# "Evaluating the impact of UKTI trade services on the performance of supported firms"

## Report to UK Trade and Investment

**Ana Rincón-Aznar, Rebecca Riley and Anna Rosso**[1]

**THE NATIONAL INSTITUTE OF ECONOMIC AND SOCIAL RESEARCH**
**2 Dean Trench Street**
**Smith Square**
**London SW1P 3HE**

**20th September 2015**

[1] We are grateful to Professor Davide Castellani at University of Perugia for advice during the project.

# Contents

# 1. Executive summary

UK Trade and Investment (UKTI) provides a range of services to help UK firms export or expanding their exports. The main objective of this study is to investigate the impact that UKTI help has had on the performance of businesses that take up these services.

This research builds on the methodology and results of earlier evaluation studies that assess the impact of selected UKTI services (Breinlich et al 2012; Helmers and Rogers, 2010). This research aims to broaden the scope of these previous analyses in various ways. We consider a wider range of UKTI services than ever analysed before. This is the first evaluation study that is able to consider the full range of UKTI services, a total of thirty-two different UKTI service categories. The richness of these data allows us to assess the implications of participating in specific services, the high-intensity support services, as well as assessing the effects of using UKTI support multiple times compared to a more isolated participation. In this evaluation we are also able to provide evidence for a more extended and recent time period, covering support provided by UKTI between 2005 and 2010.

The following research questions address the key contents of the study:

I. *Are firms that receive UKTI support significantly different from those that do not use these services?*
II. *To what extent do firms that receive UKTI support differ from non-users, in terms of turnover and employment size, sector, region, and indicators of international activity IP ownership, and productivity?*
III. *Are firms who use UKTI services multiple times different from those using the services only once?*
IV. *What is the impact of UKTI support on the performance of firms that participate in the programmes? We aim to study the effects on the following performance measures:*
    a. *Growth in turnover.*
    b. *Growth in employment.*
    c. *Growth in productivity.*
    d. *Growth of overseas turnover.*
    e. *Probability of reporting overseas turnover.*
    f. *Probability of survival.*
V. *To what extent does the use of UKTI services multiple times enhance the impact on business performance?*
VI. *To what extent does the participation in high-intensity programmes enhance the impact on business performance?*
VII. *What is the likely effect of UKTI support on UK firms on the UK economy, beyond the effects on the participant firms?*

The first step in this study was to compile a comprehensive firm-level dataset of UKTI *users* and *non-users by* linking various data sources a) the UKTI client dataset, b) the FAME

database – our source of financial information and c) the Intellectual Property Office dataset – which is our source of firms' IP activities. In the first part of the study we compare companies that benefit from UKTI support, against those that do not. We present a range of descriptive statistics, and a multivariate statistical analysis.

We found that UKTI firms tend to be larger, older, more productive and more intensively engaged in international and IP activities than non-users. This is in line with prior evidence (Breinlich et al, 2012; Helmers and Rogers, 2010). UKTI users are also more likely to be located in London and the South East, and two thirds belong to services sector.

We find firms that use UKTI services multiple times also present different characteristics to those that use UKTI services just once. Multiple users of UKTI services are larger, more productive and more likely to be engaged in IP activities than firms that participate only once. Multiple UKTI users, however, do not significantly differ in terms of age and multinational status from single users, and are less likely to be foreign owned.

When evaluating the effect of UKTI support on firm performance, the main difficulty lies in that UKTI users are not a random sample of UK firms; this presents a key challenge to estimating the causal effects that UKTI support has on firms' performance. Our evaluation exercise relies on the comparison of the performance of UKTI users relative to a group of non-users taking into account these selective participation effects, as otherwise we would be obtaining a biased picture of how UKTI support influences firms' outcomes. If UKTI users are larger or more productive than other firms before accessing UKTI support, they may also perform better, regardless of whether UKTI support has made any difference to their performance.

The effect of UKTI support is evaluated by comparing the performance of UKTI users relative to a benchmark group: a group of non-users that closely resemble the characteristics of UKTI users. The objective is to proxy *what would have happened* if firms had not received UKTI support. The identification of this *counterfactual group* is achieved using a *propensity score matching* technique; differences in average growth performance between users and non-users are attributed to the influence of UKTI support.

A caveat of this approach is that firms are likely to respond to a policy intervention in different ways, so there will be other sources of unobserved factors determining firms' growth outcomes and that cannot be fully controlled for. To minimise this problem, in this study we use a *Difference-in-Differences estimator in combination with the propensity score matching estimator.* This is intended to control for growth differences between users and non-users that were present before UKTI support. The availability of several years of data is of great importance for undertaking this type of analysis, as it enables us to track firm performance for a number of years before and after participation in the support schemes.

Our findings suggest that business performance improved in the aftermath of receiving support. We have found that UKTI support had a positive impact on turnover growth and a

more modest impact on labour productivity growth; the effects on employment expansion do not appear statistically significant. We have also found that UKTI support is positively linked with firm survival and an improvement in overseas turnover. Prior evaluations, which compared the performance of UKTI users *vs* non-users during a shorter time period, also showed evidence of positive impacts of UKTI support on a number of firm outcomes (Breinlich et al, 2012; Rogers and Helmers, 2010).

Our results suggest that participation in UKTI support schemes multiple times may lead to greater improvements in performance for firms, especially for those participating more than five times, but given the limited statistical significance we need to be cautious in interpreting the findings.

Beyond the effects on the supported firms, UKTI support can also have indirect impacts on the aggregate economy, mainly through *dynamic competition* effects. By affecting the survival of firms, UKTI support may have a significant effect on the composition of the business population. Identifying the extent of these impacts across the wider economy is however an ambitious exercise, given the limited scope for using the FAME database to capture developments in the aggregate UK economy. Our findings, which only will apply to our sample of firms, point to positive aggregate effects of UKTI support, as a consequence of within-firm productivity gains and reallocation of market share towards the group of supported firms.

## 2. Introduction

2.1 This report describes in detail the results of the project *"Evaluating the Impact of UKTI Services on Business Performance"*, undertaken by The National Institute of Economic and Social Research during the period September 2013 - March 2014.

The project aims to meet two main objectives. First we aim to understand whether, and to what extent, UK Trade and Investment (UKTI) support improves the performance of firms that receive such support. Performance is measured in terms of a range of key economic outcomes, such as growth in turnover, growth in overseas turnover, growth in the value of assets, growth in employment, growth in productivity and the likelihood of survival. We undertake robust estimation of the partial effects that support has on this array of performance indicators; discussing the channels by which these effects can occur is beyond the scope of this project. Second, we aim to understand whether UKTI support received by firms may have wider economic effects.

2.2 In section 2 of the report we summarise in detail the UKTI client database and other data sources used in this study. The database covered an extended period of time, including support provided between 2005 and 2010, and a wider range of UKTI services than ever analysed before.

2.3 In section 3 we provide an overview of all the data sources used in the study: the UKTI client database, the FAME database and the Intellectual Property Office data.

2.4 In section 4 we summarise the main methods used in matching the UKTI client data to other sources of firm information used in the study, describing in detail the process of "string matching" used to identify UKTI users across the other datasets.

2.5 In the descriptive part of the report (section 5) we draw a picture of UKTI users and establish a comparison between firms that use UKTI services and those that do not use them, in terms of employment size, turnover and asset value, age, intellectual property activities and international dimension. Using a range of multivariate statistical techniques we are able to investigate in detail which are the main features and characteristics of firms more strongly associated with the probability of receiving UKTI support.

2.6 In the econometric part (Section 6), we investigate the influence of UKTI support on growth results of firms by comparing economic outcomes of supported firms *vs*. those that do not receive such support. We use a propensity score matching estimation technique to evaluate the impact of taking up UKTI support on business outcomes (Breinlich et al, 2013). In addition, *we combine the propensity score matching estimator*, with a *Difference-in Differences estimator* to test the sensitivity of results to the choice of estimator. We undertake different robustness tests and evaluate the impact of UKTI support on different samples.

2.7. In section 7 we assess the implications of UKTI support at an aggregate level, and describe overall labour productivity performance of UKTI supported and non-supported firms.

2.8 In section 8 we draw the main conclusions of the study, focusing on the estimated impact that UKTI support has had on an array of business performance measures. We compare our baseline analysis with other relevant questions of interest to policy-makers; for example we address whether UKTI support has had a different impact on larger firms relative to smaller firms, and whether the participation in high-intensity UKTI services and multiple participation has brought about substantially larger benefits to firms.

## 3. The data

The first step in this research was to compile a comprehensive firm-level dataset containing information on the use of UKTI services by firms during the period 2005-2010, as well as on firms' financial information and intellectual property (IP) activities over the same time period. In this section we describe the main data sources used, which were: a) the UKTI client data, b) the FAME database and c) the intellectual property data, provided to us by the UK's Intellectual Property Office (IPO). We describe the main features of these databases and the methodology followed to merge these, and highlight the main issues that have arisen in the construction of the full dataset.

## 3.1. The UKTI support data

UKTI keeps a record of all the support it has provided and to whom it was provided. The UKTI client data we use contained a total of 212,203 records (a record refers to a company, UKTI service, and time period combination), corresponding to help provided by UKTI to UK-based companies during the period 2005 to 2010. This time period corresponds to PIMS[2] waves 3-22. The data was provided to us by OMB Research[3] who processes the information they receive on a quarterly basis from UKTI. These observations correspond to all instances where companies receive support from UKTI.

The files include detailed information about the companies accessing UKTI support, mainly the name of the companies, and other contact details (e.g. postcode, address, telephone, details of the contact person). In addition, the files contained information on the type of the UKTI support programme as well as the timing.

The data provided by OMB Research spans between May 2005 and September 2010. Table 1 shows the distribution of UKTI records by year for the period 2005 to 2010. The number of records for the year 2009-2010 (57,922) is more than twice the number of records corresponding to the period 2006-2007 (27,683). Records pertaining to the last two waves (2008/2009 and 2009/2010) represent over 50 per cent of records for the whole period. Firms can appear multiple times in the dataset as they can take up support in different years and can obtain a variety of different services. In fact, the total number of records (212,203) reflects the participation of 65,423 unique firms. Table 1 also contains information on the number of supported firms. The number of UKTI users has also been increasing over time. The number of firms supported in the earlier periods (2005/2006 and 2006/2007) was considerably lower than in later periods; while during the year 2005/2006 just over 18,000 firms participated, in the 2009/2010 the number of participating firms reached 31,000.

[2] The Performance and Impact Monitoring Survey (PIMS) is a client interview-based survey that provides evidence about the quality of service and about the difference that UKTI makes to business. PIMS is carried out by an independent market research company (OMB) specialising in business surveys. The survey is based on independent telephone interviews with a sample of users of UKTI's principal services. It is done on a quarterly basis.

[3] These data was facilitated by OMB research. We are grateful to James Murray for his assistance with these data.

Table 1. Distribution of UKTI records across years, 2005-2010.

| *Year* | *UKTI Records (% of total)* | *Number of supported firms* |
|---|---|---|
| 2005/2006 | 29,425 (13.87%) | 18,011 |
| 2006/2007 | 27,683 (13.05%) | 16,220 |
| 2007/2008 | 40,810 (19,23%) | 20,739 |
| 2008/2009 | 56,363 (26,56%) | 26,384 |
| 2009/2010 | 57,922 (27,30%) | 31,304 |

The UKTI client data captures the participation of businesses in a total of 32 different services. Figure A.1 in the appendix illustrates the distribution of the total number of records (212,203) across the different services.

The bars illustrate the percentage that each of the services represents over the total. Participation was relatively unbalanced, with UKTI support largely concentrated in a few services. In fact, twenty of these thirty-two services account for less than 2% of the total number of interventions. Below we summarise the most commonly used services and provide a brief description of their objectives.

