 and 1994 by US firms increased the wages of both skilled and unskilled workers by 4-13%, but takeovers by EU firms did not raise the wages in the UK.

As previously identified by Borensztein, et al. (1998), a central concern of Girma, et al. (2001) is to identify the level and extent of wage spillovers stemming from FDI in the UK. In this paper, they identify low technology gaps between foreign and domestic firms and the presence of a sufficiently high level of human capital as contributing factors towards positive wage effects stemming from increased competition. If FDI causes domestic firms to compete with foreign firms paying higher wages, which the literature would suggest is highly likely, then this competitive pressure for labour could cause domestic wages to rise through an indirect response (Lipsey and Sjöholm 2004).

Hijzen and Swaim (2008) present evidence on the impact of FDI on both wages and non-wage working conditions for two emerging economies (Indonesia and Brazil) and three developed economies (the UK, Portugal and Germany). Comparisons of MNEs and domestic firms suggest that the MNEs tend to employ more workers and provide better paid jobs than domestic firms within the countries in which they invest.

As stated by Hale and Long (2012), analysis on the indirect effect of FDI on wages has failed to produce conclusive findings. Whilst most studies show that FDI has a positive impact on wages, a few indicate small negative effects.

Our analysis of the indirect effect of FDI on average annual wages, explained in detail in the subsequent sections, shows that a 1% increase in FDI leads on average to a 0.0290% increase in average annual wages, corresponding to a net increase in average annual wages per employee of around £0.001 for every £1 million of FDI occurring in Great Britain.

## 2.4 Apparent labour productivity (ALP)

### ***What is ALP?***

Apparent Labour Productivity (ALP) is the efficiency of the workforce calculated as output per worker. Higher ALP brings about higher GDP for a given labour force. ALP can be driven by total factor productivity growth and capital enhancements.

### ***What are the channels through which FDI affects ALP?***

There are many academic studies investigating the relationship between FDI and productivity with spillovers often cited as the link between these concepts. Various studies such as Graham and Krugman (1993) show that firms undertaking FDI tend to be more productive than domestic firms. Barrell and Pain (1997) estimate that roughly 30% of the productivity growth in UK manufacturing between 1985 and 1995 has occurred because of FDI. It is argued that firms carrying out FDI must be more productive to be able to overcome the sunk costs of moving to the new market and compete with domestic firms. This is shown empirically by studies from Girma, et al. (2001) and Lipsey and Sjöholm (2004).

Horstmann and Markusen (1996) describe a scenario where increased competition in the market following FDI stimulates efficiency improvements in existing firms which aim to protect their market share. FDI has indeed been found to increase competition and hence productivity, by forcing domestic firms to increase their efficiency to remain competitive, and/or by forcing unproductive firms to exit the market (Blomström (1986) and Griffith, et al. (2002)).

Caves (1996) identifies a potential demonstration effect where domestic firms adopt superior management techniques from MNEs. Markusen (1995) shows that 'knowledge capital' is likely to be a more important source of ownership advantages than physical capital. The non-technological advantages, such as the exploitation of economies of scale, superior co-ordination of resources or managerial abilities, if adopted by a host country industry, may improve performance. Local firms can improve their operations by 'imitating' the FDI firms, who as argued by Girma, et al. (2001), are more productive, assuming that domestic firms are unable to fully appropriate all benefits of higher technology or capability.

Whilst most literature suggests that FDI has a positive effect on productivity levels, it is not clear what the direct and indirect effects of FDI are on productivity in sectors and regions within Great Britain. As such, we have carried out analysis to determine the indirect effect, which is explained in detail in the subsequent sections.

Our analysis shows that a 1% increase in FDI leads on average to a 0.0307% increase in labour productivity, corresponding to a net increase in labour productivity of around £0.002 for every £1 million of FDI occurring in Great Britain.

## 2.5 Research and development (R&D)

### *What is R&D?*

Research and development (R&D) refers to creative and systematic work undertaken in order to increase the stock of knowledge, including knowledge of humankind, culture and society, and to devise new applications of available knowledge (OECD 2015).

### *What are the channels through which FDI affects R&D?*

FDI undertaking multinationals are responsible for the vast majority of the world's R&D activities, which can lead to technological change and may allow workers to produce goods and services more efficiently. This can lead to higher economic growth. Griffith, et al. (2000) present an empirical framework in which the rate of return to R&D is composed of an effect on productivity through innovation and an effect through increased potential for imitation. This second component will be particularly important for firms, industries and countries far behind the technological frontier.

Driffield, et al. (2010) suggest that the direct effect of FDI on R&D should be positive, as MNEs tend to have higher R&D expenditure than domestic firms, raising average R&D expenditure. However, the indirect effect is less clear. As a result of FDI occurring and the subsequent increased competition within the sector, R&D activities by domestic firms may increase to try and remain competitive. Potential R&D spillovers depend on absorptive capacity. On the other hand, domestic firms may recognise that R&D produced by MNEs is available at lower costs and at less risk, and will seek to obtain technology this way, causing net R&D expenditure to decrease. This may be beneficial to the economy if there is access to improved technology. In addition, crowding out may occur, whereby foreign firms' demand for R&D may increase, subsequently causing the price of R&D to increase as a result of bidding up researchers' wages, for example. Although the nominal value of R&D expenditure may increase, this does not necessarily mean a real increase in R&D activity.

The empirical evidence on R&D is limited. Veugelers and Vanden Houte (1990) find evidence to suggest that the effect of FDI on domestic R&D and in innovative efforts more generally in Belgium is negative, particularly in the case of undifferentiated products. One study by Driffield (2001) investigating UK data suggests a small statistically significant negative effect of R&D by MNEs on domestic firms' R&D. This may be due to crowding out effects.

Cook, et al. (2013) find that MNE affiliates are less R&D intensive than domestic firms but that they are more likely to produce innovations than domestic enterprises, where innovation is defined as a good, service or process innovation which is new to the market. This effect could possibly be explained by the fact that MNEs have a larger global network of knowledge to draw on through their parent companies.

Girma, et al. (2008) show a positive effect of sector-level FDI on domestic innovations and R&D for Chinese state-owned enterprises between 1999 and 2005. Kerekes and Bitzer (2008) provides evidence that FDI has a significant positive impact on domestic R&D capital stock in 10 manufacturing sectors of 17 OECD countries between 1973 and 2000. Other studies show a strong connection between domestic firms' R&D investment and foreign firms' FDI position. Dunning (1994) argues that inward FDI may not raise the host country's innovative capabilities via spillovers. Chuang and Lin (1999) show there to be no clear evidence for the spillover effect of FDI on domestic R&D activities.

Globally, most FDI occurs in the form of mergers and acquisitions by MNEs, who account for the majority of global R&D expenditures and share their knowledge across their international affiliates. Garcia-Vega, et al. (2015) provide evidence to suggest that FDI in the form of acquisitions from technologically advanced countries increases the probability of research facilities being closed. They propose that

the complementarity between technology transfers and high-skilled workers explains why there is a simultaneous rise in high-skilled workers, technology transfers, innovation and productivity of high-skilled workers after an acquisition.

The literature investigating the effect of FDI on R&D indicates mixed results. Our analysis suggests that for every £1 million of FDI occurring in Great Britain, R&D expenditure by existing firms increases by around £1,700 on average. This takes into account the net effect of intra-mural R&D and extra-mural R&D.<sup>11</sup>

The following section describes the analytical approach undertaken including a description of the estimation methods.

<sup>11</sup>The different forms of R&D expenditure are explained in Section 5.6.

## Section 3: Analytical approach

### 3.1 Analytical introduction

We examine the indirect impact of FDI on existing firms in Great Britain separately for all economic impact factors discussed earlier. Alongside overall national impacts, effects are broken down by sector and region. This is because FDI activity varies greatly by sector in terms of investment value.<sup>12</sup>

Furthermore, sectoral characteristics may influence the extent of spillover effects. Labour-intensive sectors with active movements in the labour market for example support the demonstration effect (Girma, Greenaway and Wakelin 2001). Also, interactions with local supply chains make spillovers more likely (B. S. Javorcik 2004). For these reasons we estimate the impact of FDI separately for 18 sector groupings (data permitting) as defined by the ONS<sup>13</sup> (see Table 1).

**Table 1 – 18 sector groupings as defined by the ONS**

1. Agriculture, forestry and farming	10. Electricity, gas, water and waste
2. Mining and quarrying (including oil and gas production)	11. Construction
3. Food products, beverages and tobacco products	12. Retail and wholesale trade, repair of motor vehicles and motor cycles
4. Textiles and wood activities	13. Transportation and storage
5. Petroleum, chemicals, pharmaceuticals, rubber, plastic products	14. Information and communication
6. Metal and machinery products	15. Financial services
7. Computer, electronic and optimal products	16. Professional, scientific and technical services
8. Transport equipment	17. Administration and support service activities
9. Other manufacturing	18. Other services

FDI impacts also vary by region as demonstrated in the literature. Girma and Wakelin (2002) for example, highlight the importance of direct contact with local suppliers and distributors, as well as regional knowledge flows. We therefore estimate impacts overall for Great Britain, as well as for the following regions: London, South East, South West, East of England, East Midlands, West Midlands, Yorkshire & Humber, North East, North West, Scotland and Wales.<sup>14</sup>

<sup>12</sup>See introduction.

<sup>13</sup>More specifically, we have applied the sector groupings from the ONS' FDI statistics (Office for National Statistics 2017a). See Annex IV for a complete list of sectors.

<sup>14</sup>Due to current data limitations, Northern Ireland is excluded from the analysis.

## 3.2 Methodology

The following sections describe the estimation methods for the indirect impacts of FDI.

### 3.2.1 Indirect impact estimation

Considering the indirect impact of FDI requires us to look at how the variable of interest changes in all firms (domestic and foreign) following FDI, i.e. the spillovers generated by the investing foreign firm. As there is strong evidence in the literature that spillovers mainly occur through interactions in the supply chain, Javorcik (2004) for example finds positive productivity spillovers through the relations between foreign firms and domestic suppliers, our analysis focuses on intra-industry spillovers.

Regression analysis provides a powerful tool when estimating indirect effects. The following aspects need to be considered when defining the research specification:

1. Omitted variables bias: Unobserved variables potentially hinder the identification of impacts in a regression, as there are likely to be a number of unobserved firm-, sector- and region-specific variables that drive any observed correlation between the impact variable and FDI. In order to address the omitted variables problem, firstly, fixed effects are applied to control for fixed firm-level unobserved variation. Secondly, sector- and region-specific dummy variables are included in the estimating equation such that sectoral and regional fixed effects are controlled for. In addition, in order to control for sectoral shocks, sector-level FDI variables are normalised by sector-level GVA. Regional employment, or region-time dummies for employment-related impact variables (such as employment), is included to control for regional shocks.
2. Endogeneity may also be a concern. In the case of ALP for example, estimates may be biased because FDI may be attracted to sectors that are already productive to benefit from knowledge spillovers. In our case, the independent variable of interest, FDI, is a macro variable at sector-level and therefore less likely to be affected by productivity at the firm-level (dependent variable).<sup>15</sup> Furthermore, we incorporate lags of FDI as contemporary productivity shocks are less likely to have an influence on FDI decisions made in the past.
3. Additionally, measurement error may arise because the time horizon over which FDI impacts manifest is unclear. To address this issue, we compare impacts over different time periods and chose the optimal time horizon for the estimation accordingly.

The following econometric specification addresses the considerations above and is broadly in line with Haskel, et al. (2007) who have estimated the impact of FDI on UK productivity:<sup>16</sup>

<sup>15</sup>See chapter on data sources.

<sup>16</sup>Haskel, et al. (2007) measures the impact of foreign-owned firms on productivity in terms of employment. As we are interested in the impact by investment value, we adjusted his specification by changing the independent variable to FDI stock.