- The most used service was **Post Significant Assists**, which accounted for just over 26% of all UKTI records during the period 2005-2010. This service is defined as "*one-to-one support provided by staff at British embassies/consulates overseas. The contact could have been by any method, including e-mail or while attending a larger event".*
- The second most prevalent service in our data is the **English Regions Trade Advisors Significant Assists (ERTA)**, which consists of *"Support and/or advice given by international trade advisors working in the English regions"*. It represents 11% of all recorded help.
- The third most important service in our data is **TAP (Tradeshow Access Program) group**, which accounts for 8.6% of all records. It refers to "*Grant support for eligible SME firms to attend trade shows/fairs overseas".*
- The **Overseas Market Introduction Service (OMIS)**[4] accounts for 7% for all records. Within this service "A*dvice is provided to firms about a market (e.g. analysis of possible market entry strategies, identification of possible business partners)".*

[4] The Breinlich et al (2012) study focuses on OMIS and other support programmes such as Market Visit Support Programme, Passport to Export and International Trade Advisors in the English Regions.

- **English Regions' Events** account for 6.5% of the total number of records. These are "E*vents arranged by UKTI's regional teams to provide advice on business opportunities overseas"*.
- **Inward missions**: This service accounts for 4.1% of all records. It consists of "M*eetings in the UK with overseas businesses".*
- **Passport to Export**[5] accounts for 4% of all records. This is a "S*cheme aimed at helping businesses who are either new to exporting or fairly inexperienced exporters (readiness assessment and an export plan, services aimed at helping firms to research and visit prospective overseas markets)"*.
- Other services were (percentage that they represent of the total number of records given in brackets): **Post events** (3.6%), **Sector Events Abroad** (3%), **New to Export Assists** (2.3%), **Outward Missions** (2.2%), **Market Visit Support** (2.2%), **TAP Solo** (1.8%), **International Business specialists** (1.6%), **CBBC Significant assists** (1.3%).
- There are nineteen services that account for less than 1% of the total records. In this group we have the following services: **Special Reports** (0.7%), **Exports Communication Review** (0.6%), **Gateway to Global Growth** (0.6%), **Export Market Review Service** (0.5%), **TAP Non-funded** (0.4%) etc.

## 3.2. Companies' economic performance: The FAME database

The FAME (Financial Analysis Made Easy) database is a commercial database developed by *Bureau van Dijk* that provides comprehensive financial information for UK companies every year. FAME contains a rich array of financial variables as filed at Companies House; it also provides other background information on variables such as size, age, ownership, industry, and location, allowing us to compile a detailed picture of UK companies. The list of variables that are most useful for our analysis includes: annual turnover, overseas turnover, the total value of assets of a firm, the total number of employees and profitability. For the purpose of this analysis, we have extracted information on FAME for the financial years 2004-2005 to 2011-2012.

One of the main drawbacks of using the FAME database, however, is that for many of the companies registered with Companies House there are no (or minimal) reporting requirements and therefore key information is often missing. Reporting requirements are lighter for small companies[6] and as a result the sub-set of firms for which we can observe performance measures, such as turnover (and overseas turnover), employment and profits is heavily biased towards large companies. In other words, small companies (some of which receive UKTI support) will tend to be under-represented in the database we use. Some small companies do submit full accounts to Companies House. However, these are unlikely to

[5] The Rogers and Helmers (2010)'s study covers Passport to Export scheme and the Export Marketing Research Scheme (EMRS).
[6] Whether a company is small or not is determined by their employment, turnover and/or balance sheet totals.

constitute a representative sample of the spectrum of small companies[7]. The FAME database contains information for the majority of companies only on few variables: total assets, their industry (this is self-reported), their postcode, age, number and country of foreign subsidiaries, nationality of ultimate owner, and survival (date of exiting the market).

In order to obtain accurate company information on an annual basis, we extracted annual snapshots of the data from annual historical discs provided by *Bureau van Dijk*. This way we capture changes in industry and ownership structures and are able to proxy a live register of UK companies over time[8]. We identify FDI from changes in nationality of ownership. We identify subsidiaries in order to avoid double counting company activity (companies may file group (consolidated) and individual (unconsolidated) accounts, and to measure internationalisation of activities of UK companies. Overseas turnover may relate to export activity or the turnover of foreign subsidiaries. While we cannot accurately distinguish between the two, we can observe whether or not a UK-owned firm owns a foreign subsidiary.

### 3.3. Intellectual property data (IPO)

Information on intellectual property activities of UK companies was provided to us by the UK's Intellectual Property Office[9]. The data includes patents and trademarks granted to UK companies for the period 1995-2013. The data contains UK-based IP data, but also includes international information from the European Patent Office (EPO) patents, Patent Cooperation Treaty (PTC) patents and European Community trademarks and designs.

The link between intellectual property, UKTI support and exporting activity is of high policy relevance and has been explored in detail in prior studies (Rogers and Helmers, 2010; Breinlich et al, 2012; Sena et al, 2011). While the analysis of the relationship between a firm's innovation output (proxied often in the literature by the number of patents and trademarks) and firms' performance is not the main subject of this research, the information on intellectual property attained by UK firms will be a fundamental control variable in our econometric analysis. Firm data on innovation and performance captures a large degree of the heterogeneity of behaviour and capabilities between individual companies.

## 4. Matching datasets

The first step in the data linking exercise was to try to identify each UKTI users amongst the larger population of UK registered companies using the FAME database. The main difficulty in combining the UKTI and FAME datasets was identifying uniquely companies in both

[7] It is difficult to rectify this selection issue - the selection of small companies into the full accounting sample- as we do not know much about those companies that do not provide the full accounts.
[8] The internet version of the data removes some, but not all, companies that have been inactive for 4 years.
[9] We want to thank Tony Clayton, Peter Evans and Dominic Webber at the IPO for providing assistance with these data.

datasets. This was the most challenging and important part of the data processing exercise as we had to rely on the company name (and to a lesser extent on the postcode) to construct a reliable match of firms across the two datasets. Section 4.1 below explains details of the matching methodology we followed which is in many ways similar to the method used in Breinlich et al (2012).

After undertaking a two-way merging of UKTI and FAME datasets we added a third data set by merging the information on the companies' IP activities (IPO data). The linking to the IPO data was a much more straightforward exercise, as the data developed by IPO included the actual Companies House' registration numbers which allowed us to match these data directly to FAME.

### 4.1. Matching methodology

In order to link UKTI client records data with the FAME database we implemented a "string" matching exercise using the companies' names[10]. String matching was complicated by differences in the reported name of a company across the two datasets. The name of a company may be recorded differently in the two datasets. First, and most importantly, UKTI does not necessarily record the name with which the company is registered within Companies House. Moreover, names are often misspelled; the affixes attached to the name, identifying the legal status of the company (ltd, plc, llp), are only recorded using acronyms or may not be reported at all; an additional problem arises when companies change their name over time.

The above issues can lead to two important types of problems. First, we may incorrectly match two different companies with similar names (this is what we call risk of false matching). Second, we may not be able to match some companies at all. Because we are interested in the effect that UKTI support has on the company performance, the correct identification of treated *vs*. non-treated companies is crucial for the correct interpretation of the estimates of the average treatment effect[11].

In order to deal with the above problems, we harmonised company names in the two datasets so they were as similar as possible[12]. We thus created a cleaning algorithm, in several steps, allowing us to minimise the occurrence of both false matching and mis-matching problems.

[10] We could potentially use phone numbers or name of the reference person given for the company, yet there are some issues; the phone number is often missing and the name of the reference person reported in FAME is usually the one of the director, which is not necessarily the name of the person that UKTI has contact with.
[11] The term "treatment" is used in the evaluation literature referring to those individuals (or firms) participating in a programme.
[12] The alternative would be to manually match the two datasets, but given the large number of companies in the UKTI dataset, this is not feasible, nor efficient.

The UKTI data, supplied to us by OMB research, contained an additional unique identifier (DUPE number) assigned to each company which had received a service[13]. These company identifiers were held constant within each company (across different periods of time and different programme participation). This allowed us to distinguish companies who formally changed their names or simply reported a different name for a different service/period[14]. This information was very useful when constructing the dataset of treated companies, minimising the probability of not finding a match at all for some companies.

*The Matching Algorithm*

First of all, the algorithm standardized all the company names, so that in both datasets these were shown in lower case. We then removed all the punctuation (commas, brackets, double spaces, etc.) and the articles (the, and, &). We had to ensure that all the affixes reported at the end of the name were harmonized across the two datasets: "limited" became "ltd", "public limited company" became "plc" (and similarly for llp and co[15]). The first round of matching was performed using only the company names with no restriction on the year in which the company was observed. No other company information was used at this stage. This first algorithm allowed us to match companies even if in a particular year a dataset recorded a change in company name while in the other dataset the old name was still being reported. We then used the information on the registration numbers (for FAME) and the DUPE numbers (available in the UKTI dataset) in order to assign the relevant information to the yearly observation in which the company received treatment.

After the first round of matching, we were able to match just under 60% of the observations in the original UKTI client dataset. We then implemented a second algorithm using the observations that had not been paired during the first round of matching. This second algorithm is less restrictive than the first one, in the sense that less information from the company name is used (i.e. the legal status is now removed completely from the name[16]). But this means that the risk of classifying companies that did not receive UKTI support (non-treated) as companies that did receive support (treated) becomes higher, thus creating some measurement error. This second matching algorithm also uses the postcode “sector” information (that is, the first four digits of the full postcode) to minimise risk of false matching after removing important information from the company's name.

The second round allowed us to improve the matching rate, that is, the percentage of observations from the UKTI dataset that we are able to observe in FAME. The matching rate was now 68.3%.

[13] For some companies the information is missing. When the DUPE number is not present, it is assumed that the company has only that single observation in the dataset, and therefore can still be uniquely identified.
[14] The service may be given to a branch of the parent company which may have a slight different name but is not financially independent from the parent company.
[15] This cleaning exercise is performed using the statistical package R which is more flexible and computationally faster than other similar programmes.
[16] Note that a lot of companies in the UKTI dataset simply do not report an affix next to the name at all.

The linking of the third data set, the IPO dataset, turned out to be a simpler exercise as the data made available to us contained the companies' registration numbers. We were provided with the registration numbers of companies that have obtained patents and trademarks during the period 1995-2012 (a total of 211,876 records). We also had information on the patent publication date (from which we then derived the year) and the patent publication number. We were provided with a separate look-up file containing information on the patent publication numbers and the corresponding FAME id (company registration number) for a total of 56,703 records. Of these, we were able to successfully match to FAME a total of 45,611 observations[17].

The main challenge of the data linking exercise was being able to the identify correctly the UKTI users in the FAME database. As UKTI does not record the Company House identifier of each user, we need to rely largely on the information on the name of the companies. Achieving a good proportion of matches depends on the ability of researchers to apply text mining techniques to identify companies across datasets. Given the absence of a direct link to FAME, the data linking exercise could be made easier for future researchers if UKTI was able to record the users' names using similar formatting guidelines to those in Company House data. A better recording of addresses and postcodes would also be helpful. It is convenient to bear in mind, however, that a full identification of UKTI users is not feasible in this type of framework, as many of UKTI small users that are not obliged to report to Companies House would be excluded from our analysis.

## 4.2. Results of the matching exercise

In this section we summarise the results of the matching exercise between FAME and the UKTI dataset, using the methodology detailed in section 4.1. In addition to locating the firms across the datasets, it was also important to take into account the time structure of the data. Therefore, we drew a correspondence between the timing of each of the support programs and the different annual observations in FAME; this will be a crucial step later on when establishing the link between the intervention and its impact on growth outcomes. The matching procedure thus had to ensure that the each UKTI record was paired with the correct annual observation in FAME.

Table A.3a in the Appendix shows the timing of each of the PIMS waves, which have a quarterly frequency. The first PIMS wave (Wave 3) refers to the period October to December 2005 for the majority of UKTI schemes. The last PIMS wave included in this research - Wave 22- took place between July 2010 and September 2010. Two exceptions are the Passport and Gateway to Global Growth schemes, which differ slightly in terms of timing, in comparison to the rest of the programmes. These two services have different start

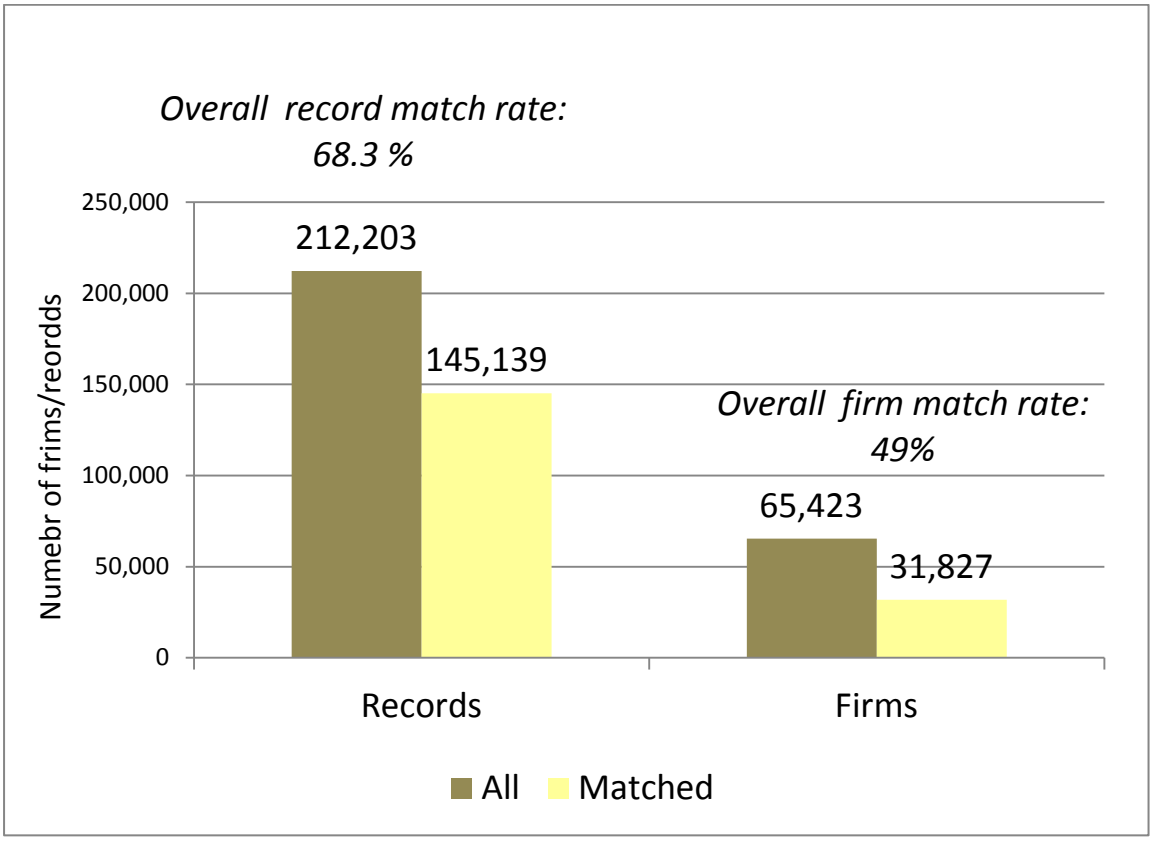
[17] This is because some of the records in the look up file belonged to an earlier or later period than the one considered in this study.

and finish periods, with PIMS Wave 3 taking place between May and July 2005 and PIMS Wave 22 between January and March 2010.

Tables A.3b-A.3c in the Appendix show details of the correspondence between the timing of the different programs (which have a quarterly frequency) and the corresponding yearly observations of the companies in the FAME database (based on financial year). For example, we can see that PIMS Waves 3 and 4 took place between October 2005 and March 2006; this time period falls within financial year 2005-2006 (which spans from April 2005 and March 2006). The following PIMS Waves (5, 6, 7, and 8) were then matched to financial year 2006-2007. For two of the programmes however (GGG and Passport) the timing was slightly different and all 3, 4, 5 and 6 fell within the first financial year of our sample, 2005-2006. This detailed matching ensured that we paired each UKTI observation with its contemporaneous financial information.

The total number of annual UKTI records that we were able to link to FAME was 145,139 (out of the 212,202 original records). This corresponds to a match rate of 68.3%. When considering the number of firms, the percentage of successful matches was lower, at just under fifty per cent. The exact number of firms that we matched was 31,827, out of a total number of 65,423. The reason why we match a lower number of firms than records is that many of the matched companies have several entries in the UKTI data. See Figure 1 below for an illustration of the match rate, both in terms of the total number of records and in terms of the number of firms.

Figure 1. Overall match rate (Percentage of UKTI firms for which we were able to find a match in the FAME database).

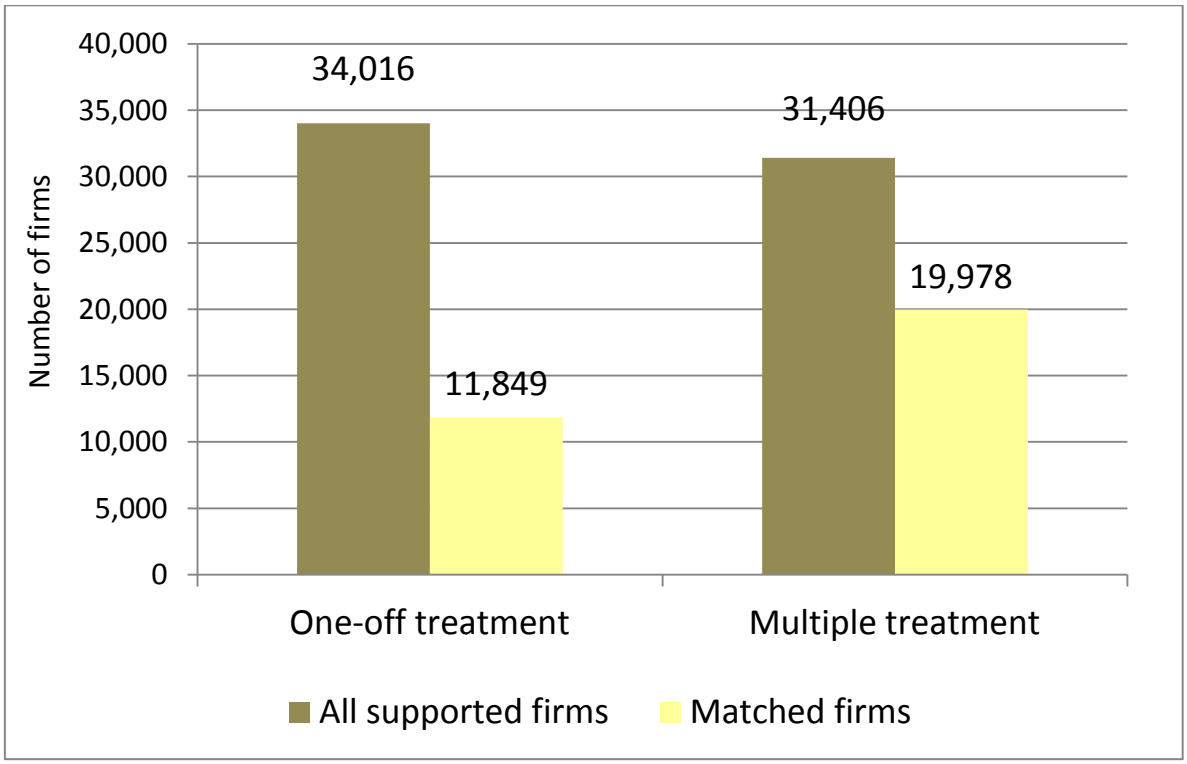



The UKTI-FAME match rate was not the same across different UKTI services, and we were more successful at finding a FAME match for companies receiving certain UKTI services than others. Figure A.2 in the Appendix shows the variation in the match rate across the range of services provided by UKTI. **OMIS** (77.4%), **TAP group** (74.5%), **TAP solo** (75.6%) and **Export Market Research Service** (EMRS) (79.1%) have a higher match rate. Interestingly, **Post Significant Assists**, the service accounting for the largest share of UKTI records, shows a below-average match rate, at 65.7%. For schemes such as **Passport** (64%), and the **English Regions Trade Advisors** (66.1%) the match rate was also below the overall rate. Table A.2 in the Appendix contains detailed match rates by service type. While the match rate varies by service, the only programme for which we could identify less than 60% of records on average was **R&D events** (56.5%), which is a service of relatively little incidence (0.2 % of all records) and was only provided between October 2007 and September 2009.

The match rate varies also when looking at individual years as we do not observe the same firms in all waves (see table A.2 in the Appendix). For example, in the case of the Post Significant Assists the match rate has improved in recent years.

Figure 2 shows the match rate for two types of supported firms: those that received treatment (UKTI support) only once, and those that received it more than once. The number of firms in our sample that received treatment only once was 11,840, and the number of firms that receive treatment more than once was 19,978. The total number of firms is 31,827. As expected, the proportion of multiple users that were matched was higher relative to single users. The percentage of multiple users that we were able to match was 63%, while the percentage of the single users was around 35%.

Figure 2. Percentage of UKTI observations for which we were able to find a match in the FAME database; by multiple and single treatment; 2005-2010.




## 4.3. Characteristics of the matched sample

### 4.3.1 Distribution of UKTI matched firms by year

As discussed in section 4.2, we achieved an overall 68.3% match rate. Table 2 contains the distribution of `matched' UKTI client and FAME records across PIMS waves (as shown in table 1 for the raw client data) by year. Each of the first two years -2005/2006 and 2006/2007- accounts for approximately 13% of all records. The number of records increased over time and we can see that a larger number of records belong to later years, in particular to 2008/2009 (representing 26% of all matched records) and 2009/2010 (27.3% of all matched records). Reassuringly, the distribution of `matched' records is very close to that of the original set of records. In terms of firms, the number of matched firms in 2008/2009 was

14,612, of a total of 26,384 firms (or 55% match rate), and the number of matched firms in 2009/2010 was 14,281 out of a total of 31,304 (46% match rate). The number of unique companies that we were able to match was higher in the most recent years. Figure A.3 shows the distribution of matched records across the different UKTI services.

Table 2. Distribution of UKTI `matched' records across years, 2005-2010.

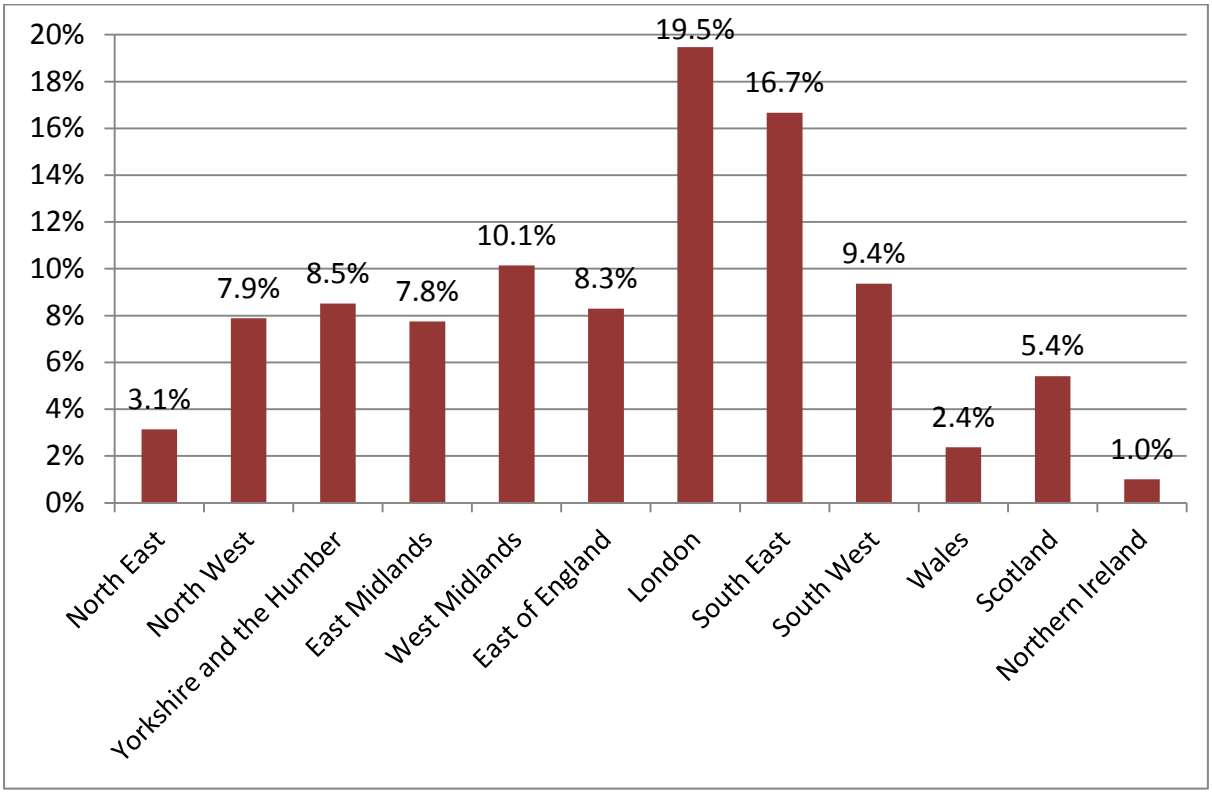
| *Year* | *Records* *(% of total)* | *Number of supported firms* |
|---|---|---|
| 2005/2006 | 20,010 (13.8%) | 9,842 |
| 2006/2007 | 19,338 (13.3%) | 9,545 |
| 2007/2008 | 28,397 (19.8%) | 12,055 |
| 2008/2009 | 37,540 (25.9%) | 14,612 |
| 2009/2010 | 39,854 (27.5%) | 14,281 |

### 4.3.2 Distribution of `matched' firms by region and sectors of economic activity

After reviewing the distribution of UKTI client records across time periods we then focused on the distribution by sector of economic activity and regions.