**Equation 1 – Econometric specification**

$$\begin{aligned} \log(y_{ist}) = & \text{const} + \alpha \cdot \text{foreign}_{it} + \sum_{l=0}^{\text{max lag length}} \beta_l \cdot \left( \frac{FDI_{st-l}}{GVA_{st-l}} \right) \\ & + \sum_{l=0}^{\text{max lag length}} \gamma_l \cdot \left( \frac{\text{Domestic capital stock}_{st-l}}{GVA_{st-l}} \right) + \delta \cdot \text{reg shock} \\ & + \varepsilon \cdot \text{sector}_{it} + \zeta \cdot \text{region}_{it} + \eta \cdot X_{it} + \theta_{it} \end{aligned}$$

Where  $y_{ist}$  indicates the outcome variable of firm  $i$  in sector  $s$  at time  $t$ , *foreign* is a dummy variable indicating whether a firm is foreign owned or not. The foreign ownership dummy controls for different levels of the outcome measure of foreign owned firms compared to domestically owned firms.  $FDI_{st-l}$  indicates the overall stock of FDI in sector  $s$  at time  $t$  lagged  $l$  years, which is normalised by GVA in the sector in the same time period. This is the main variable of interest to derive the impact of the presence of FDI on the economic impact factor. It captures spillover effects of higher levels of FDI stock in a sector on firms in the same sector where the investment takes place as well as effects operating through the prices in same-sector factor and product markets. Impacts are derived as the sum of the coefficients on the normalised FDI variables  $(\sum_{l=0}^{\text{max lag length}} \beta_l)$ .

The *Domestic capital stock* in sector  $s$  at time  $t$  lagged  $l$  years is included as a control variable and also normalised by GVA. Normalising FDI and domestic capital by each industry’s GVA is consistent with the approach taken in Haskel, et al. (2007) which controlled for varying sector sizes by normalising the foreign (in their case) employment in a sector by the total employment of that sector. As such, these variables reflect sector-specific cyclical and trend conditions. *reg shock* is a regional shock variable which controls for fluctuating regional economic conditions and stands for either regional employment, or region-time dummy, where the impact variable itself is employment-related. Furthermore, sector and region dummies are included to account for sector- and region-specific effects. Finally,  $X$  is a vector containing economic impact factor specific control variables for firm specific characteristics. The model was estimated using fixed effects to control for fixed firm-level unobserved variation, using cluster robust standard errors at the firm level.

To derive regional impacts, both industry level variables (normalised FDI and normalised domestic capital stock) were interacted with regional dummies. Regional impacts were then calculated as the sum of the coefficients on the FDI stock in industry variables and the coefficients on the interaction terms of the FDI variable and the regional dummies.

We have estimated a number of models in which greater or fewer lags were included to test over which time horizon indirect effects are realised. For the majority of economic impact factors, we found that the model including the contemporaneous normalised sector-level FDI variable and two lags performed the best. This suggests that indirect effects are manifested mostly by the end of the second year since the FDI has taken place.

Two key robustness tests were carried out where firstly, the regional shock variable was removed to test for the impact of time-varying regional shocks. Alternatively, regional employment was replaced by region-time dummies to capture all possible time-varying regional shocks.<sup>17</sup>

Indirect effects are estimated at the sector level, therefore capturing intra-industry spillovers. If there are significant, positive (for example) inter-sectoral indirect effects, the true magnitude of indirect effects may be larger than the estimates provided. As the sector groupings used are very broad, we ensure that spillovers between sectors of the same category including supply chains are captured, for example

between all manufacturing sectors relating to ‘transport equipment’. This approach, however, may not be the most suitable to comprehensively capture spillovers from the ‘financial services’ sector, which interacts with most other parts of the economy. Results referring to this sector should therefore be treated with caution.

### 6.2.3 Evaluation

Estimation results represent the elasticity of the outcome variables to the exposure of sectoral FDI, i.e. the percentage change in the variable following a 1% increase in the normalised FDI stock. As the sectoral FDI stock and most economic impact factors, e.g. national and sectoral employment figures, are publicly available through the ONS, we can transform the obtained elasticities into pound values and estimate the change in the economic impact factor associated with £1 million FDI.<sup>18</sup>

#### **National:**

We *evaluate* our elasticity coefficients into absolute values using the following formula, denoting by  $\beta$  the relevant coefficient for the variable being evaluated (e.g. 0.0391 for GVA) and by  $\mu$  the final, absolute value:

**Equation 2 – Evaluation equation for Great Britain**

$$\beta \frac{\text{Variable}_1 \times \text{Investment Value}}{\text{FDI}_1} \equiv \text{Variable}_2 - \text{Variable}_1 \equiv \mu$$

where:  $\text{Variable}_1$  = quantity of variable before investment  
 $\text{Variable}_2$  = quantity of variable *after* investment  
 $\text{FDI}_1$  = quantity of FDI before investment

When we say the quantity of the variable (e.g. GVA), or FDI, we mean the quantity *across Great Britain as a whole*. We can observe this value from ONS statistics for  $\text{Variable}_1$  and  $\text{FDI}_1$ , but we cannot observe  $\text{Variable}_2$ . This is unimportant, as the value of  $\mu$  can be determined without it and  $\mu$  is what we’re trying to establish.

This formula has been derived algebraically from the definition of elasticities, and can be thought of, not as an approximation or assumption, but as a mathematical identity.

#### **Sectoral:**

For our sectoral results, we use our national coefficient estimates in combination with our evaluation procedure; this is equivalent to assuming that the estimated coefficient is identical across all sectors. As a result, we produce sectoral effects for a given sector (in this example imaginary sector ‘A’) using the following formula:

<sup>17</sup>Further details on model identification and robustness checks can be found in Annex II.

<sup>18</sup>See Section 4 on ONS FDI data and Annex III for the calculation.

**Equation 3 – Sector-specific evaluation equation**

$$\beta \frac{\text{Variable}_A \times \text{Investment Value}}{FDI_A} = \mu_A$$

where:  $\text{Variable}_A$  = quantity of variable *in sector 'A'* before investment  
 $FDI_A$  = quantity of FDI *in sector 'A'* before investment

The figures we require to compute this value are available from official data sources<sup>19</sup>. We can see from inspection of this equation that our sectoral evaluation methodology captures two basic intuitions:

- The effect of an FDI project is decreasing in the stock of FDI present in that sector of Great Britain.
- The effect of an FDI project is increasing in the amount of the variable (e.g. GVA) present in that sector of Great Britain.

The evaluation approach leads to a decreasing impact with increasing levels of FDI in the sector. This reflects the assumption of diminishing marginal returns to FDI. If a sector is already characterised by high levels of FDI, the additional impact of any further FDI project is limited. This is because existing firms are already exposed to MNEs, and spillovers may have already been realised; the industry is *saturated*. On the other hand, the lower the current stock of FDI in a sector, the *higher* the potential impact of a new FDI firm entering the market on existing firms.

Similarly, our approach leads to an increasing impact with increasing levels of the variable of interest in the sector. This reflects the assumption that sectors with high levels of our variable of interest will produce greater indirect effects, owing to the strength of the sector to produce that variable. For instance, consider a sector that employs a large number of workers; an FDI project landing in that sector is more likely to raise employment in existing firms than an investment into a sector with relatively low levels of employment.

<sup>19</sup>Further information on data sources can be found in Section 4 and in Annex I.

## Section 4: Data sources

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When we estimate the elasticities of the impact variables to FDI, we use a combination of micro variables referring to the firm-level, and macro variables. The main data source used for the indirect impact estimation is the Annual Respondents Database X (ARDx). It provides the longest comprehensive panel database at reporting unit level available on Great Britain. It combines survey responses from the ABI1 (1998-2008), ABI2 (1998-2008), ABS (2009-2014) and BRES (2009-2014), providing a consistent database for the period of 1998-2014.<sup>20</sup> Further reasons for choosing the ARDx as the main data source for the analysis are the large sample size (on average 50,000 firms per year) and the inclusion of small firms in the database.<sup>21</sup> In addition to respondent data, the ARDx also contains information from the IDBR, such as ownership, turnover and employment data.

R&D expenditure is the only impact variable not included in the ARDx. For this economic impact factor, we rely on the Business Expenditure on Research and Development (BERD) dataset. It covers survey data for up to 26,000 organisations between 1994 and 2015 and R&D spend is split into intra- and extramural R&D expenditure carried out inside or outside the UK, either funded by the government or otherwise. It should be noted that only firms carrying out R&D in house are surveyed. Therefore, firms performing extramural R&D captured in the dataset may not be truly representative of the whole population.<sup>22</sup> Hence, estimated results are only indicative and should be treated with caution.

Our main independent variable, the stock of FDI, is a macro figure included in the 'Foreign direct investment involving UK companies: Inward tables' ONS dataset. This is the UK's official dataset capturing flows, positions and earnings of inward and outward FDI. FDI positions data is calculated based on survey responses on the total investment value of a firm at a point in time including equity and other capital. For the majority of sectors, data is available from 1998. We are using OECD 'FDI positions by industry' data to back cast the ONS series for sectors where data is not available for the whole period, such as 'transportation and storage'.

In order to fully capture the impact of FDI, it is vital to have a good understanding of the actual stock value within a sector. The ONS macro series is therefore better suited for the analysis than relying on aggregation of survey data. This is because the respective firm-level variable of interest, the capital stock of foreign firms, is not sufficiently well populated in the ARDx database, which means results could be driven by data limitations.<sup>23</sup> Further datasets used are listed in Annex I.

All monetary values used are deflated and 2013 was chosen as the baseline year.

<sup>20</sup>As is inherent in large survey databases, this is not exempt from relatively lower representation from smaller sized firms. This may potentially bias the estimated elasticities and to offset this, the analysis also uses the macro series for the sectoral variables of interest and subsequent evaluation. These have been scaled up to total economy level by the ONS.

<sup>21</sup>Further documentation regarding the ARDx can be found from the ONS Virtual Microdata Laboratory (VML), and University of the West of England, Bristol (2017).

<sup>22</sup>The BERD is also available as a macro dataset which we use for the impact evaluation. Macro-level extramural R&D expenditure data is only available from 2013. Furthermore, it is only available at UK level. To obtain GB figures, we have deducted the share of expenditure in Northern Ireland, by applying the observed share in the intramural R&D data.

<sup>23</sup>As our indirect impact estimation is based on data for Great Britain only, we have deducted the share of the FDI stock that can be attributed to Northern Ireland. This share was calculated based on ONS tables on GVA (production approach).

## Section 5: Results

In this section, we present the results of our analysis. We begin with an overview of our indirect impact model estimates, followed by a brief description of how these estimates are to be interpreted. Specifically, we highlight that our analysis produces estimates of the *elasticities* between FDI and our dependent variables (GVA, employment, average annual wages, apparent labour productivity and R&D).

With these estimates in place, we then turn to describing our *evaluated* results. These have been constructed using the evaluation methodology outlined in Section 3.2.2. These results allow us to make statements about what the absolute effect of a given investment project will likely be. For the purposes of applying our analysis, we assume that, all things being equal, an FDI project raises the total FDI stock by its respective investment value and therefore estimate the potential impact of the project based on the evaluated results.

Finally, we provide a detailed overview of the results of each of the five measures analysed. In this overview, we present regression readouts, accompanied by commentary on the intuition underlying our results.

It is worth noting that the analysis identifies the impact of FDI on each of the variables of interest separately and does not estimate the impact these variables have on each other, as this is outside the immediate scope of this analytical exercise. Furthermore, as is inherent in the econometric analysis of any large dataset, given the various data limitations, the range of sources used (which are not necessarily comparable with each other) and the numerous assumptions in the modelling, our results should be treated as indicative rather than being precise estimates.