Figure 3 illustrates the distribution of UKTI supported firms across **regions** in the UK for the whole period (for those firms that we matched to FAME and could identify their location through the postcode). Considering the period as a whole, we observed that 19.5% of all firms that received UKTI support during the period 2005-2010 were located in London (5,920 firms), followed by 16.7% in the South East (5,346 firms) and 10.1% in the West Midlands (3,679 firms). Firms in the South West represented 9.4% of all supported firms (3,112); 8.5% were located in Yorkshire and the Humber (2,703 firms) and 8.3% in the West of England (3,679). The areas with a lower number of recipient firms were Scotland, with 5.4% of the total (1,727 firms), the North East with 3.1% (982 firms), Wales with 2.4% (941 firms) and Northern Ireland, accounting for 1% of the total (424 firms).

Figure 3. Distribution of UKTI (matched) firms across regions in the UK.




Distinguishing by **economic activity** (at 1 digit SIC level, see figure 4) we find that the largest proportion of UKTI users operate in the manufacturing sector (27% of the total), followed by firms in service sectors such as the administrative and support sector (17%) and in the wholesale and retail sector (14.4%). Some knowledge-intensive service sectors such as the professional and scientific sector (12.6% of the total), and the information and communication sector (10.7%) also accounted for a sizable share of firms.

The number of supported firms that belong to non-manufacturing production sectors, such as agriculture, hunting, and forestry (0.4%), mining and quarrying (0.6%), electricity, gas and water (0.7%), and construction (3.3%), is relatively small. The number of supported firms in other services sectors, such as arts and entertainment (2.2%), finance and insurance (1.5%), real estate (0.6%), and other primarily public sector activities, such as public administration (0.3%), education (1.5%) and health (0.9%), is also modest.

Grouping by broader industry category enables us to see that a higher share of firms (66.5%) belong to the services sectors in comparison to manufacturing and other production industries (33.5%).

Figure A.4 in the Appendix shows the distribution of users for the different UKTI services, by broad industry. We can see there is some variation across service type in the percentage of firms that operate in the primary sector, the production sector, the construction sector and the services sector. The share accounted for by the services sector as a whole ranges between 57% and 72%. Those programmes presenting a higher fraction of service sector firms are Outward Missions, Post events, HQ events, and Market Visa Support; these programmes are all relatively small though, each of them accounting for less than 3% of all records. Those schemes with the lowest share of service sector firms are Gateway to Global Growth (58%) and ECR (57%); in these programmes manufacturing firms had a relatively high weight (39% of the total).

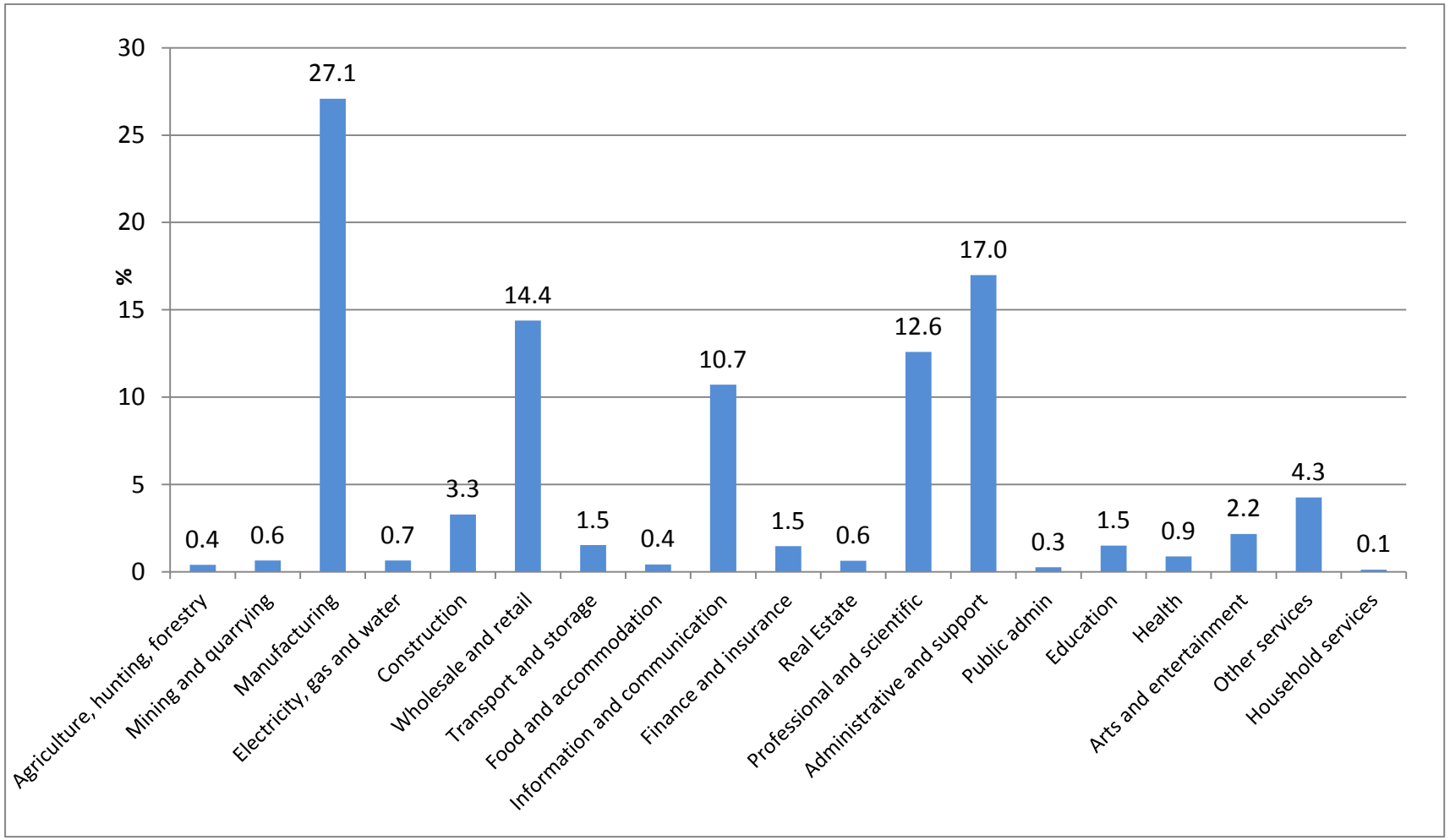
Figures A.5 and A6 in the appendix illustrate the characteristics of the supported firms in terms of their **size and age** profiles, for each service type (figure A.4). These age and size profiles are likely to be skewed towards larger companies, as we are only able to portray the characteristics of the UKTI users observed in FAME. In section 2 we have noted that smaller firms have lighter Company House reporting requirements and therefore are likely to be under-represented in the sample of FAME firms providing information on employment and annual turnover.

More than half of all UKTI users (for those who report their number of employees in FAME) have over 50 employees (this is the case for all service types, see figure A.5). Those services accounting for the highest percentage of firms with more than 50 employees are: Post events (80%), Special Reports (80%), Post events (80%), HQ events (79%), CBBC Significant assists (78%), Inward missions (76%), International Business specialist (76%), Post Significant assists (75%), ER Event (75%) and OMIS (75%). Services with a lower proportion of firms with more than 50 employees include: TAP solo (58%), Market Visit Support (59%) and Passport (60%). In the latter services the share of firms with less than 20 employees was approximately 20%, nearly double that in many other services.

Figure A.6 illustrates the distribution of firms by age band in each type of service. More than half of firms are older than 10 years, in all services except for: TAP solo (47%), Passport (37.3%), ERTA (48.9%), Market Visit Support (43.2%) and New to Export (43.6%). In the Passport scheme the percentage of firms who are less than 5 years old is 36%, compared to 20% or less for most other services.

The evidence shows that UKTI firms tend to be larger and older, but some services (i.e. Gateway to Global Growth, ECR, Passport, TAP group, TAP solo, Market Visit Support and New to Export) account for a higher percentage of smaller and younger firms.

Figure 4. Distribution of UKTI (matched) firms across economic activities (SIC1 Digit).



# 5. Descriptive analysis

The main research questions we address in this section are (see also executive summary):

I. *Are firms that receive UKTI support significantly different from those that do not use these services?*
II. *To what extent do firms that receive UKTI support differ from non-users, in terms of turnover and employment size, sector, region, and indicators of international activity IP ownership, and productivity?*
III. *Are firms who use UKTI services multiple times different from those using the services only once?*

The main objective of this section is to provide an economic characterisation of the companies that receive UKTI support, in comparison to firms that do not receive this type of business support. Our comparison group, i.e. non-participant firms, is drawn from the larger population of UK companies (available in FAME). We describe the main traits of participant firms in terms of size, age, turnover, profits, international activities, labour productivity and IP ownership. Prior evidence has shown that UKTI users are unlikely to be a random sample of UK firms (Breinlich et al, 2012; Helmers and Rogers, 2010).

First, we took our sample of `matched' firms and mapped each of the UKTI annual observations to the corresponding financial year in FAME. Table A.3a contains details of years and quarters in which the support was provided. Tables A.3b and A.3c in the Appendix show details of the concordance between PIMS waves and each of the financial years.

The majority of firms registered with Companies House supply information on the total value of their assets. This information is required even for small firms[18]. The percentage of firms in our sample of FAME that provide information on the total value of fixed assets is 98%. This percentage is only a little lower for our sample of UKTI clients matched to FAME (91%). This is the broadest sample for which we have financial information and are able to draw a comparison between UKTI users and non-users using the information on asset value.

A different picture arises when we look at the coverage of basic variables such as employment and turnover. We find that only 25% of companies in our FAME sample report information on turnover. This is however, larger in the case of our sample of matched UKTI-FAME companies (32%). In the case of the employment variable, the percentage of companies that provide information on the number of employees is only 7%. This percentage is considerably higher, at 25%, in the case of our sample of matched UKTI/FAME companies.

[18]Small companies can file simpler and less detailed accounts than those required by medium and large companies. A small company must meet two of the following conditions: a) to have annual turnover of £6.5 million or less b) a balance sheet of £3.26 million or less, c) an average number of employees of 50 or less.

Table 3. Percentage of FAME companies for which we have basic financial information.

| | *All companies in FAME* | *Sample of UKTI Clients matched to FAME* |
|---|---|---|
| Assets | 98% | 91% |
| Turnover | 25% | 32% |
| Employment | 7% | 25% |

In this section we summarise the main features of UKTI supported vs. non-supported firms for a series of variables available in FAME database, which include:

- Employment: total number of employees.
- Turnover: Turnover in 2008 prices. The value of total turnover at current prices from the FAME database deflated by, output deflators at detailed industry level.
- Assets: Total value of fixed assets. From the balance sheet information available in the FAME database.
- Total overseas turnover: Overseas turnover in 2008 prices (refers to either the total value of exports of a firm, the value of turnover of its subsidiaries abroad or a combination of the two).
- Labour productivity: we derive a measure of labour productivity using information on three variables available in FAME (gross operating surplus, employee remuneration, number of employees). First, we construct, for each firm, a measure of gross value added in current terms, by summing up gross operating profit and remuneration of employees. We then convert this into constant price terms by deflating the measure of value added with 2008 industry deflators. Finally we divide value added in constant terms by the number of employees to obtain the productivity indicator.
- Profitability.
- Information on the last year in which a firm has filed the accounts (which allows us to look at survival).

## 5.1 Characteristics of UKTI supported *vs.* non-supported firms

We start this section by providing a range of descriptive statistics based on the broadest sample of FAME firms for which we have financial information. We select those firms that provide information on the value of their assets and distinguish those firms that have received support from those that have not. Table 4 below presents the average and median value of assets of UKTI supported firms in comparison with non-supported firms, for the whole period of analysis, 2005-2011. Separately, we show the information for the group of multiple users, which include those firms that participate in different years and/or in different schemes. The statistics are based on a sample of 67,303 annual observations belonging to supported firms (of which 56,943 are for multiple users) and a total of 10,499,905 observations belonging to non-supported firms.

Comparing the **value of assets**, supported firms are considerably larger than non-supported firms, both when we look at mean values and when we look at median values (this is shown in table 4). The asset value of the median supported firm is £803,000, while the mean is considerably higher at £570,774,000. Those firms that receive UKTI support multiple times are larger than the ones that receive support only once: the median asset value is £916,000 (and the mean £653,335,000). In contrast, the asset value of the median non-supported firm is £57,000, while the mean is £21,215,000. UKTI supported firms are older: the median firm is 11 years old, whereas the median of the non-supported firm is 7 years old.

We also describe this sample of firms in terms of several other relevant characteristics, such as **ownership** and intellectual property (IP) activity. The percentage of supported firms that are foreign-owned is 10%.; the proportion of non-supported firms that are foreign owned is significantly lower (3.3%).

The proportion of supported firms that are part of a UK-multinational group is 5.6%; in the case of the multiple support firms, this percentage is 6.1%. The share of non-supported firms that are part of a UK-multinational is significantly lower (0.1%).

With regards to **IP activity**, 2.4% of the supported firms owned a patent; whereas only 0.5% of non-supported firms held a patent. The percentage of multiple-support firms that have a patent is highest at 2.7%.

In the bottom panel of Table 4 we include the same set of descriptive statistics for our sample once we exclude the largest firms (top 5% of observations in terms of assets). Once we remove the largest companies from the sample, the average and median value of assets decrease considerably and the values of the mean and median are much closer. This reflects the influence of a small number of large companies in the sample. However, the relationships highlighted above remain valid, UKTI clients are larger, older and more likely to be foreign-owned and engage in IP. But the differences with respect to non-users are now smaller.

Table 4. Characteristics of supported and non-supported firms for the broad sample (firms for which there is information on the value of assets), 2005-2011.

| | *Full sample* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***Supported*** | | | ***Non-Supported*** | | | ***Multiple support*** | | |
| | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* |
| Assets('£000) | 570,774 | 803 | 67,303 | 21,215 | 57 | 10,494,905 | 653,335 | 916 | 56,943 |
| Age (years) | 16.8 | 11 | 67,582 | 11.1 | 7 | 10,648,275 | 17.3 | 11 | 57,188 |
| | Percentage | | *Obs.* | Percentage | | *Obs.* | Percentage | | *Obs.* |
| Foreign owned | 9.9% | | 74,869 | 3.3% | | 10,662,103 | 10.0% | | 63,038 |
| Part of a UK multinational | 5.6% | | 67,583 | 0.1% | | 10,648,516 | 6.1% | | 57,189 |
| Patents | 2.4% | | 74,869 | 0.5% | | 10,662,103 | 2.7% | | 63,038 |
| | *Excluding the largest companies ( top 5% in terms of assets)* | | | | | | | | |
| | ***Supported*** | | | ***Non-Supported*** | | | ***Multiple support*** | | |
| | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* |
| Assets('£000) | 879 | 389 | 51,807 | 294 | 49 | 9,982,252 | 913 | 418 | 42,919 |
| Age (years) | 13.5 | 9 | 51,807 | 10 | 6 | 9,982,169 | 13.8 | 9 | 42,919 |
| | Percentage | | *Obs.* | Percentage | | *Obs.* | | | |
| Foreign owned | 5.8% | | 51,807 | 2.0% | | 9,982,169 | 5.7% | | 42,919 |
| Part of a UK multinational | 1.2% | | 51,807 | 0.2% | | 9,982,169 | 1.7% | | 42,919 |
| Patents | 1.6% | | 51,807 | 0.1% | | 9,982,169 | 1.2% | | 42,919 |

Table 5 compares UKTI users and non-users in terms of employment, sales and productivity performance. As previously discussed, we can only report this for a smaller sample of firms, as not all companies in FAME are required to provide this information. Only those companies that surpass a certain threshold are required to provide information on employment and turnover; as a result, the sample is largely biased towards larger companies. This sample will form the basis for our regression analysis as it has information on all the main variables of interest. The total number of annual observations corresponding to supported firms, for which we have information on employment and turnover is 17,507; of these 15,624 observations refer to multiple users and 1,883 observations refer to single use. The total number of annual observations for non-supported firms is 547,216.

The average **asset value** of supported firm is now £822,110,000. This figure is higher than that for the broader sample[19] (£570,774,000 - see table 4). This divergence reflects that the sample for which we have information on employment and turnover is biased towards larger companies. Providing information on the number of employees and the annual turnover is only compulsory for larger companies who have to meet more stringent Companies House reporting requirements. The median value in this case is £10,095,000 pounds, which also considerably higher than that shown in table 4 (£803,000), reflecting the bias towards larger firms in the sample of analysis.

In terms of **employment**, the average supported company has 1,550 employees; this is much higher than the average size of the non-supported firm (284). Multiple users of UKTI services are on average larger (1,679 employees). In all cases the median size is significantly below the mean. The median size of the supported firm is 96 employees, of the multiple user is 101 employees, and of the non-supported firm 27 employees. These figures provide more evidence that UKTI users are indeed larger than the non-users. Moreover, firms that have had multiple services are usually larger than those that have only had one service from UKTI. A similar picture emerges when we undertake the size analysis in terms of turnover. Supported firms have a higher annual turnover (mean of £419,280,000 pounds) than non-supported firms (mean of £56,850,000 pounds). With an annual turnover of £459,060,000 pounds the multiple users are slightly larger than the average UKTI user.

Looking at the **age** of companies we can also see that UKTI clients are on average older than other firms: the average age of supported firms in our sample is now 26 years, which is above the average age of supported firms in the broader sample (17 years). The average age of non-supported firms is now 19 years compared to 11 years in the broader sample.

[19] This is the sample of firms for which we have information on value of assets, but not necessarily on employment and turnover.

Table 5 also describes firms in terms of levels of **labour productivity**, measured as value added (in thousands of pounds) per employee. When looking at mean labour productivity we find that this is higher for the non-supported firms (£67,000 pounds per employee) compared to supported firms (£52,000 pounds per employee). However, when looking at medians, which are more robust in the presence of outliers, the median value for the group of supported firms (£42,000 pounds per worker) is higher than that of the non-supported firms group (£32,000 pounds per worker). This result reflects the influence of some highly-productive non-supported firms (which are not necessarily the largest firms).

With regards to **ownership**, approximately 27% of supported firms are foreign-owned (see figure 6 for an illustration); this percentage is much higher than that for the broader sample (just under 10%, see upper panel of table 4). This percentage is higher than the percentage of non-supported firms which are foreign owned (22%). The percentage of firms that have subsidiaries abroad is again higher than for the broader sample: 17% for the supported group, 14.1% for the multiple-supported group and 4.5% for the non-supported firms.

When excluding the largest companies in the sample (table 5, bottom panel) approximately 5% of firms in this sample own a patent, whereas the percentage is marginally higher for multiple users (5.2%); the percentage of non-supported firms that engage in this type of IP activity is 0.5%.

Next, we report these descriptive statistics for different sub-samples of firms. First, in table A.4 we show these descriptive figures for those companies that file unconsolidated accounts. We want to ensure that the results are not driven by double-counting of firms (several firms reporting group accounts). By excluding firms that file consolidated (group) accounts we exclude some of the largest companies. We report in the same table the results after excluding firms at the top (99%) and bottom (1%) percentiles of the distribution of productivity and profitability[20] thus excluding observations with extreme values of these variables. We remove these other potential outliers as large firms are not the only source of extreme data points. Once we remove these observations from the sample it becomes clearer that supported firms are more productive than non-supported firms (both when looking at means and medians). The descriptive analysis of these various sub-samples yields similar conclusions to those discussed in this section.

[20] Calculated on a year and industry-by-industry basis.

Table 5. Characteristics of supported and non-supported firms for the regression sample (firms for which we have information on employment and turnover).

| | *Full sample* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***Supported*** | | | ***Non-Supported*** | | | ***Multiple support*** | | |
| | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* |
| Employees | 1,550 | 96 | *17,507* | *284* | *27* | *547,216* | 1,679 | 101 | 15,624 |
| Turnover('£000) | 419,280 | 14,364 | 17,356 | 56,850 | 4,617 | 532,693 | 459,066 | 14,900 | 15,500 |
| Labour productivity('£000) | 52 | 42 | 17,180 | 67 | 32 | 488,837 | 55 | 42.2 | 15,353 |
| Assets('£000) | 822,110 | 10,095 | 17,489 | 157,505 | 3,731 | 545,663 | 900,010 | 10,566 | 15,606 |
| Age (years) | 26.1 | 19 | 17,507 | 19 | 13 | 547,088 | 26.4 | 19 | 15,624 |
| | Percentage | | Obs. | Percentage | | Obs. | Percentage | | Obs. |
| Foreign owned | 27.5% | | 17,507 | 22.0% | | 547,088 | 32.0% | | 6,635 |
| Part of a UK multinational | 17.0% | | 17,507 | 4.5% | | 547,216 | 14.1% | | 6,635 |
| Patents | 5.4% | | 17,507 | 0.6% | | 547,216 | 4.4% | | 6,635 |
| | *Excluding the largest companies ( top 5% in terms of assets)* | | | | | | | | |
| | ***Supported*** | | | ***Non-Supported*** | | | ***Multiple support*** | | |
| | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* |
| Employees | 215 | 83 | 15,607 | 113 | *25* | 519,316 | 223 | 86 | 13,846 |
| Turnover('£000) | 34,617 | 11,960 | 15,464 | 18,088 | 3,906 | 505,586 | 35,759 | 12,272 | 13,728 |
| Labour productivity('£000) | 56 | 41 | 15,312 | 60 | 32 | 463,206 | 57 | 41 | 13,603 |
| Assets('£000) | 27,152 | 8,206 | 15,607 | 14,038 | 3,166 | 519,316 | 27,947 | 8,490 | 13,846 |
| Age (years) | 25 | 19 | 15,607 | 19 | 13 | 519,234 | 25 | 19 | 13,846 |
| | Percentage | | *Obs.* | Percentage | | *Obs.* | Percentage | | *Obs.* |
| Foreign owned | 26.7% | | 15,607 | 21.6% | | 519,316 | 25.6% | | 13,846 |
| Part of a UK multinational | 12.6% | | 15,607 | 3.6% | | 519,316 | 12.9% | | 13,846 |
| Patents | 4.9% | | 15,607 | 0.5% | | 519,316 | 5.2% | | 13,846 |

Figure 5. Percentage of firms that have subsidiaries abroad- Firms with basic information on employment and turnover, 2006-2011.