### 5.1 Overview of model estimates

#### 5.1.1 Indirect effects

Having performed the methodology for the indirect impact estimation outlined in previous sections, and referring to Equation 1, we arrive at the following estimates for the elasticity of FDI with respect to the specified dependent variable of interest:

**Table 2 – Estimated coefficients**

GVA	Employment	Average annual wages	ALP
0.0391***	0.0382***	0.0290***	0.0307***

#### R&D expenditure:

Intramural	Extramural domestic	Extramural overseas business funded	Extramural overseas government funded
-0.065**	0.343***	0.371**	0.542***

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

These values indicate the percentage change in the respective variable following a 1% increase in FDI. For example, for a 1% increase in FDI, we estimate an increase in GVA of 0.0391%. These estimates are computed across all specified sector groupings and regions, and so can be thought of as the estimated values for Great Britain.

They are also computed across several time periods; in the case of employment and R&D, the coefficients denote the total effect over a three-year period, and for GVA, average annual wages and ALP, across a two-year period. As such, the final coefficients denote the expected effect after three or two years respectively. Please see Section 3.2.1 for further details on this procedure.

### 5.1.2 Evaluation

The evaluation is performed at a national and sectoral level and enables us to transform the elasticities into pound values and estimate the change in the economic impact factor for every £1 million of FDI.<sup>25</sup>

#### *Evaluated results*

Using Equation 2 which refers to our evaluation procedure, we arrive at the following results:

**Table 3 – Sector-specific evaluated results**

Sector	GVA	Employ.	Wages	ALP
<b>Total Great Britain</b>	<b>£69,299</b>	<b>1.31</b>	<b>£0.001</b>	<b>£0.002</b>
Administration and support service activities	£102,824	3.53	£0.02	£0.04
Agriculture, forest and fishing	£393,884	10.68	£0.27	£0.84
Computer, electronic and optical products	£16,020	0.23	£0.08	£0.08
Construction	£399,213	8.61	£0.08	£0.16
Electricity, gas, water and waste	£32,450	0.24	£0.03	£0.09
Financial services	£20,705	0.18	£0.01	£0.02
Food products, beverages and tobacco products	£20,993	0.32	£0.03	£0.04
Information and communication	£42,652	0.50	£0.02	£0.03
Metal and machinery products	£56,407	0.98	£0.06	£0.08
Mining and quarrying	£13,366	0.03	£0.03	£0.15
Other manufacturing	£26,411	0.50	£0.03	£0.05
Other services	£952,595	18.13	£0.03	£0.07
Petroleum, chemicals, pharmaceuticals, rubber, plastic products	£38,619	0.37	£0.05	£0.10
Professional, scientific and technical activities	£120,169	2.48	£0.03	£0.04
Retail and wholesale trade, repair of motor vehicles and motor	£58,114	1.73	£0.01	£0.01
Textiles and wood activities	£85,283	1.78	£0.13	£0.20
Transport equipment	£62,100	0.83	£0.14	£0.19
Transportation and storage	£67,663	1.39	£0.03	£0.04

In the next section, we provide an overview of the results on a variable-by-variable basis. We start with GVA, followed by employment, average annual wages, ALP, and finally R&D.

<sup>25</sup>R&D macro data is not consistently available at sectoral level. Therefore, the evaluation is carried out at the national level only; see Section 5.6.3. For all measures, robust macro data is not readily available at sector-region level, therefore the evaluation is restricted to the national and sectoral level.

## 5.2 Gross value added (GVA)

As already indicated in the preceding sections of this paper, the indirect impact of FDI on GVA is defined as the change in the GVA of firms already existing in Great Britain following an FDI project, operating in the same sector as that project. As an example, if a £100 million FDI project results in the creation of an automotive manufacturing plant (i.e. a project landing in ‘transport equipment’), the indirect GVA impact of that project would be the additional GVA produced by existing operators in the ‘transport equipment’ sector grouping.

### 5.2.1 National

Table 4 shows econometric results for our final model specification (Equation 1). The following firm-level controls were added to the specification described in equation 1 above: employment, age, average employment costs, and a dummy indicating whether the firm is foreign or not. We include the p-values for these figures in the row below the relevant variable. We control for varying regional economic conditions by including regional employment as a variable.

**Table 4 – GVA: baseline econometric estimates and robustness tests**

Analysis: GVA	
	Regional employment
Employment (logged)	0.754 *** (<0.00001)
Age (logged)	0.129 *** (<0.00001)
Average employment costs (logged)	0.212 *** (<0.00001)
Foreign dummy	-0.00490 (0.6167547)
FDI stock (normalised by GVA, lag 0)	0.0290 *** (0.0000157)
FDI stock (normalised by GVA, lag 1)	-0.0258 *** (0.0002237)
FDI stock (normalised by GVA, lag 2)	0.0359 *** (<0.00001)
Domestic capital stock (normalised by GVA, lag 0)	-0.0362 *** (0.0006078)
Domestic capital stock (normalised by GVA, lag 1)	0.152 *** (<0.00001)
Domestic capital stock (normalised by GVA, lag 2)	0.0182 * (0.0748616)
Regional employment (logged)	0.0966 (0.2126404)
Constant	7.645 *** (<0.00001)
r2	0.1720025
r2_a	0.171917
aic	220816.7
bic	221227.7
Observations	368400
Fixed effects model using cluster robust standard errors. ***, ** and * denote statistical significance of 1%, 5% and 10%.	

Each factor input (employment and industry-wide domestic capital stock) has a positive and significant *overall* impact on output, as one would expect (we combine the lagged variables for domestic capital stock and produce a statistically significant and positive overall figure for its effect on GVA). Foreign ownership has no statistically significant impact on GVA. And finally, the variable of interest (FDI stock normalised by GVA) has a relatively small but positive and statistically significant impact on output suggesting that indirect effects on GVA are present in Great Britain. We calculate the total value of the effect by combining the results for all lag lengths, which produces our final estimate for the total effect of FDI on GVA, an effect spread across 2 years’ worth of lags. *We find that a 1% increase in FDI stock results in an indirect increase in GVA of 0.0391%.*

### **Robustness tests**

Two robustness tests were carried out where we removed the regional shock variable in the first instance and alternatively in the second test replaced the regional employment variable by a region-time dummy to control for any time-varying regional impacts. Results are shown in Table 5.

**Table 5 – GVA robustness tests**

<b>Robustness test</b>	<b>Evaluated impact</b>	<b>Coefficient</b>	<b>P-value</b>
Regional Employment	£69,299	0.039054692***	1.22064E-05
No Regional Shock Var	£73,226	0.041267771***	2.65179E-06
Region Time Dummies	£24,254	0.013668554	0.134794474

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

The results of our model specification show that sector-level FDI is a statistically significant determinant of output, implying that FDI indirect effects on GVA exist sector by sector within Great Britain. However, the magnitude of the indirect effects diminishes if time-varying regional shocks are controlled for through regional employment (row 1, our final model), compared to the case where the regional shock variable is removed (row 2) and diminishes further and becomes *statistically insignificant* through inclusion of region-time dummies (row 3). As a result, our estimates indicate that in models that do not account for regional shocks, the sector-level FDI variable may be picking up some of the effects of regional shocks on GVA. This would lead to *biased estimates* of the impact of FDI on the dependent variable, suggesting controls for regional shocks are appropriate in selecting the model.

We perform similar robustness checks across all economic impact factors and find similar results consistently. As such, they will not be repeated. The model specification is listed alongside the regression results in all subsequent sections.

### **Intuition**

These results support the claim that FDI has a positive indirect effect within the receiving firm’s sector; in other words, introducing FDI into an industry in Great Britain’s economy appears to raise the GVA of firms within that industry. This confirms the view from the literature that states that FDI can result in growth-enhancing output expansions (De Mello (1999) and Alfaro (2003)). This could be driven by the competitive pressures induced by the entrance of new firms that encourages expansion of productive capacity (Blomström (1986) and Griffith, et al. (2002)), or as a result of some demonstrative effect as described by Markusen (1995).

It is worth mentioning that the overall effect is positive; as such we can infer that the negative effects of competitive and demonstrative influences stemming from FDI are overwhelmed by the positive externalities and competition effects. This is consistent with the growth-enhancing characteristics of FDI in the context of developed economies as outlined by De Mello (1999).

## 5.2.2 Regional

**Table 6 – GVA: regional employment**

Region	Coefficient	P-value
East Midlands	0.017778575	0.47080183
East of England	0.074389078***	0.002348732
London	0.019242439	0.537334144
North East	-0.02578407	0.549602985
North West	0.028042058	0.198958471
Scotland	0.049981222**	0.014081683
South East	0.080938049***	0.000440551
South West	0.067063168***	0.006068548
Wales	0.031164035	0.331465632
West Midlands	-0.004495674	0.874280095
Yorkshire and the Humber	0.037370235	0.110234633

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

Of the 11 regions investigated, we produce **four statistically significant results**, all of which are positive. These results further strengthen our confidence in the association between FDI and GVA.

The strongest results are found in the South East. The South East is the 2<sup>nd</sup> largest region by GVA (after London), and is also *highly diversified*, hosting firms from industries such as ICT, pharmaceuticals, high tech engineering and aerospace (European Commission 2018a). It is fast-growing, has the largest population of any of the regions (~9 million), and has the largest share of FDI projects outside of London (Department for International Trade 2018).

These characteristics of the South East help explain the strong results produced by our analysis; if indirect effects stem from either improved competition or imitation, then the South East is well-placed to compete, and also less likely to suffer from a prohibitive ‘technology gap’ that would hinder successful imitation.

The weakest results are found in Scotland, although these are still positive. The GVA for Scotland is the 2<sup>nd</sup> lowest of the four regions with statistically significant results (only the South West is lower, and very marginally) (Office for National Statistics 2017d). This might suggest that the lower overall size of the economy in Scotland is responsible for the weaker results.

Scotland is also the least densely-populated region analysed. Distance between organisations has been shown to have a negative impact on the magnitude of FDI spillovers (Halpern and Muraközy 2007). The geographically dispersed nature of Scotland may therefore further contribute to the lower results.

In total, the regional effects highlight and support the broad claim that FDI projects are likely to have stronger indirect GVA impacts in *areas that are already strong* at producing GVA. There may also be region-specific factors, such as distance between firms and the existence of *clusters* that further drive our results.

On the regions with statistical insignificance, it is pertinent to highlight that the analysis does not interpret these regions as weak or not suitable for FDI. Rather, this could be driven by a lack of sufficient variation within a given region to show significant impacts. Also, as we are looking at the additional impact of FDI relative to domestic (and other forms of) investment captured by the domestic capital stock variable, we may also need to consider the relative regional strengths that influence the effectiveness of FDI. In the London example, we found that FDI does not generate impacts relative to domestic investment and this might be because high quality investment of all forms is attracted to the capital. Alternatively, local firms in

London may already be productive such that they do not necessarily learn more from foreign firms. Thus, a lack of significance does not necessarily imply that the region in question is somehow deficient; indeed, it could be the opposite.