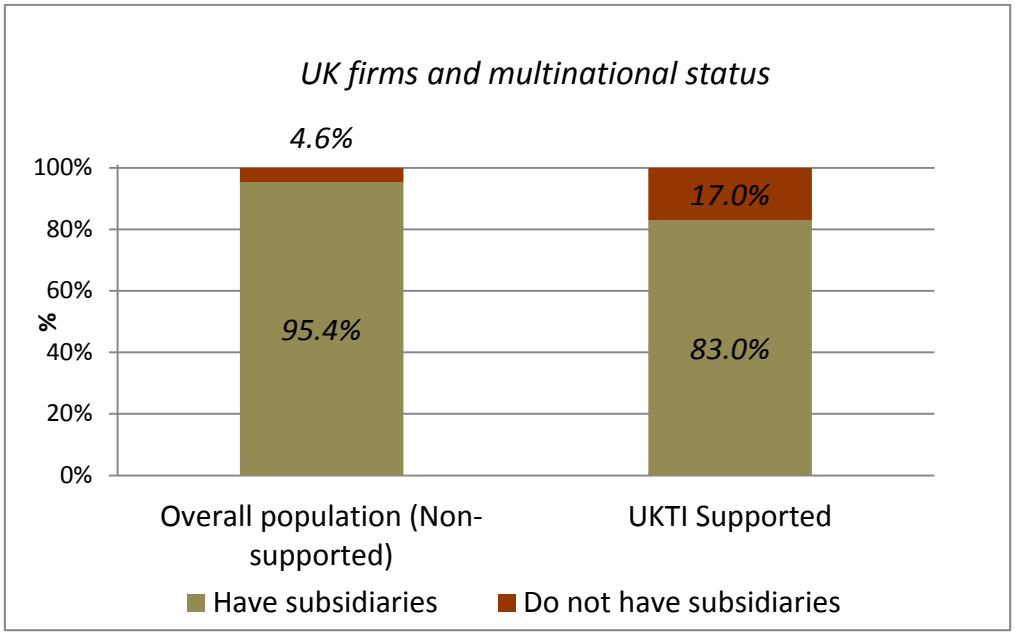
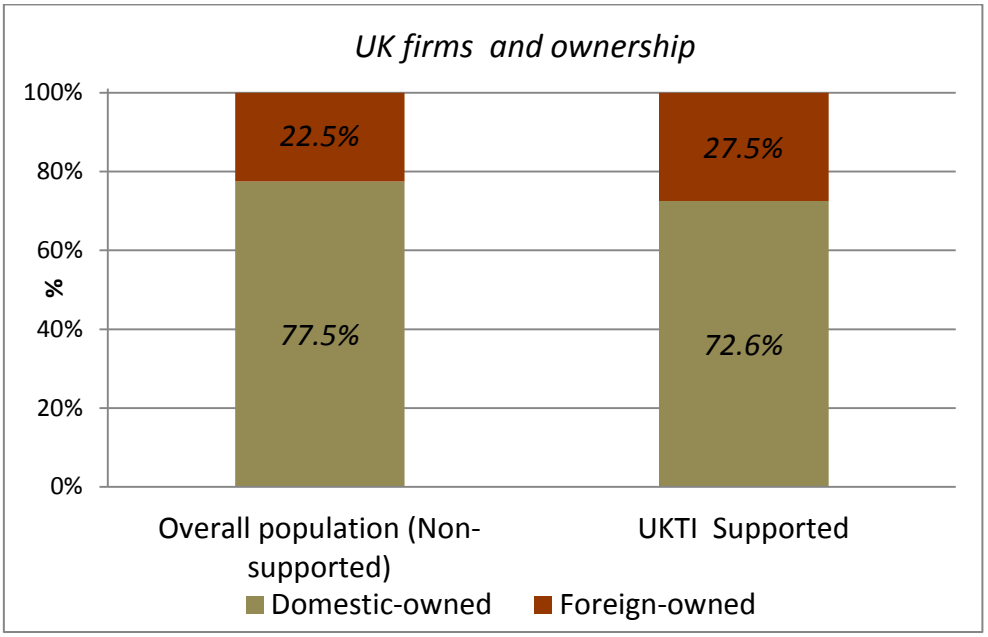



Figure 6. Percentage of firms that are foreign owned- Firms with basic information on employment and turnover, 2006-2011



## *Age, size, industry and regional distribution of UKTI users*

Figures 7 and 8 below illustrate the age and size distributions of our sample of matched firms. We consider here the sample of firms reporting employment and turnover (which will form the basis of our regression sample) and distinguish supported from non-supported firms.

Figure 7 shows the share of firms belonging to each different age groups: "<2 years", "2-5 years", "6-10 years", "11-20 years" and "> 20 years". Almost 50% of supported firms are older than 20 years. In contrast, the share of non-supported firms older than 20 years is only just over 30%. The fact that the age distribution is skewed to the right is consistent with the mean age being above the median (highlighted in the previous section). Non-supported firms are more evenly distributed across age bands than supported firms.

In the case of employment (figure 8) we group the firms into the following categories: "less than 10 employees", "10-19 employees", "20-49 employees", "50-99 employees", "100-249 employees" and "more than 250 employees". A higher share of larger firms is found amongst the group of supported firms than the group of non-supported firms. An interesting finding is that only around 7% of supported firms have less than 10 employees, while the share of this size group in the group of non-supported firms is over 30%.

Given the skewness of the age and size distributions, it is essential to report both the median and means of the variables when describing the samples. These graphs illustrate the extent to which large and older firms are over-represented amongst supported firms in comparison with the general population of firms.

Figure 7. Age distribution of supported and non-supported firms, 2005-2010 (for firms with information on employment and turnover).

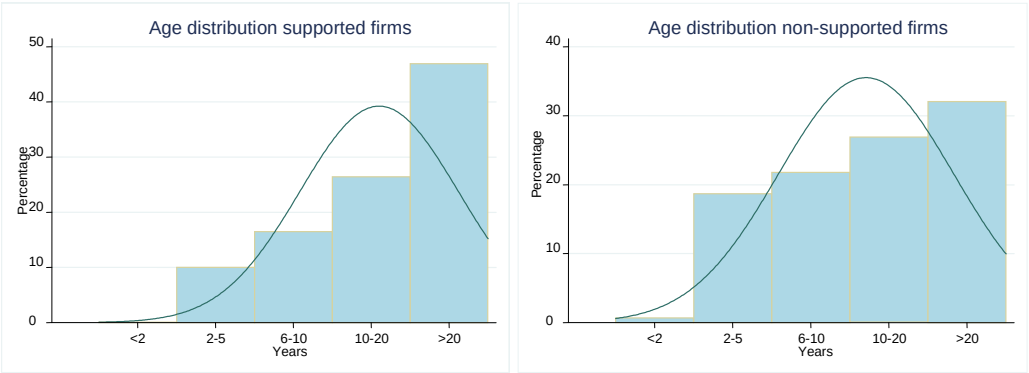
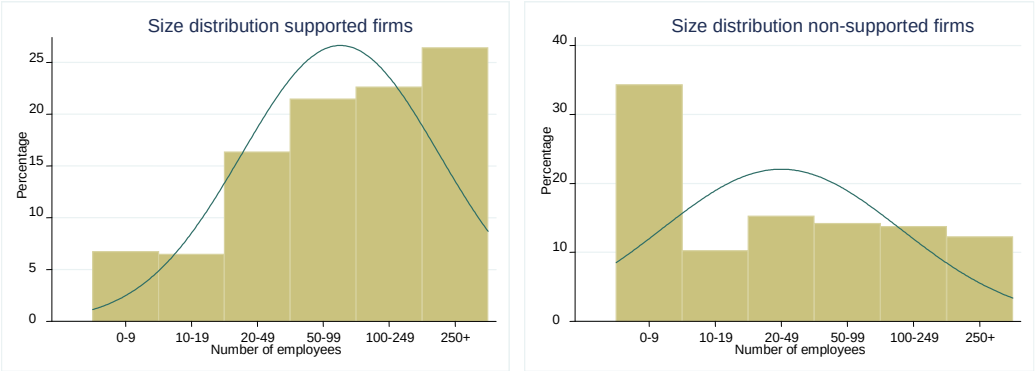


Figure 8. Size distribution of supported and non-supported firms, 2005-2010 (for firms with information on employment and turnover).




In the previous section (Figure 3.1) we showed that the largest proportion of UKTI users are located in London and the South East, followed by the West Midlands and the South West, and the smallest proportions are in the North East, Wales, Scotland and Northern Ireland regions.

Figure 9 shows the regional distribution of UKTI supported firms and other firms for the sample for which we have information on employment and turnover. Comparison with Figure 3.2 shows that this sample has larger proportions of UKTI users in London and the South East (23.2% and 19.2% respectively, *vs.* 19.5% and 16.7% in Fig 3.2).

Focusing on the comparison between users and non-users, in Figure 9, the most striking difference between the two groups is that supported firms are less concentrated in London than non-supported firms (23.2% *vs.* 29.7%). The share of supported and non-supported firms located in the South East is almost the same (just over 19% of the total). The West Midlands accounts for 9.6% of all supported firms, and 7.6% non-supported firms.

Several other regions also account for a larger proportion of supported firms than non-supported firms. These are Yorkshire and the Humber (8.0% *vs* 6.4%), the North West (7.7% *vs.* 7.0%), the East Midlands (6.4% *vs.* 5.45), the North East (2.3% *vs.* 1.8%) and Scotland (6.7% *vs*. 5.6%). On the contrary, Wales (2.2% *vs*. 2.7%) and Northern Ireland (1.2% *vs*. 1.4%) account for a smaller share of supported firms in comparison to the total business population of non-supported firms.

Figure 9. Distribution of firms across regions in the UK (sample of firms for which we can observe employment and turnover in FAME).

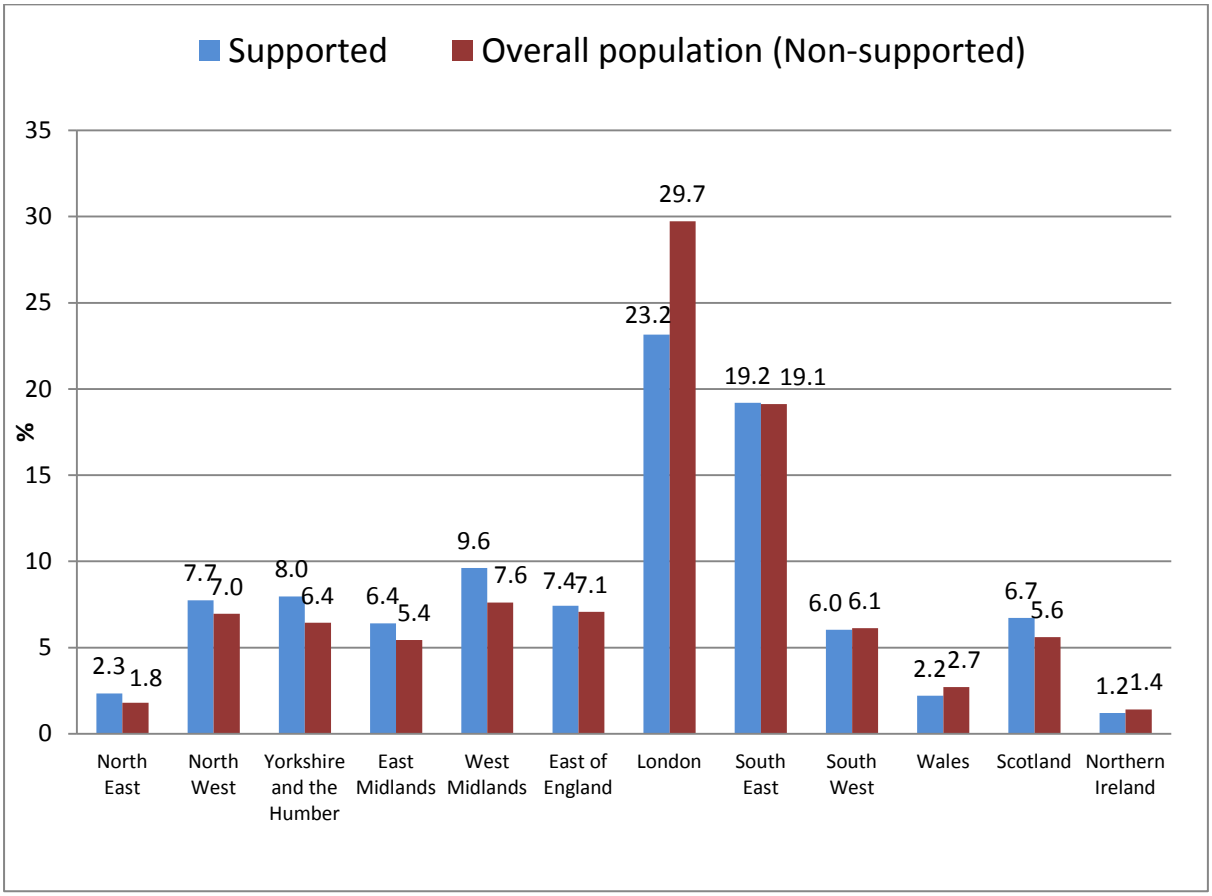
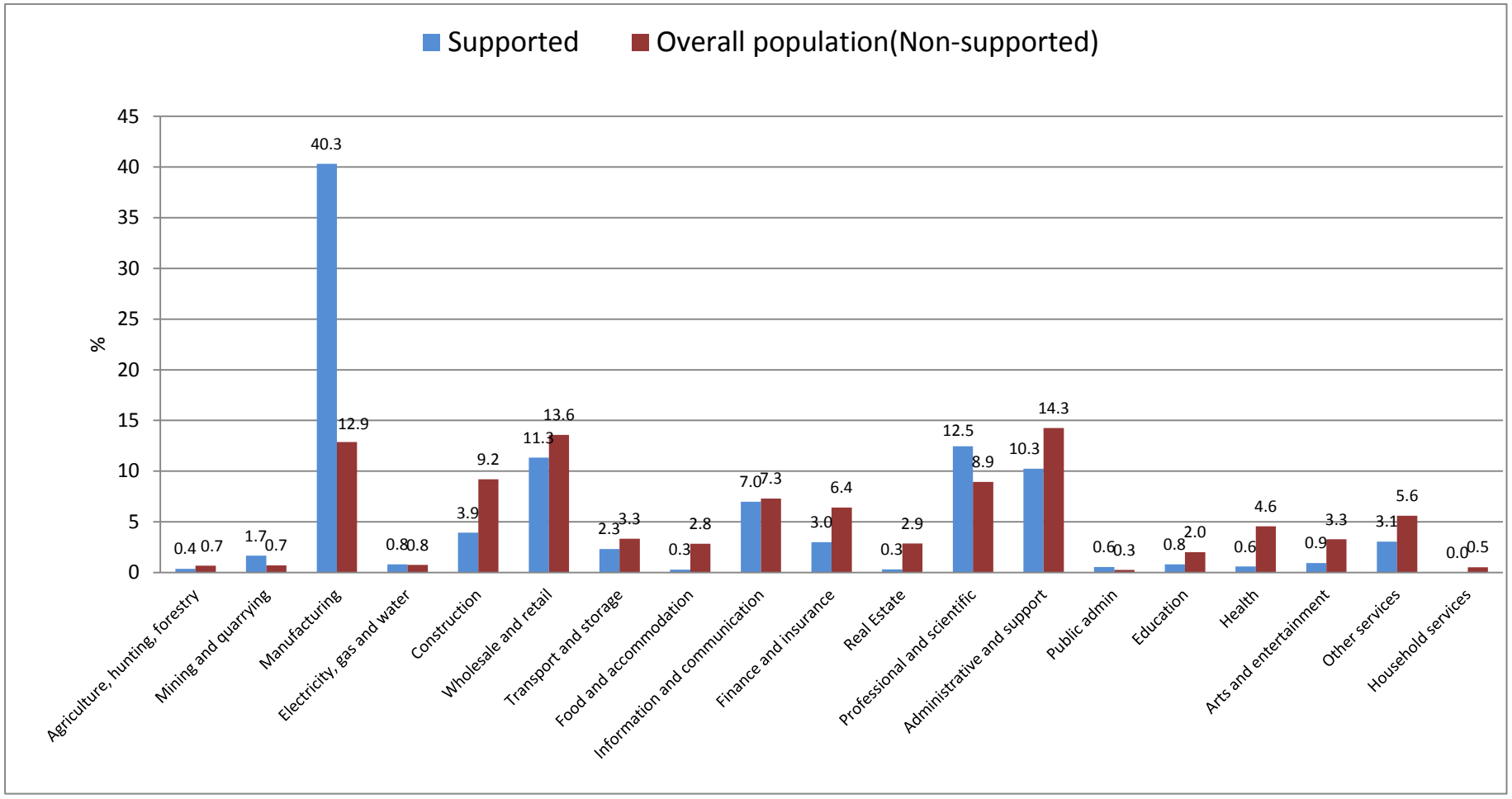



Figure 10 below shows the distribution of supported firms according to their main economic activity (again for those for which we have basic information on employment and turnover). Comparison with figure 5 shows that within this reduced sample the manufacturing sector accounts for a substantially larger proportion of users than was the case for the whole sample (40.3% in Figure 10 vs. 27.1% in Figure 5); by contrast the 'administrative and support' sector is under-represented in the reduced sample (10.3% *vs*. 17%). The ranking of other services sectors by share of UKTI users is also different in the reduced sample, with figure 10 showing 'Professional and scientific' as the 2nd largest sector group among UKTI users (after manufacturing), while Figure 5 shows this sector as accounting for a smaller share of UKTI users than 'administrative and support' and 'wholesale and retail'.

Focusing on the reduced sample, Figure 10 shows that the proportion of UKTI supported firms in the manufacturing sector is much higher than for non-supported firms (40.3% vs 12.9%). Within services, UKTI supported firms are more likely to be in the professional and scientific sectors than non-supported firms. Firms in the professional and scientific sectors represent 12.5% of the total number of supported firms and 9% of non-supported firms In all other service sectors (at the 1 digit SIC level), UKTI firms are under-represented relative to non-supported firms.

Figure 10. Distribution of firms across economic activities, SIC 1 digit codes (sample with information on employment and turnover).



## 5.2 Estimation of probability models

In this section we employ probability models to estimate the structural characteristics most closely associated with the likelihood of accessing UKTI services. Using a Probit model, we are able to quantify the probability that a firm with certain characteristic falls into the group of supported firms.

This type of model is based on the principle that the probability of a firm accessing support $(y^*)$ is a latent (unobserved) variable. Instead, we observe whether a firm receives support $(y = 1)$ or not $(y = 0)$. In this model, when the actual value of the latent variable is positive, given a set of attributes denotes by the vector $X$, the observed value equals 1.

More formally:

$$\Pr(y = 1|X) = p(y^* > 0\ |X)$$

$$UKTI_i = \begin{cases} y = 1 \quad \cdots if\ a\ firm\ \ receives\ UKTI\ suport \quad \left(y^*{}_i > 0\right) \\ y = 0 \quad \cdots if\ a\ firm\ does\ not\ receive\ \ UKTI\ support \ \ (y^*{}_i < 0\ ) \end{cases}$$

We estimated a binary Probit model, where the dependent variable is a dummy variable $(1,0)$ that takes a value of 1 if the firm receives UKTI support and 0 if it does not. While statistical techniques cannot fully predict take up, we can model the probability of receiving support as a function of several key characteristics that are internal to the firm (e.g. productivity, age, size, internationalisation and innovation activities, type of ownership) and/or external to the firm (e.g. sector, year, region). These characteristics are captured by the vector of variables denoted by $X$. We estimated the Probit models using maximum likelihood methods[21].

$\Pr(y = 1|x) = F(\beta' X)$ where $F(.)$ is a function between 0 and 1

*Probit model:* $\mathrm{F}(x) = \phi(X) = \int_{-\infty}^{x} \phi(z)dz$

The estimated coefficients $(\beta)$ on the vector of variables $X$ reveal the extent to which firms that have received UKTI support differ significantly from those that do not. These shows us the way in which the regression terms relate to the probability of obtaining support. For example, if the coefficient on firm size is positive and statistically significant, then this

[21]Maximum likelihood estimation (MLE) is an alternative approach to parameter estimation and inference in statistics. While Ordinary Least Squares which is used primarily to estimate linear models MLE is tied to estimation of non-linear models.

suggests that UKTI users are on average larger than non-users. While this is informative, these estimates do not tell us the extent to which, holding other variables constant, an increase in this particular variable may increase the probability of obtaining support. To this end we report the estimates of the marginal effects underlying the Probit model as they have an easier interpretation, as per discussion below. In this type of binary model the marginal effects can be interpreted as the slope of the probability curve relating $X$ to $\Pr(y = 1|X)$, holding all other variables constant.

In table 6 we see the results of estimating the Probit model for the overall sample (in column 1) and also after excluding the largest companies from the sample (column 2, excluding the top 5% of firms in terms of assets). We make use of a richly specified Probit model where in addition to firm-specific characteristics[22] we also include region, sector, and year dummies, which account for differences in the take-up of UKTI services across regions, economic activities and stages of the business cycle.

First of all, we can see that the marginal effects associated with **size**, captured by number of employees, are positive and statistically significant. In this regression we have included the number of employees as a categorical variable, mirroring the size categories used in PIMS. The categories are the following: "0-9 employees" [23], "10-19 employees", "20-49 employees", "50-99 employees", "100-249 employees" and ">=250 employees". This is to identify different take up probabilities for different sizes. The marginal effects can be interpreted in relation to the reference or omitted category. The estimated effects are higher for the larger size dummies. Companies within the 50-99 size band have the highest probability of being in the group of UKTI users (1.12 percentage points higher than for the "0-9 employees" group).

The model also includes age as a categorical variable. The **age** categories, which are the same ones used in PIMS are: "<2 years", "2-5" years", "6-10" years" "11-20 years" and ">20 years". In comparison to the chosen reference or omitted category (<2 years) we can see that the likelihood of taking up UKTI support rises with age. The age group with the highest chance of accessing the support is that of "11-20" years (this is higher than for the ">20 years" group). The estimates show that those firms with ages between 11 and 20 years are just over 2% more likely to receive UKTI support than firms aged less than 2 years. The results are similar when we exclude the largest companies (column 2).

With regards to the other measures of size, the coefficients on the **assets and turnover** variable are positive and statistically significant. The exception is the coefficient on turnover when we exclude the top 5% firms (in asset value). The coefficient on turnover is positive

[22] Note that all the variables in the Probit models are measured in levels (number of employees), while the outcome variables in the regression models will be measured in growth terms (e.g. growth in employment).
[23] While we have 6 categories in our regression we include 5 dummies. We omit one category to avoid problems of multi-collinearity. The omitted category is "0-9 employees".

but not statistically significant. The results largely confirm that larger firms are more likely to participate in the UKTI programmes.

**Labour productivity** also has a positive influence, so we can infer that more productive firms will be more likely to participate in the programmes than less productive firms. This is also the case, as we would expect, for firms with a higher level of overseas turnover.

We include several other variables in the regression model, as dummy variables. These are mostly dichotomous variables that distinguish whether the firms are **foreign-owned**, whether firms are part of a **UK multinational**, and whether the firms have **patents**. The results show that those UK firms with subsidiaries abroad have a higher probability of using UKTI services. However, in contrast to the raw data that suggested that UKTI users were more likely to be foreign-owned than non-users (figure 6), the coefficient on the foreign ownership variable is negative and significant; this finding suggests that foreign-owned firms in the UK are less likely to receive support compared to the domestic-owned firms. However, this result arises only after controlling for the size of the firm and the sector of operation. The interpretation is that, within a particular sector, foreign-owned firms are less likely to access support compared to domestic-owned firms. When we look at a more basic model without dummies for size and economic activity, we obtain a positive association between accessing support and foreign ownership as in the raw data. Finally, we see that firms engaging in IP activities are approximately 2% more likely to be in the group of supported firms. Table 6 shows similar conclusions when we exclude observations at the top 5% of the distribution for asset value.