### 5.2.3 Evaluation

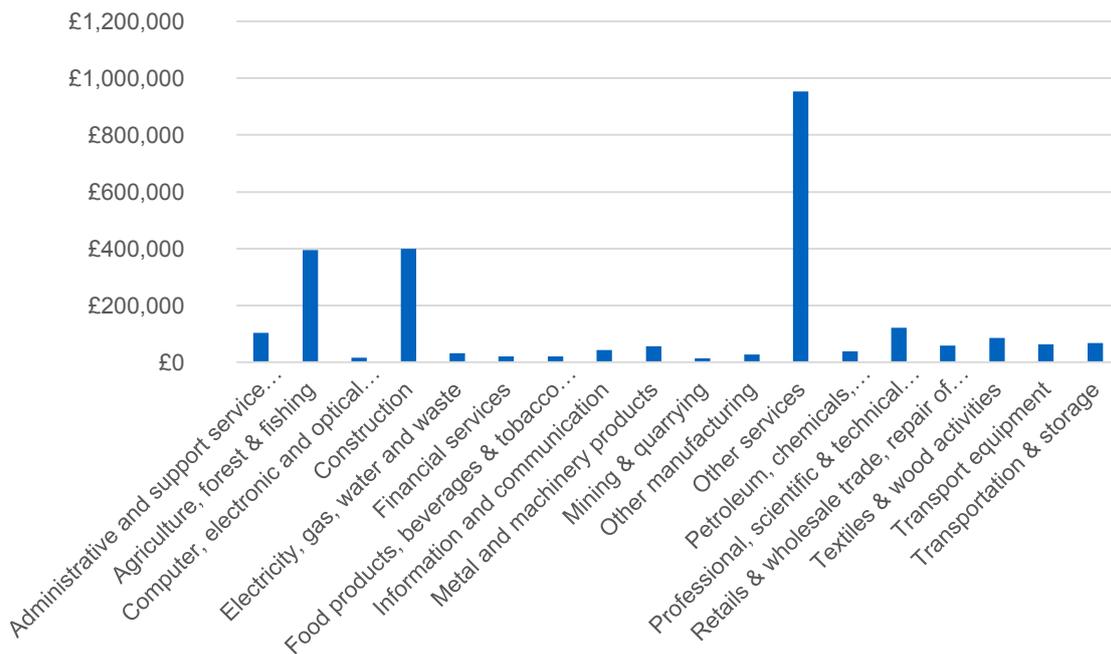
#### *National*

A £1 million increase in FDI in a given sector is estimated to produce, on average, around a £69,000 net increase in GVA among firms in the same sector (indirect impact) that is highly statistically significant. This result is obtained through application of the coefficient derived in Equation 1, with GVA being the outcome variable, into Equation 2.

#### *Sectoral*

A £1 million increase in FDI is associated with a net increase in GVA in all other existing firms (indirect effect) that varies from around **£13,000** in the ‘mining and quarrying’ sector, to around **£953,000** in the ‘other services’ sector. Results are obtained by applying the coefficient derived in Equation 1 into Equation 3. Figure 6 presents the average relationship between GVA and FDI by sector.

**Figure 6 – The impact of FDI on GVA, sector-level results**



Evaluation is always performed using the same basic pair of assumptions:

1. The evaluated figure is increasing in the amount of the variable (in this case GVA) present in that sector of Great Britain;
2. The evaluated figure is decreasing in the stock of FDI present in that sector of Great Britain.

These assumptions are therefore reflected in the figures offered above. For example, the large reported value for 'other services' is a function of **high values of GVA** in that sector, whereas the high value for 'agriculture, forestry and fishing' is a result of **low levels of FDI** in that sector. Similarly, low evaluated figures in 'food products, beverages and tobacco products' are formed due to **low levels of GVA**, and in 'financial services' and 'mining and quarrying' reflect the **high levels of FDI stock** found in that industry.

The evaluated results also produce intuitively appealing results. The 'other services' sector is highly diversified including sub sectors such as education, social work activities and activities of membership organisations, and so any indirect effects are likely to be amplified by the broad reach of the sector. As firms in this sector often interact with a wider range of firms, both through the supply chain and competitively, it is not surprising that the GVA result for 'other services' is high. We also know that 'other services' is a very labour-intensive industry; given that demonstration effects are often transmitted through the labour market (Girma, Greenaway and Wakelin 2001), the movement of employees across firms within the 'other services' sector may also explain the strong results we report here.

Similarly, in the 'agriculture, forestry and fishing' sector where exposure to technologies and practices of foreign firms is highly limited, we would expect to see the entrance of a foreign competitor to have a more significant effect on GVA than in other industries, simply because there is more room for improvement. This is consistent with our narrative surrounding the impact of competition and demonstration effects; sectors with high levels of FDI are already competing with foreign firms and have already observed foreign innovations in the context of their sector. By comparison, in sectors with low FDI, new foreign entrants are likely to act as a more disruptive force, both in terms of competition and demonstration.

## 5.3 Employment

The indirect impact of FDI on employment is defined as the change in the number of employees *working in firms already existing in Great Britain* following an FDI project, operating in the same sector as that project. As an example, if a £100 million FDI project results in the creation of an automotive manufacturing plant (i.e. an FDI project landing in 'transport equipment'), the indirect employment impact of that project would be the additional workers employed by existing firms in the 'transport equipment' sector in response to the new FDI project.

### 5.3.1 National

Table 7 shows econometric results for our final model specification (Equation 1). The only additional control variables that were added were age and a foreign ownership dummy. We control for regional shocks by employing region-time dummies. We include the p-values for these figures in the row below the relevant variable. Our final estimated coefficient is **0.0382**; this can be interpreted as a 1% increase in FDI stock resulting in a 0.0382% increase in employment. In the case of employment, this is the composite effect across three years' worth of lags, and so represents the effect of FDI spread across three years.

**Table 7 – Employment: baseline econometric estimates**

Analysis: Employment	
	Region-time dummies
Age (logged)	0.325*** (<0.00001)
Foreign dummy	0.0188** (0.01242)
FDI stock (normalised by GVA, lag 0)	0.0298*** (<0.00001)
FDI stock (normalised by GVA, lag 1)	0.00179 (0.674486)
FDI stock (normalised by GVA, lag 2)	-0.00369 (0.406539)
FDI stock (normalised by GVA, lag 3)	0.0103* (0.064314)
Domestic capital stock (normalised by GVA, lag 0)	0.0516*** (<0.00001)
Domestic capital stock (normalised by GVA, lag 1)	0.00227 (0.733857)
Domestic capital stock (normalised by GVA, lag 2)	0.0163** (0.019807)
Domestic capital stock (normalised by GVA, lag 3)	0.0352*** (0.000013)
Constant	1.675*** (<0.00001)
r2	0.0413
r2_a	0.0409
aic	-176885.6
bic	-174924
Observations	399329
Fixed effects model using cluster robust standard errors. ***, ** and * denote statistical significance of 1%, 5% and 10%.	

As we might expect, the age of a firm has a positive and highly statistically significant correlation with the number of employees at the organisation. Older firms tend on average to be larger, both in terms of revenue and employment (Litan and Hathaway 2014).

The foreign ownership dummy has a positive coefficient that is statistically significant. This is consistent with the notion that foreign owned firms *tend to be larger than domestic firms* (Bellak 2004). The variable of interest (FDI stock normalised by GVA) has a relatively small but positive and statistically significant impact on employment suggesting that indirect effects on employment are present in Great Britain.

We calculate the total value of the effect by combining the results for all three lag lengths, which produces our final estimate for the total effect of FDI on employment. *We find that a 1% increase in FDI stock results in an indirect increase in employment of 0.0382%.*

**Intuition**

These results support the claim that FDI has a positive indirect effect within the receiving firm’s sector; in other words, introducing FDI into an industry in Great Britain’s economy appears to raise the employment of firms within that industry. This confirms the view from the literature that states that existing firms respond overall positively to FDI taking place in the sector (Braunstein and Epstein (2002), Spiezia (2004) and Vacaflares (2011)). This could be driven by the competitive pressures that the presence of foreign firms creates that incentivises the existing firms to increase their productive capacity or utilise their existing economies of scale, both of which result in employing more people (Hale and Long 2012). It should be noted that the increase in their productive capacity could also be because of the demonstration effects whereby the existing firms now take advantage of the spillover effects resulting from the new FDI project (Hale and Long 2012).

It is pertinent to mention that the result above is positive overall. It is the net effect of FDI on employment, including any potential negative effects of competitive and demonstrative effects that would result in employment displacement. This implies that employment creation is higher than employment displacement in the context of indirect employment effects. Again, this is consistent with the findings of Braunstein and Epstein (2002), Spiezia (2004) and Vacaflares (2011).

**5.3.2 Regional**

**Table 8 – Employment: region-specific time dummies**

Region	Coefficient	P-value
East Midlands	0.048204076**	0.045710335
East of England	0.035961159	0.203963583
London	0.086535618***	0.004638820
North East	0.015962452	0.763595592
North West	0.035115898	0.234700726
Scotland	0.053268205**	0.026224155
South East	0.009942966	0.661385101
South West	-0.002871175	0.907468853
Wales	0.059581786*	0.064765343
West Midlands	0.040791865	0.101087569
Yorkshire and the Humber	0.0315874	0.143997911

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

Of the 11 regions investigated, we produce **four statistically significant results**, all of which are positive. These results further strengthen our confidence in the association between FDI and employment.

The strongest results are found in London. London has the largest labour force of any region (Office for National Statistics 2017c), which may help explain the strong results produced by our analysis; given that London is a region conducive to supporting a large workforce, it is unsurprising that the corresponding results for employment are suitably larger than in other regions.

The population density of London is the largest of any sector, indicating that the region is highly concentrated. As mentioned above, distance between organisations has been shown to have a negative impact on the magnitude of FDI spillovers (Halpern and Muraközy 2007). The geographically concentrated nature of London may therefore help explain why spillovers are stronger here.

The weakest results are found in the East Midlands, although these are still positive, and not hugely dissimilar from other statistically significant results. East Midlands has the second smallest labour force of all the statistically significant results (after Wales) (Office for National Statistics 2017c). The comparatively strong performance by Wales may be driven by low current exposure to FDI; in terms of numbers of FDI projects landed between the 2013/14 and 2017/18 financial years, Wales ranks 8<sup>th</sup> (Department for International Trade 2018). As a region that has yet to experience the indirect benefits attached to foreign investment, an FDI project in Wales is more likely to have a disruptive effect on the wider regional economy than an area more accustomed to FDI projects.

In total, the regional effects highlight and support the broad claim that FDI projects are likely to have stronger indirect employment impacts in *areas that are already strong* at supporting employment. Lack of FDI exposure may also contribute to stronger estimated results, as may be the case in Wales. There may also be region-specific factors, such as distance between firms that, consistent with Halpern and Muraközy (2007), further drive our results.

As discussed in Section 5.2.2, where we describe the regional results for GVA, we emphasise that a lack of statistical significance should not be interpreted as these regions being weak or not suitable for FDI. The arguments outlined there are equally relevant to this subsection on employment, and so will not be repeated.

### 5.3.3 Evaluation

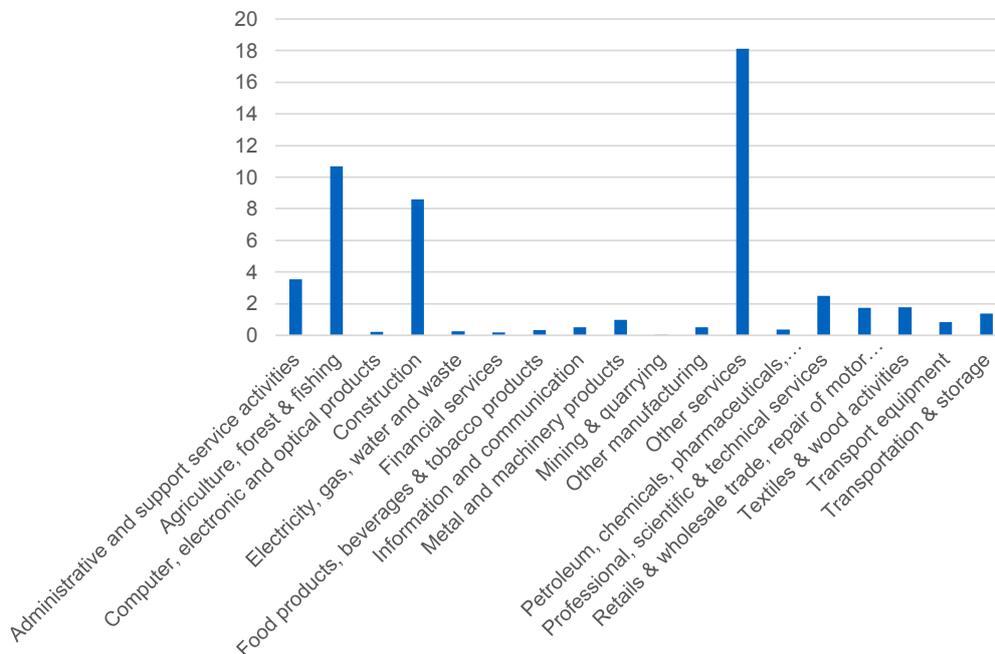
#### National

A £1 million increase in FDI in a given sector is estimated to produce, on average, around **1.3 jobs** among firms in the same sector (indirect impact); this estimate is highly statistically significant. This result is obtained through application of the coefficient derived in Equation 1, with employment being the outcome variable, into Equation 2.

#### Sectoral

A £1 million increase in FDI is associated with a net increase in employment in all other existing firms (indirect effect), that varies from around **0.03 jobs** in the ‘mining and quarrying’ sector, to around **18.1 jobs** in the ‘other services’ sector. Results are obtained by applying the coefficient derived in Equation 1 into Equation 3. Figure 7 presents the average relationship between employment and FDI by sector.

**Figure 7 – The impact of FDI on employment, sector-level results**



The evaluation is always performed using the same basic pair of assumptions.

The arguments relevant in the previous subsection on GVA are equally pertinent here, and so will not be repeated. An additional relevant factor driving the distribution of impacts across sectors is the degree of labour-intensity.

Take 'construction' as an example; as a sector that is traditionally very labour-intensive, it is unsurprising that the indirect impact of FDI on employment across the sector would be large. In order to produce more output to compete, firms in the sector *require more labour relative to other industries to do so*. The same argument holds for 'agriculture, forestry and fishing', another traditionally labour-intensive industry.

Similarly, sectors that are traditionally more capital-intensive, such as 'computer, electronic and optical products', have correspondingly small values attached to their indirect impact on employment.

## 5.4 Average annual wages

The indirect impact of FDI on average wages is defined as the change in the average annual wage of employees *working in firms already existing in Great Britain* following an FDI project, operating in the same sector as that project. As an example, if a £100 million FDI project results in the creation of an automotive manufacturing plant (i.e. a project landing in 'transport equipment'), the indirect average annual wages impact of that FDI project would be the change in the wages of workers employed by existing firms in the 'transport equipment' sector.

### 5.4.1 National

Table 9 shows econometric results for our final model specification (Equation 1). The only additional control variables that were added were age and a foreign ownership dummy. We include the p-values for these figures in the row below the relevant variable. We control for varying regional economic conditions by including regional time dummies as a variable. Our final estimated coefficient is **0.0290**; this can be interpreted as a 1% increase in FDI stock resulting in a **0.029% increase in average annual wages**. In the case of average annual wages, this is the composite effect across lag 0, lag 1, and lag 2, and so represents the effect of FDI spread across two years.

**Table 9 – Average annual wages: baseline econometric estimates**

Analysis: Average annual wages	
	Region-time dummies
Age (logged)	-0.0924*** (<0.00001)
Foreign dummy	-0.00656 (0.332047)
FDI stock (normalised by GVA, lag 0)	-0.0502*** (<0.00001)
FDI stock (normalised by GVA, lag 1)	0.0201*** (0.000199)
FDI stock (normalised by GVA, lag 2)	0.0591*** (<0.00001)
Domestic capital stock (normalised by GVA, lag 0)	-0.00116 (0.896566)
Domestic capital stock (normalised by GVA, lag 1)	0.121*** (<0.00001)
Domestic capital stock (normalised by GVA, lag 2)	0.0461*** (<0.00001)
Constant	9.271*** (<0.00001)
r2	0.0932
r2_a	0.0928
aic	43719.1
bic	45769.7
Observations	380688
Fixed effects model using cluster robust standard errors. ***, ** and * denote statistical significance of 1%, 5% and 10%.	

The age of a firm has a negative and highly statistically significant correlation with the average annual wage of the organisation. This is an interesting result; whilst there does exist a significant body of evidence suggesting that average wages are positively linked with firm age and firm size (Heyman 2007), there is also a competing view that firm age may be inconsequential to, or even negatively associated with wages (Quimet and Zarutskie (2014) and Brown and Medoff 2003)). In this competing school, the authors recognise a failure to control for worker characteristics (such as age of employees and educational background) as the key factor driving the positive association between firm age and wages other authors have identified. Whilst identification of the relevance of worker characteristics in the context of FDI entrants may be of value and relevance to a fuller understanding of the consequences of FDI itself, such ambitions go beyond the scope and purpose of this analytical exercise and report.

The variable of interest (FDI stock normalised by GVA) has a relatively small but positive and statistically significant impact on average annual wages suggesting that indirect positive effects on annual wages are present in Great Britain.

We calculate the total value of the effect by combining the results for all three lag lengths, which produces our final estimate for the total effect of FDI on average annual wages. *We find that a 1% increase in FDI stock results in an indirect increase in average annual wages of 0.0290%.*

## Intuition

These results support the claim that FDI has a positive indirect effect within the receiving firm's sector; in other words, introducing FDI into an industry in Great Britain's economy appears to raise the average annual wage of firms within that industry. This confirms the view from the literature that the entrance of foreign firms prompts a rise in wages in existing domestic firms (N. L. Driffield 1996). At the root of this increase could either be the amplification of competitive pressures within the economy, a position supported by Borensztein, et al. (1998) and Lipsey and Sjöholm (2004), or alternatively some demonstrative influence as suggested by Hijzen and Swaim (2008).

## 5.4.2 Regional

**Table 10 – Average annual wages: region-specific time dummies**

Region	Coefficient	P-value
East Midlands	0.009575916	0.644298806
East of England	0.052640233**	0.024658692
London	0.058881372*	0.069138798
North East	-0.012826442	0.712595248
North West	0.033401366*	0.059286974
Scotland	0.036156274*	0.058186403
South East	0.028102241	0.211374072
South West	0.037491225*	0.062142118
Wales	0.016796866	0.479716072
West Midlands	-0.056034759**	0.022895826
Yorkshire and the Humber	0.061181773***	0.000137964

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

Of the 11 regions investigated, we produce **seven statistically significant results**, six of which suggest positive average annual wage effects, and one of which suggests a *negative* effect. These results strengthen our confidence in the association between FDI and average annual wages, though with some caveats.

The strongest result is found in Yorkshire and the Humber. The result for this region is also the only one to have significance at the 99% confidence level. According to data from the 2016 edition of the Annual Survey of Hours and Earnings<sup>26</sup>, Yorkshire and the Humber scores 10<sup>th</sup> out of 11 regions in terms of average annual pay (only Wales is lower), with average gross annual pay across all employee jobs of £24,439 (Office for National Statistics 2017b).

Given that FDI exposure in the region is also relatively low (Yorkshire and the Humber ranks 7<sup>th</sup> in number of FDI projects landed between the 2013/14 and 2017/18 financial years (Department for International Trade 2018)) we might expect the entrance of foreign firms paying higher wages to have a considerable impact on the wage rate in the region. In order to meet the competition for labour created by the foreign entrant, existing firms may be forced to raise their wages to remain competitive.

The only negative result is found in the West Midlands, where we estimate statistically significant negative indirect effects. This may reflect the fact that the average wage in the West Midlands is reasonably low (6<sup>th</sup> out of 11) (Office for National Statistics 2017b), but the number of FDI projects is quite high (3<sup>rd</sup> out of 11) (Department for International Trade 2018).

<sup>26</sup>This is the most recent dataset to be fully confirmed and approved by the ONS available at the time of writing this report.

This result may also reflect an ongoing trend in the region towards falling levels of innovation and R&D; the European Commission describes the West Midlands as the region with 'the lowest proportion of 'innovation active' firms in England' (European Commission 2018b). If the sophistication of industry in the region is falling, it is possible that the FDI projects that the West Midlands attracts are not the sort of productive, innovative firms that pay a wage premium. Indeed, FDI may be contributing towards a wider trend of lower skilled employment in the region, hence the negative effect on average annual wages.

Furthermore, we could argue that our findings are an indicator for a lower absorptive capacity in sectors in the West Midlands compared to other regions. This would be consistent with the arguments outlined in Borensztein, et al. (1998), who identify the existence of a sufficiently well-established and advanced industry capable of interacting and competing with foreign investments as necessary for spillovers to be positive. Indeed, they highlight that in the absence of sufficient absorptive capacity, spillovers can be negative. This explanation may therefore be at the heart of our negative results for the West Midlands.

As discussed in Section 5.2.2, where we describe the regional results for GVA, we emphasise that a lack of statistical significance should not be interpreted as these regions being weak or not suitable for FDI. The arguments outlined there are equally relevant to this subsection on employment, and so will not be repeated.

### 5.4.3 Evaluation

#### *National*

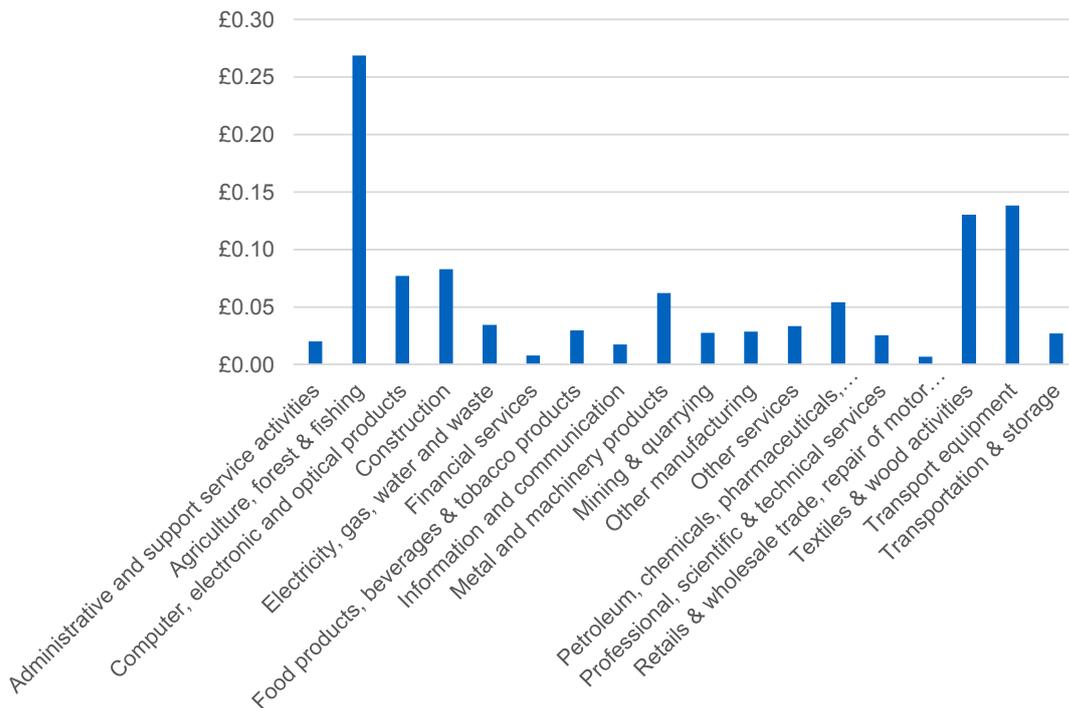
A £1 million increase in FDI in a given sector is estimated to raise the average annual wage, on average, by around **£0.001** among firms in the same sector (indirect impact); this estimate is highly statistically significant. This result is obtained through application of the coefficient derived in Equation 1, with average annual wage being the outcome variable, into Equation 3.

#### *Sectoral*

A £1 million increase in FDI is associated with a net increase in average annual wages in all other existing firms (indirect impact) that varies from around **£0.01** in the 'financial services' sector, to around **£0.27** in the 'agriculture, forestry and fishing' sector. Results are obtained by applying the coefficient derived in Equation 1 into Equation 3. Figure 8 presents the average relationship between annual average wages and FDI by sector.

Evaluation is always performed using the same basic pair of assumptions. See the previous subsection on GVA for intuitions that are equally pertinent here.

**Figure 8 – The impact of FDI on average annual wages, sector-level results**



### 5.5 Apparent labour productivity (ALP)

The indirect impact of FDI on ALP is defined as the change in the ALP of firms already existing in Great Britain following an FDI project, operating in the same sector as that project. As an example, if a £100 million FDI project results in the creation of an automotive manufacturing plant (i.e. a project landing in ‘transport equipment’), the indirect ALP impact of that project would be the change in the ALP of existing firms in the ‘transport equipment’ sector.

#### 5.5.1 National

Table 11 shows econometric results for our final model specification (Equation 1). The following firm-level controls were added: age, average employment costs, an R&D dummy, and a dummy indicating whether the firm is foreign or not. We include p-values for these figures in the row below the relevant variable. We control for varying regional economic conditions by including regional employment as a variable. Our final estimated coefficient is **0.0307**; this can be interpreted as a 1% increase in FDI stock resulting in a **0.0307% increase in ALP**.

**Table 11 – ALP: baseline econometric estimates**

Analysis: ALP	
	Regional employment
Age (logged)	0.0868 *** (<0.00001)
Average employment costs (logged)	0.221 *** (<0.00001)
R&D dummy	0.00395 (0.4286499)
Foreign dummy	0.00399 (0.6196767)
FDI stock (normalised by GVA, lag 0)	0.0204 *** (0.000305)
FDI stock (normalised by GVA, lag 1)	-0.0243 *** (0.0000514)
FDI stock (normalised by GVA, lag 2)	0.0346 *** (<0.00001)
Domestic capital stock (normalised by GVA, lag 0)	-0.0519 *** (<0.00001)
Domestic capital stock (normalised by GVA, lag 1)	0.131 *** (<0.00001)
Domestic capital stock (normalised by GVA, lag 2)	0.0108 (0.1885632)
Regional Employment	0.174 *** (0.0060349)
Constant	5.932 *** (<0.00001)
r2	0.1340958
r2_a	0.1340077
aic	136572.7
bic	136984.3
Observations	373700
Fixed effects model using cluster robust standard errors. ***, ** and * denote statistical significance of 1%, 5% and 10%.	

The age of a firm has a positive and highly statistically significant correlation with the ALP of the organisation. This is consistent with the wider literature (Office for National Statistics (2016) and Idson and Oi (1999)). We fail to find a significant result for the dummy on foreign ownership in explaining ALP; this is surprising as many results in the wider literature suggest that foreign owned firms are more productive (Blomström (1986), Driffield (2001) and Javorcik (2004)). However, given a lack of statistical significance, we cannot comment on the wider relevance of this finding.

The variable of interest (FDI stock normalised by GVA) has a relatively small but positive and statistically significant impact on ALP suggesting that indirect positive effects on ALP are present in Great Britain.

We calculate the total value of the effect by combining the results for all three lag lengths, which produces our final estimate for the total effect of FDI on ALP. *We find that a 1% increase in FDI stock results in an indirect increase in ALP of 0.0307%.*

**Intuition**

These results support the claim that FDI has a positive indirect effect within the receiving firm’s sector; in other words, introducing FDI into an industry in Great Britain’s economy appears to raise the ALP of firms within that industry. This confirms the view from the literature that states that the introduction of foreign entrants to a domestic market encourages productivity gains in existing firms (Girma, Greenaway and Wakelin 2001). These productivity gains may reflect adaptations to enhanced competitive pressures in the economy that encourage firms to invest in improving their productive capacity (Horstmann and Markusen (1996), Blomström (1986) and Griffith, et al. (2002)). Alternatively, there may be some demonstration effects that existing firms are able to appropriate to their own productive advantage (Markusen (1995) and Caves (1996)).

It is worth mentioning that the *overall* effect is positive; as such we can infer that any *negative* effects of competitive and demonstrative influences stemming from FDI are overwhelmed by the positive externalities. Whilst we may be concerned that excessive productivity differentials between foreign and domestic firms might produce negative overall effects, as described by Girma, et al. (2001) and Borensztein, et al. (1998), their shared conclusion that developed economies ought to possess the human capital advantages to profit from these competitive and demonstrative pressures are confirmed by our analysis.

**5.5.2 Regional**

**Table 12 – ALP: regional employment**

Region	Coefficient	P-value
East Midlands	0.024107480	0.223376676
East of England	0.071443036***	0.000610701
London	0.022709252	0.334094763
North East	-0.003014400	0.934694111
North West	0.021321915	0.246219546
Scotland	0.049025878***	0.002833537
South East	0.061098799***	0.001751196
South West	0.028178809	0.192002937
Wales	0.013769416	0.593724370
West Midlands	0.007513611	0.764390707
Yorkshire and the Humber	0.008871904	0.630682766

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

Of the 11 regions investigated, we produce **three statistically significant results**, all of which are positive. Much of the discussion around regional differences in the subsection on GVA are equally relevant here and will not be repeated. One additional comment worth consideration is the high figure associated with the ‘East of England’ region.

As a well-known hub for science and technology firms (Cambridge is located in this region), the strong and statistically significant coefficient presented here is consistent with our understanding of the industry dynamics of the region.

### 5.5.3 Evaluation

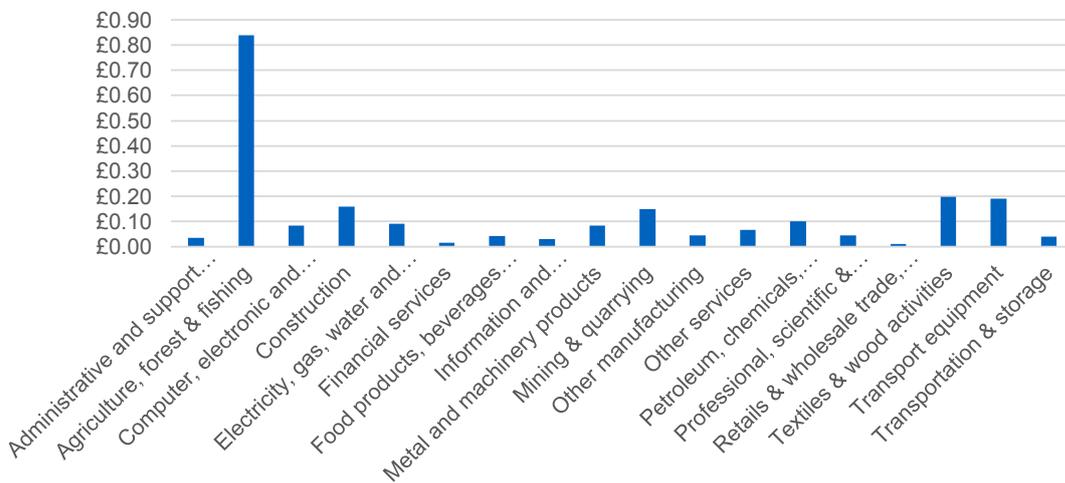
#### National

A £1 million increase in FDI in a given sector is estimated to raise the ALP, on average, by around **£0.002** among firms in the same sector (indirect impact); this estimate is highly statistically significant. This result is obtained through application of the coefficient derived in Equation 1, with ALP being the outcome variable, into Equation 2.

#### Sectoral

A £1 million increase in FDI is associated with a net increase in ALP in all other existing firms (indirect impact) that varies from around **£0.01** in the ‘retail and wholesale trade, repair of motor vehicles and motor cycles’ sector, to around **£0.84** in the ‘agriculture, forestry and fishing’ sector. Results are obtained by applying the coefficient derived in Equation 1 into Equation 3. Figure 9 presents the average relationship between ALP and FDI by sector.

**Figure 9 – The impact of FDI on ALP, sector-level results**



Evaluation is always performed using the same basic pair of assumptions. See the previous subsection on GVA for intuitions that are equally pertinent here.

### 5.6 Research and development (R&D)

The indirect impact of FDI on R&D is defined as the change in the R&D spending of firms already existing in Great Britain following an FDI project, operating in the same sector as that project. As an example, if a £100 million FDI project results in the creation of an automotive manufacturing plant (i.e. a project landing in ‘transport equipment’), the indirect R&D impact of that FDI project would be the change in the R&D spending of existing firms in the ‘transport equipment’ sector.

It is also worth noting that when we investigate the indirect R&D effect, we discuss four distinct forms of R&D that could be affected by the entrance of a new FDI project: intramural R&D, extramural R&D carried out domestically, extramural R&D carried out overseas funded by the government, and extramural R&D carried out overseas funded by business. Intramural (meaning literally, *inside the walls*) refers to R&D undertaken in-house, such as by a dedicated research department, for example. Extramural refers to R&D sourced externally (*outside the walls*). Due to data limitations, indirect effect analysis for R&D is not broken down at a sectoral level.

### 5.6.1 National

The final reported coefficients for each of the four forms of R&D are derived by applying Equation 1 and are listed here. These values are calculated by combining the results across three years’ worth of lags, which produces our final estimate for the total effect of FDI on R&D spending across each of the four categories.

**Table 13 – R&D coefficients**

	<b>Intramural</b>	<b>Extramural domestic</b>	<b>Extramural overseas business funded</b>	<b>Extramural overseas government funded</b>
Coefficient	-0.065**	0.343***	0.371**	0.542***

\*\*\*, \*\* and \* denote statistical significance of 1%, 5% and 10%.

Table 14 shows econometric results for our final model specifications. The following controls were added: age and a foreign dummy. We include p-values for these figures in the row below the relevant variable in parentheses. We control for varying regional economic conditions by including regional time dummies as a variable.

**Table 14 – R&D baseline econometric estimates**

<b>Analysis: R&amp;D; Region-time dummy</b>	<b>Intramural</b>	<b>Extramural domestic</b>	<b>Extramural overseas bus. funded</b>	<b>Extramural gov. funded</b>
Age (logged)	0.134 (0.190204)	0.332* (0.071872)	0.237 (0.289155)	0.229 (0.638368)
Foreign dummy	-0.00978 (0.711385)	0.00291 (0.960123)	0.0505 (0.483934)	-0.235 (0.111875)
FDI stock (normalised by GVA, lag 0)	0.00675 (0.741402)	-0.0385 (0.459307)	-0.426*** (<0.00001)	-0.164 (0.483948)
FDI stock (normalised by GVA, lag 1)	0.0255 (0.246056)	0.185*** (0.002216)	1.252*** (<0.00001)	1.190*** (<0.00001)
FDI stock (normalised by GVA, lag 2)	-0.138*** (<0.00001)	-0.342*** (<0.00001)	-1.095*** (<0.00001)	-2.294*** (<0.00001)
FDI stock (normalised by GVA, lag 3)	0.0400* (0.091036)	0.539*** (<0.00001)	0.812*** (<0.00001)	1.639*** (<0.00001)
Domestic capital stock (normalised by GVA, lag 0)	-0.292*** (<0.00001)	0.535*** (<0.00001)	-1.699*** (<0.00001)	0.461 (0.226315)
Domestic capital stock (normalised by GVA, lag 1)	0.0298 (0.459305)	0.106 (0.250154)	0.302** (0.014293)	0.830** 0.030803
Domestic capital stock (normalised by GVA, lag 2)	0.0743* (0.061491)	0.234*** (0.008798)	1.351*** (<0.00001)	0.303 (0.322204)
Domestic capital stock (normalised by GVA, lag 3)	0.0292 (0.477708)	0.0382 (0.681809)	0.197* (0.068772)	0.735** (0.013532)
Constant	12.06*** (<0.00001)	4.458*** (<0.00001)	3.905*** 0.000157	-6.027** (0.022634)
r2	0.0619	0.939	0.153	0.319
r2_a	0.0574	0.0877	0.147	0.304
aic	70482.1	76497.5	74253.3	15816.5
bic	72020.4	77962.4	75699.7	16953.3
Observations	38021	26479	23877	7894
Fixed effects model using cluster robust standard errors. ***, ** and * denote statistical significance of 1%, 5% and 10%.				

The age of a firm has a positive and statistically significant correlation with R&D spending only when that spending occurs domestically and extramurally, otherwise we do not identify a statistically significant relationship.

We fail to find a significant result for the dummy on foreign ownership in explaining R&D; although the wider literature suggests that foreign-owned firms typically spend more on R&D than domestic counterparts (Driffield, Du, et al. 2010), there may be insufficient variation in our own dataset that makes statistical significance difficult to establish.

The variable of interest (FDI stock normalised by GVA) has a positive and statistically significant impact on R&D spending across all categories, with the exception of intramural R&D, where it is statistically significant and negative.

**Intuition**

These results support the claim that FDI has a positive indirect effect within the receiving firm’s sector for **extramural R&D spending only**; in other words, introducing FDI into an industry in Great Britain’s economy appears to encourage firms within that industry to increase their expenditure on outsourced R&D. In terms of intramural R&D, our analysis suggests a negative impact. This is in line with conclusions from Veugelers and Vanden Houte (1990) and Driffield (2001), who find evidence that MNEs reduce domestic R&D. Driffield, et al. (2010) furthermore argue that a substitution of foreign for domestic R&D may be beneficial to the economy if it is more efficient to access improved technology through the market than through R&D carried out domestically.

Although our findings suggest a decrease in intramural R&D, the estimated increase in extramural R&D outweighs this decline, leading to an overall positive impact of FDI on R&D expenditure. This is shown in the evaluation section below (Section 5.6.3).

**5.6.2 Regional**

We relied on the BERD dataset for this impact measure, with a considerably lower sample size compared to the ARDx. For this reason, we decided not to perform the indirect impact estimation for R&D at a regional level, as data limitations could impact the results.

**5.6.3 Evaluation**

**National**

A £1 million increase in FDI in a given sector is estimated to raise R&D spending according to the following categories:

**Table 15 – R&D evaluated**

	<b>Total R&amp;D</b>	<b>Intramural</b>	<b>Extramural domestic</b>	<b>Extramural overseas business funded</b>	<b>Extramural overseas government funded</b>
Evaluated	£1,656	-£1,376	£531	£20	£2,482

Results are obtained by applying the coefficient derived in Equation 1 into Equation 2. If we add up these results, we get a total net effect of **£1,656** additional R&D spending.

**Sectoral**

R&D macro data is not consistently available at sectoral level. Therefore, the evaluation is carried out at the national level only.

## Section 6: Conclusion

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### 6.1 Summary

This report considers the topic of the impact of FDI on Great Britain's economy. It draws in the definition of FDI as cross-border investments from one country into another with the aim of establishing a lasting interest in an enterprise, where the investor's purpose is to have an effective voice in the management of the enterprise.

The report further explores the extent of FDI in the UK and identifies that the UK has been consistently ranked in the top four for inward FDI stock globally – the highest in Europe. According to the ONS, the UK inward FDI stock value in 2016 was £1.2 trillion (Office for National Statistics 2017a).

DIT, the investment promotion agency for FDI in the UK, has been involved in attracting new FDI and helps foreign-owned businesses to expand in the UK. This is through promoting the UK as an attractive destination for inward investment and facilitating and supporting investors with the landing of inward investment.

The rationale for promoting inward FDI is primarily driven by the benefits that accrue through such FDI projects. In particular, any technological or managerial spillover effects that positively impact existing firms in the economy, thus contributing towards economic growth and development. The characteristics and extent of these indirect effects are dependent on the sector, the destination's absorptive capacity, and the amount of capital involved in the investment. It is important to understand under which circumstances these benefits are maximised in order for DIT to promote FDI in the most effective manner to support and encourage economic growth and prosperity.

The report discusses the analysis undertaken to understand the impact of FDI on Great Britain's economy. This was based on a review of the economic literature to identify economic impact factors that are relevant for Great Britain in the context of FDI. The economic impact factors that have been identified are gross value added (GVA), employment, labour productivity, average annual wages and R&D expenditure. The report details the econometric methodology for the analysis which is based on firm level data and macro data covering the period between 1998 and 2014 in Great Britain for 18 ONS sector groupings.

The analysis is undertaken to assess the indirect impact of FDI. This focus reflects a decision to emphasise the spillover benefits associated with foreign direct investment, as opposed to the direct effects. In doing so, we capture one practical and three strategic advantages, associated with the indirect effect estimation compared to the direct effect estimation as detailed in Section 1.5.

In exploring the indirect effect of FDI on the economy, we first establish estimates for the elasticity of our impact variables with respect to the introduction of additional FDI projects, i.e. the percentage change in the variable following a 1% increase in the normalised FDI stock, on a national and regional level. We then transform these elasticities into absolute pound values, so as to estimate the change in the economic impact factor associated with a £1 million increase in FDI on a national level and for each sector.

We find that in almost all cases, **FDI has a net positive effect on Great Britain's economy**. At a national level, we find that, on average, FDI projects improve all five of our key economic impact factors. Specifically, a £1 million FDI project into Great Britain leads to a net increase in national levels of **GVA of around £69,000**, a net increase in **employment of around 1.3 jobs**, a net increase in **average annual wages of around £0.001**, a net increase in **ALP (which is GVA per worker) of around £0.002**, and a net increase in **R&D expenditure of around £1,700**.<sup>27</sup>

<sup>27</sup>This is the net effect including intra-mural and extra-mural R&D.

These findings, that can be attributed to respective firm level investments, can be used as an indication for the economic impact of each potential FDI project.

We can put these figures into context by broadly applying them to the observed increase in FDI stock. Over the last five years of our sample period (2010-2014) the **FDI stock in Great Britain has risen by around £270 billion**.<sup>26</sup> If we apply the evaluated change in the economic impact factors to the change in FDI stock in Great Britain, this equates to an approximate net increase in **GVA of £19 billion** and around **355,000 estimated net additional jobs**.

With regards to **average annual wages and ALP** (which is GVA per worker), **the estimated net increase corresponds to around £280 and £510 respectively**. Applying the increase in FDI stock to the total estimated evaluated **R&D** impact implies **a net increase in expenditure of around £448 million**.

As explained in earlier sections, the estimates for the analysis are derived using data for Great Britain. Assuming they are broadly similar for the UK, when including Northern Ireland,<sup>29</sup> leads to following UK-wide results: the increase in FDI stock within the UK over the last five years of available data (2012-2016) amounts to around £287 billion (Office for National Statistics 2017a).<sup>30</sup> This implies a net GVA increase of around £20 billion, an estimated 376,000 net additional jobs, a net increase of £290 in average annual wages, a net increase of £540 in ALP and an estimated additional R&D expenditure of £474 million.

## 6.2 Application

By establishing an understanding of how characteristics such as region and sector influence the efficacy of FDI in impacting key economic variables like GVA, employment, etc., we enable the government to focus attention towards investment promotion activities that maximise the positive impact on Great Britain's economy.

With global FDI flows reducing, and with governments becoming more competitive in attracting FDI, a more sophisticated and sharper operational approach to target the right inward investment has become more pertinent.<sup>29</sup> The analysis helps to ensure that DIT maximises value for money in FDI promotion activities and the UK remains competitive in the global race for FDI.

This analysis is the first step in developing an understanding of the overall economic additionality of DIT through assessing the impact of FDI projects it supports in landing. The economic impact will be identified through the suite of economic impact factors covered in the analysis of each FDI project. This can then be used to form predictive baseline impact rates to identify good value future FDI projects. Targeting DIT's efforts to FDI projects with the highest economic value addition will contribute to higher economic growth in Great Britain.

<sup>28</sup>This refers to the change in FDI stock between 2010 and 2014 in Great Britain in constant prices. See Section 4 for further details on FDI data used in this report.

<sup>29</sup>In 2017/18, only around 1% of recorded FDI projects landed in Northern Ireland (Department for International Trade 2018).

<sup>30</sup>In 2016 current prices.

<sup>31</sup>Global FDI flows fell 13% in 2016, as global economic growth remained weak and world trade volumes posted anaemic gains (UNCTAD 2017a).

Further applications of the analytical findings are:

1. **Inform the development of departmental performance metrics in FDI with a focus on economic impact and value addition;** By constructing performance metrics rooted in the economic impact factors considered in the analysis, we can encourage an impact-led approach to investment promotion. This approach would support the inclusion of the number of FDI projects and associated job creation as secondary measures and focus first and foremost on the potential economic impact.<sup>30</sup>
2. **A tool to support up-front triaging of FDI projects** using the analysed measures in addition to specialist knowledge to filter out FDI projects likely to have a negative or negligible economic impact.
3. **An outcome-based performance framework** to support internal and external reporting of DIT's results in FDI.

### 6.3 Limitations and further research

Whilst the econometric analysis provides a good indication of the impact of FDI on Great Britain, it is pertinent to highlight the limitations of the analysis. Though this report attempts to offer a modern and comprehensive approach to FDI analysis, certain abstractions were necessary in order to produce workable results. Closer inspection of these abstractions offers up a wide spectrum of additional research topics, many of which have the potential to further enrich our understanding of FDI. These extensions, aside from their academic value, offer the opportunity to improve the government's approach to investment promotion and policy formulation in FDI. Here, we point out some possible extensions and limitations of the analysis currently covered.

While the current analysis assesses the impact of FDI based on the value of the capital investment or the fixed cost of investment, it would be interesting to assess the impact also on the basis of the operating cost of the businesses or the variable cost. This can also be a pertinent predictor of the economic impact of FDI in the new modes of economic production and the digital economy with an increased shift towards 'asset-light' investment as reported in UNCTAD (2017b). Providing a toolkit for prioritising FDI promotion needs to take into account the operating costs of investors, if it is to help the government achieve its economic and industrial development targets in the context of new and emerging industrial structures.

A limitation of our analysis is the inability to distinguish between different forms of investment. Our definition of FDI captures greenfield, expansions, mergers and acquisitions (M&A) and joint venture investment projects. As a result, our analysis in its current form is unable to identify varying impacts of FDI based on the type of investment. A more granular understanding of the variation in the impact by investment type is a crucial necessity in prioritising promotion of FDI projects.<sup>33</sup>

Furthermore, as our main variable of interest is the normalised FDI stock, it is important to note that in addition to the various forms of investment listed above, stock values can also be impacted by non-transactional effects such as revaluations (exchange rate movements, revaluation of assets etc.) and corporate restructures. Our estimation results therefore not only incorporate the impact of all types of FDI, but also impacts of other non-transactional effects.

A further limitation of the current modelling approach is that it captures the indirect effect *only on an intra-sectoral basis*. If there are significant, positive *inter-sectoral* indirect effects (which the literature suggest ought to exist<sup>34</sup>), the estimates provided may be lower than the true magnitude of total spillovers. This limitation is particularly relevant in the case of sectors such as 'financial services', where there is a higher

possibility of interaction with other sectors.

Although not directly related to the scope of the current analysis, from an investment promotion perspective rooted in a 'value for money' mindset, it is vital that we determine how best to use DIT's resources in investment promotion. For this, it is important to understand the extent of the market failure and the 'additionality' of any investment promotion activity. In other words, if the government intervention did not happen, would foreign businesses undertake investment, or would the size or quality of the investment landed be inferior? This is justified by the government's obligation to focus on what the market cannot or will not deliver to maximise benefits to the taxpayer. Adopting a market failure approach means that the objective of an investment promotion policy is not simply to promote engagement with foreign investors. The objective must be to help overcome market failures and deliver impact through FDI activity above and beyond what would have happened otherwise.

Although we had initially planned to consider the effect of FDI on the UK, we were not able to obtain the necessary data to analyse the impact on Northern Ireland, so the current analysis only looks at the effect of FDI on Great Britain. We aim to source firm-level data for Northern Ireland and intend to analyse the impact of FDI on Northern Ireland, and consequently the UK.

As previously discussed, due to data disclosure issues, the analysis couldn't be carried out to examine the variation in the impact of FDI by source country. There is empirical evidence suggesting that the impacts of FDI vary depending on the source country.<sup>35</sup> These types of insights could be very helpful in informing inward FDI promotion activity. One way to potentially respond to disclosure concerns is by grouping countries together. For example, FDI originating in country groups such as Western Europe, North America, Emerging Asia, or by their economies' size, as well as other characteristics.

Finally, this report focusses on the impact of FDI on five economic measures. However, it will be important to expand the analysis and consider the impacts on a wider range of factors. In particular, as the Government is committed to delivering the UN Sustainable Development Goals (Cabinet Office 2017), it will also be vital to understand the impact of FDI on environmental and other socio-economic factors.

We intend to address some of these issues in the second phase of the analysis.

<sup>33</sup>For example, the extent to which employment in foreign-owned firms reflects the impact on employment as a result of FDI depends on whether FDI occurs through greenfield investment or M&A. Whilst greenfield FDI is generally considered to have large positive impacts, OECD (2008) suggests that cross-border M&A may also have a significant positive impact on employment.

<sup>34</sup>Javorcik (2004) on Lithuania; Blalock and Gertler (2008) on Indonesia; Kugler (2006) on Colombia; Javorcik and Spatareanu (2008) on Romania find a positive correlation between the presence of multinationals in downstream industries and the performances of domestic firms in the supplying sectors. In non-manufacturing sectors, Javorcik, et al. (2008) documents how the entry of Wal-Mart into Mexico facilitated the modernization of the retail sector and stimulated fundamental changes in the relationship between retailers and suppliers. Javorcik and Li (2013) examined how the presence of global retail chains affects firms in the supplying industries using firm level Romanian data and found that the expansion of global retail chains leads to a significant increase in the total factor productivity in the supplying industries.

<sup>35</sup>See Haskel et al (2007).

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## Annex I: Data sources

In addition to the data sources mentioned in Section 4, some economic impact factors required complementary datasets which are listed below:

- Annual Respondents Database (ONS)
- Business Enterprise Research and Development (BERD) (ONS)
- Foreign direct investment involving UK companies: Inward tables (ONS)
- FDI positions by industry (OECD)
- Structural Analysis database (STAN) (OECD)
- Gross and net capital stocks for total economy, by industry and asset (ONS)
- Value Added at factor costs (OECD)
- Unconstrained regional gross value added (production approach) reference tables (ONS)
- Labour Market Statistics time series dataset (ONS)
- Table sbs\_r\_nuts03: SBS data by NUTS 2 regions (NUTS 2006) and NACE Rev. 1.1 (1995-2007) (Eurostat)
- Table sbs\_r\_nuts06\_r2: SBS data by NUTS 2 regions and NACE Rev. 2 (from 2008 onwards) (Eurostat)
- Regional labour market statistics: HI00 Headline indicators for UK regions and countries (ONS)
- JOBS05 Workforce jobs by region and industry (seasonally adjusted) (ONS)

## Annex II: Econometric model

Further to the Fixed Effects (FE) model, pooled Ordinary Least Squares (OLS) and Random Effects (RE) were considered. The model was chosen based on the following specification tests: Breusch and Pagan Lagrange multiplier test (Pooled OLS vs. RE), and Sargan-Hansen test for over-identifying restrictions (RE vs. FE).

A number of models were estimated in which greater or fewer lags of the variable of interest (normalised sector-level FDI) were included to test over which time horizon indirect effects are realised. Seven models were estimated in total: in four models, either the contemporaneous, first, second or third lag of sector-level FDI normalised by GVA was used; in an additional three models, the contemporaneous normalised sector-level FDI variable was used and either one, two or three lagged terms.

Model performance was judged based on whether additional lagged terms increased the explanatory power of the model (i.e. whether the term was statistically significant) and through a comparison of information criteria across the models.

In general, it was found that across the different economic impact factors, the model including the contemporaneous normalised sector-level FDI variable and two lags performed the best. This result suggests that indirect effects are manifested mostly by the end of the second year since the FDI has taken place.

### Annex III: Evaluation of indirect impacts

In order to obtain a £ value of the indirect impact of FDI per £1 million investment, the elasticities estimated in Section 3.2.1 are evaluated at national (and sector) level using the following steps:

1. Obtain the percentage increase in FDI stock represented by a £1 million investment for each year (and sector) (£1 million / FDI stock (in the sector)).
2. Multiply the elasticities by the percentage increase in FDI represented by a £1 million investment (step 1) – this represents the percentage increase in the economic impact factor (e.g. GVA) brought about by a £1 million investment.
3. Multiply the percentage increase in the economic impact factor brought about by a £1 million investment (step 2) by the level of the economic impact factor in each year (and for each sector) – this represents the absolute £ increase in the economic impact factor brought about by a £1 million investment.

The three steps can be represented through the following equation:

4. The above steps give us a time-series of evaluated indirect effects nationally (and for each sector) for the years 2010 to 2014. We then take a three-year moving average of the evaluated indirect effects, followed by a simple three-year average.

$$\begin{aligned}
 & \textit{Indirect impact following £1 million investment} \\
 & = \% \textit{ increase in FDI stock associated with £1 million investment} \\
 & \times \textit{ Impact of FDI on economic impact factor } (\approx \textit{ elasticity}) \\
 & \times \textit{ Level of economic impact factor}
 \end{aligned}$$

## **Annex IV: ONS sector groupings**

### **Agriculture, forestry and fishing**

**010** Crop and Animal and Production, hunting and related services activities

**020** Forestry and Logging

**030** Fishing and Aquaculture

### **Mining and quarrying (including oil and gas production)**

**050** Mining of coal and lignite

**060** Extraction of crude petroleum and natural gas

**070** Mining of metal ores (ferrous and nonferrous including Uranium and Thorium)

**080** Mining and Quarrying - other

**090** Mining and oil gas extraction - support service activities daily

### **Food products, beverages and tobacco products**

**100** Manufacture of food products

**110** Manufacture of beverages

**120** Manufacture of tobacco products

### **Textiles and wood activities**

**130** Manufacture of textiles

**140** Manufacture of wearing apparel

**160** Manufacture of wood and wood products (except furniture), straw articles and plaiting materials

**170** Manufacture of paper and paper products

**180** Printing and reproduction of recorded media

### **Petroleum, chemicals, pharmaceutical rubber and plastic products**

**190** Manufacture of coke and refined petroleum products

**200** Manufacture of chemicals and chemical products (non pharmaceutical)

**210** Manufacture of basic pharmaceuticals products and pharmaceutical preparations

**220** Manufacture of rubber and plastic products

### **Metal and machinery products**

**240** Manufacture of basic metals (including first processing, e.g. tubes, pipes, hollow profiles etc)

**250** Manufacture of fabricated metal products (excluding machinery & equipment)

**280** Manufacture of machinery not elsewhere classified

## **Computer, electronic and optical products**

- 260** Manufacture of computer, consumer electronic and optical products
- 261** Manufacture of electronic components
- 262** Manufacture of loaded electronic boards
- 263** Manufacture of communication equipment
- 264** Manufacture of consumer electronics
- 265** Manufacture of instruments and appliances for measuring, testing and navigation: watches and clocks
- 266** Manufacture of irradiation, electro medical and electrotherapeutic equipment
- 267** Manufacture of optical instruments and photographic equipment
- 268** Manufacture of magnetic and optical media

## **Transport equipment**

- 290** Manufacture of motor vehicles, trailers and semi-trailers
- 300** Manufacture of other transport equipment
- 301** Building and shipping and boats
- 302** Manufacture of railway locomotives and rolling stock machinery
- 303** Manufacture of air and spacecraft and related
- 304** Manufacture of military
- 309** Manufacture of transport equipment not fighting vehicles elsewhere classified

## **Other manufacturing**

- 150** Manufacture of leather and other related products
- 230** Manufacture of other non-metallic mineral products
- 270** Manufacture electrical equipment (*including* domestic appliances)
- 310** Manufacture of furniture (domestic and non-domestic)
- 320** Manufacturing of other articles not elsewhere specified (toys, jewellery, musical instruments, sports goods, dental supplies, brooms and brushes)
- 330** Repair, maintenance and installation of machinery and equipment

## **Electricity, gas, water and waste**

- 350** Supply of electricity, gas, steam and air conditioning
- 360** Water collection, treatment and supply services
- 370** Sewerage services
- 380** Waste collection, treatment, disposal recycling services
- 390** Remediation and other waste management services not elsewhere specified

**Construction**

**410** Construction of buildings (residential, non-residential, commercial, development of building projects)

**420** Civil engineering (roads, railways, utilities and water projects, other civil engineering projects)

**430** Specialised construction activities (demolition and site preparation, wet and dry trade activities, other construction activities)

**Retail and wholesale trade, repair of motor vehicles and motorcycles**

**450** Wholesale and retail trade, repair of motor vehicles and motorcycles and accessories

**460** Wholesale trades (excluding motor vehicles and motorcycles)

**470** Retail trade (excluding motor vehicles and motorcycles)

**Transportation and storage**

**490** Transport on land (including pipelines)

**500** Transport on water (sea, coastal and inland)

**510** Transport in the air (passenger and freight)

**520** Transport support activities (warehousing, operation of terminals and stations, cargo handling)

**530** Postal & courier activities

**Information and communication**

**580** Publishing activities (books, newspapers, periodicals directories, software)

**590** Motion picture, video and TV production, sound recording and publishing activities

**600** Programming and broadcasting activities of radio and TV (over air or via satellite, cable or internet)

**610** Telecommunications activities (wired, wireless, satellite and other telecommunications activities)

**620** Computer programming, consultancy and related activities (games, software development, programming, computer facilities management)

**630** Information services activities (data processing and hosting, web portals, news agencies, other information activities)

**Financial services**

**641** Banks (64.11 and 64.191)

**642** Building societies (64.192)

**643** Non Financial holding companies only (64.201/4)

**644** Financial holding companies only (64.205)

**645** Other financial services trusts and funds

**651** Life insurance only (65.11)

**652** General insurance, reinsurance and pensions funding (65.12, 65.2, 65.3)

**661** Security dealing for others only (66.12)

**662** Financial services (services auxiliary to financial services and insurance activities excluding security dealing)

**663** Fund managers

### **Professional, scientific and technical activities**

**691** Legal activities

**692** Accounting activities

**701** Head office activities

**702** Management consultancy activities (public relations, financial management, consultancy and management activities)

**710** Architectural and engineering activities (architecture, urban planning, engineering consultancy, testing and analysis)

**720** Scientific research and development (biotechnology, natural sciences, engineering, social sciences and humanities)

**731** Advertising

**732** Market research (market research, opinion polls, media representation)

**740** Design, photography, translation and other professional, scientific and technical services

**750** Veterinary activities

### **Administration and support service activities**

**770** Rental and leasing activities (motor vehicles, personal and household goods, intellectual property - excluding copyrighted works)

**780** Employment activities (employment agencies, entertainment castings, other human resources activities)

**790** Travel agencies, tour operators, other reservation service activities

**800** Security and investigation activities (investigation, private security, security systems)

**810** Services to buildings and landscape activities (facilities support, cleaning, disinfection and extermination, landscaping)

**820** Office administrations, support and other business support activities (document preparation, call centres, conference organisers, collection agencies, packaging, other support activities)

### **Other services**

**550** Accommodation (hotels, holiday accommodation, hostels, camping, other)

**560** Food and beverage service activities (restaurants, takeaways, catering, pubs, clubs, other food service activities not elsewhere specified)

**680** Real estate activities

**840** Public administration, compulsory social security

**850** Education (primary, secondary and higher education, driving schools, sports education, cultural education, educational support)

**860** Human health defence, activities (hospitals, nursing homes, general and specialist medical practice, dental practice)

**870** Residential care activities

**880** Social work activities without accommodations (elderly, children, other social work activities)

**900** Creative arts and entertainment activities (performing arts, operation of arts facilities, artistic creation, support of performing arts)

**910** Libraries, archives, museums and other cultural activities (botanical, zoological nature reserve sites, historical buildings and sites)

The UK's Department for International Trade (DIT) has overall responsibility for promoting UK trade across the world and attracting foreign investment to our economy. We are a specialised government body with responsibility for negotiating international trade policy, supporting business, as well as delivering an outward-looking trade diplomacy strategy.

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