Table 6. Probit model of the probability of receiving UKTI support, 2005-2011.

| *Dependent variable (support=1 if firm receives UKTI support, and support=0 if it does not receive support)* | | |
|---|---|---|
| | *All companies* *(1)* | *excl. largest firms (top 5% in terms of assets)* *(2)* |
| Age 2-5 yrs | 0.0154*** | 0.0188** |
| Age 6-10 yrs | 0.0196*** | 0.0227*** |
| Age 11-20 yrs | 0.0207*** | 0.0237*** |
| Age >20 yrs | 0.0194*** | 0.0221*** |
| | | |
| 10-19 employees | 0.00500*** | 0.00551*** |
| 20-49 employees | 0.00840*** | 0.00933*** |
| 50-99 employees | 0.0112*** | 0.0128*** |
| 100-249 employees | 0.0103*** | 0.0123*** |
| >=250 employees | 0.0108*** | 0.0133*** |
| | | |
| Ln(Turnover) | 0.000399*** | 0.0000344 |
| Ln(Assets) | 0.000271*** | 0.000336*** |
| Ln(Labour productivity) | 0.00137*** | 0.00167*** |
| Ln(Overseas turnover) | 0.000130*** | 0.000127*** |
| Foreign ownership dummy | -0.00213*** | -0.00196*** |
| UK multinational dummy | 0.00589*** | 0.00477*** |
| Patent dummy | 0.0195*** | 0.0202*** |
| | | |
| Year dummies | Yes | Yes |
| Region dummies | Yes | Yes |
| Sector dummies | Yes | Yes |
| Pseudo R2: | 0.1806 | 0.1828 |
| Observations | 384,146 | 363,997 |
| NOTES: Continuous variables are measured in logs; coefficients represent marginal effects; omitted size category is 0-9 employees; omitted age category is <2 years old. | | |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Next we estimate a multinomial logit model to address research question (ii). Our objective here is to investigate whether firms that use UKTI services multiple times differ significantly from those that use UKTI services only once. This is an important question, as recent evidence from PIMS suggests that there has been an increase in multiple service use by individual businesses (London Economics, 2012).

This time we set $UKTI_i$ to be a categorical indicator that takes three different values. We assign the value 0 if the firm does not receive support, 1 if the firm receive one-off support and 2 if the firm receive support more than once.

$$UKTI = \begin{cases} y = 0 \cdots \ if\ a\ firm\ has\ never\ received\ support \\ y = 1 \cdots \ if\ a\ firm\ has\ received\ support - \ single \\ y = 2 \cdots \ if\ a\ firm\ has\ received\ support \ - \ multiple \end{cases}$$

The outcome variable now takes multiple values, and each of them can be compared to the base category or reference group. In this case our chosen reference category is comprised of those firms receiving single support ($y = 1$). This allows us to establish a direct comparison of the factors associated with multiple and single support, the main focus of this section.

We estimate the multinomial logit of the conditional probability of accessing support multiple times ($y = 2$) in comparison to the probability of obtaining support only once ($y = 1$), as a function of several firms' characteristics such as size, age, productivity and a vector of regional, sector and year dummies.

The multinomial logit model is given by the following expressions:

$$\Pr(y = 1\ ) = \frac{1}{1 + \exp(X_i\beta_1)}$$

$$\Pr(y = 0) = \frac{\exp(X_i\beta_0)}{1 + \exp(X_i\beta_0)}$$

$$\Pr(y = 2) = \frac{\exp(X_i\beta_2)}{1 + \exp(X_i\beta_2)}$$

The coefficients $\beta_0$ and $\beta_2$ show the relationship between each firm's characteristics and the probability of being in each of the groups. We can thus test directly whether firms that repeatedly use UKTI support differ from those that use the support once.

Table 7 shows the results of estimating the multinomial logit model for all companies (columns 1 and 2) and also when excluding the largest companies from the sample (columns 3 and 4).

The table shows the coefficients (rather than the marginal effects) for non-users (column 1) and multiple users (column 2), relative to single users. The omitted category is that of "single use" so we can establish a direct comparison between the coefficients of multiple and single supported firms, which is of interest to us.

The coefficient on the **employment** variable for multiple users is positive and significant, suggesting that firms that are multiple users of UKTI support are larger, in terms of number of employees, than those that receive support only once. The coefficient on the employment variable is negative and statistically significant for the non-supported firms group, which confirms that supported firms are larger than non-supported firms.

In terms of **age**, the coefficient on age for multiple users is non-significant (although positive); this result indicates that multiple users are not significantly different from one-time users in terms of their age. The coefficient for non-users is negative and significant, indicating that UKTI clients are older than other firms.

The results for the **labour productivity** variable suggest that the multiple users are more productive than the single users, and confirm that single users are more productive than non-supported firms. There is also a higher chance that multiple supported firms report overseas turnover in comparison to the single users, and the latter are more likely to report overseas turnover than non-users.

The results also show that multiple use is not significantly associated with the probability of being part of a **UK multinational** in comparison to single use firms; but UKTI users generally are more likely to be part of a UK multinational group than non-supported firms. In relation to **IP activity**, we can see that, as expected, multiple support firms have a higher probability of being IP active than single supported firms, while single supported firms are more likely to have a patent than non-supported firms. These results hold when excluding the largest companies (top 5% of the distribution in terms of asset value) – see Table 7.

Table A.6 in the appendix shows the results when we estimate the multinomial model for those companies that file unconsolidated accounts; this sample excludes many large firms. The results are again broadly similar with a few small differences. First, in this case we do see that multiple users are more likely to be part of a UK multinational firm relative to single users. The coefficient on the UK multinational dummy is now positive albeit only significant at the 10% level. Second, when we also exclude the largest companies in terms of assets, we can see some differences in the characteristics of single users compared to the non-users. Single users are not significantly different from non-users in terms of foreign ownership or IP ownership. Firms that use multiple services are more likely to engage in IP activity.

Table 7. Estimation of a multinomial logit, 2005-2011.

| *Dependent variable (0= no support 1=single support 2=multiple support)* | | | | |
|---|---|---|---|---|
| | All companies | | Excl. largest companies (top 5% in terms of assets) | |
| | No support (1) | Multiple support (2) | No support (3) | Multiple support (4) |
| | *base category (single support)* | *base category (single support)* | *base category (single support)* | *base category (single support)* |
| Ln(Age) | -0.149*** | 0.0306 | -0.137*** | 0.0471 |
| | (0.0276) | (0.029) | (0.0291) | (0.0308) |
| Ln(Employment) | -0.113*** | 0.144*** | -0.146*** | 0.135*** |
| | (0.013) | (0.0138) | (0.0154) | (0.0165) |
| Ln(Labour productivity) | -0.155*** | 0.175*** | -0.180*** | 0.190*** |
| | (0.0281) | (0.0295) | (0.0317) | (0.0336) |
| Ln(Overseas turnover) | -0.0124*** | 0.00801*** | -0.0123*** | 0.00848*** |
| | (0.00134) | (0.00141) | (0.0014) | (0.00148) |
| Foreign Ownership dummy | -0.196*** | -0.601*** | -0.179*** | -0.584*** |
| | (0.0539) | (0.0573) | (0.0563) | (0.0601) |
| UK multinational dummy | -0.395*** | 0.0307 | -0.407*** | 0.00906 |
| | (0.08) | (0.0832) | (0.0878) | (0.0916) |
| Patent | -0.455*** | 0.605*** | -0.472*** | 0.653*** |
| | (0.168) | (0.17) | (0.182) | (0.184) |
| Constant | 6.880*** | 0.859* | 7.266*** | 1.059** |
| | (0.412) | (0.442) | (0.467) | (0.497) |
| Year dummies | Yes | Yes | Yes | Yes |
| Region dummies | Yes | Yes | Yes | Yes |
| Sector dummies | Yes | Yes | Yes | Yes |
| Pseudo R2: | 0.1441 | 0.1441 | 0.1446 | 0.1446 |
| Observations | 341,091 | 341,091 | 323,448 | 323,448 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

# 6. Econometric analysis

The research questions we address in this section are (see also executive summary):

IV. *What is the impact of UKTI support on the performance of firms that participate in the programmes? We aim to study the effects on a range of performance measures (Growth in turnover, Growth in employment, Growth in productivity, Growth of overseas turnover, Probability of reporting overseas turnover, Probability of survival).*

V. *To what extent does the use of UKTI services multiple times enhance the impact on business performance?*

VI. *To what extent does the participation in high-intensity programmes enhance the impact on business performance?*

## 6.1 Methodology

The key issue in identifying the impacts of UKTI support on firms' behaviour lies in the construction of an appropriate counterfactual intended to mimic *what would have happened* if firms had not received UKTI support. By definition this counterfactual is unobserved. In the descriptive section we have consistently shown that supported firms are unlikely to be a random sample of the population of UK firms. In general, UKTI users are likely to be larger, older, more productive, and more intensively engaged in international and intellectual property activities. This presents a key challenge to estimating the causal effects that UKTI support has on firms' performance. It is crucial to take into account these selective participation effects. Failure to do so would lead to a biased picture of how UKTI support influences firms' outcomes.

To obtain a valid estimate of programme impact, the effect of selection must be accounted for. A first simple approach to estimating the effect of a given program would be to compare the outcome of programme participants, with those of non-participants. This could be a valid approach if the participants in the programme constituted a random sample of all the eligible population. However, this is unlikely to be the case in the majority of evaluations. A simple comparison of outcomes would probably result in over-estimating of the effectiveness of the programme. This would be the case if those participants with more favourable characteristics were more likely to have chosen to participate. It is therefore likely that participating individuals would have performed better on average than non-participating individuals, irrespective of whether they actually participated in the programme.

In addressing research tasks (iv)-(vi) we use a combined Propensity Score Matching (PSM) and Difference-in-Differences (DID) estimator. In the first instance, we apply the matching technique to derive the hypothetical behaviour of UKTI clients had they not received

support. This is proxied by the behaviour of a sample of UK companies that do not receive support from UKTI, but have similar observable characteristics to UKTI clients. Our approach represents an extension of that adopted in previous studies investigating the effect of UKTI support on the growth of supported firm outcomes (Breinlich et al 2012[24]). We follow Barba-Navaretti and Castellani and Disdier (2009), which use a PSM-DID type of approach to investigate the effect of foreign investment activities on growth outcomes of Italian multinational firms. For the UK, Greenaway and Kneller (2008) also use a DID approach on matched firms to assess how exporting influences productivity for a panel of manufacturing firms. It is important to stress that the PSM-DID approach does not take into account unobservable differences between UKTI users and non-users that vary over time.

The main principle behind the application of the PSM method to construct the counterfactual is to find a large group of non-participant firms who are similar to the participant firms in a series of relevant *pre-treatment* observable characteristics, which constitute the counterfactual or control group (Caliendo and Kopeinig, 2008; Caliendo and Künn, 2011). The PSM method attempts to reduce the bias that might arise from a simple comparison of UKTI clients to a random set of non-users due to the influence of confounding variables.

More formally, in the Propensity Score Matching method, the outcome equations differ for `treated' and `non-treated' firms and are given by:

$$Y^{UKTI} = f^{UKTI}(X) + u^{UKTI} \quad (1)$$

$$Y^{NUKTI} = f^{NUKTI}(X) + u^{NUKTI} \quad (2)$$

where $Y^{UKTI}$ denotes the outcome of the treated firm; $Y^{NUKTI}$ denotes the outcome of the non-treated firm, which can be expressed as a function of a set of observable variables $X$ and unobservable terms, $u^{UKTI}$ and $u^{UKNTI}$.

The impact of the `treatment' on the treated (*ATT*) will be given by the following expression ($\alpha_{UKTI}$):

$$\alpha_{UKTI} = E({Y^{UKTI}}_{t+s} - {Y^{NUKTI}}_{t+s} | X, UKTI = 1) = E({Y^{UKTI}}_{t+s} | X, UKTI = 1) - E({Y^{NUKTI}}_{t+s} | X, UKTI = 1) \quad (3)$$

where $s \geq 1$

[24] Breinlich et al (2012) use mainly Propensity Score Matching and the Heckit estimator to assess the effects of several UKTI support programs on firm-level performance.

The problem for the identification of the ATT is the term $E(Y^{NUKTI}|\ X, UKTI = 1)$ because it is not observable. Therefore causal inference relies here on the construction of this counterfactual. We do this by entering the term $(Y^{NUKTI}|X, UKTI = 0)$ in the equation instead of the term$(Y^{NUKTI}|X, UKTI = 1)$.

This method relies on the conditional independence assumption (CIA), which is the identifying assumption of the matching method. The CIA assumption assumes that, once one controls for the observable variables of interest contained in the vector of variables $X$, the outcomes of the non-treated and participation in the program are two independent events. Therefore, it allows for any difference between the treated and non-treated to be attributed to the effects of the programme.

$$Y^{UKTI}, Y^{NUKTI} \perp UKTI \mid X, \quad \cdots \forall\, X \tag{4}$$

Thus, conditional on $X$, the distribution of outcome $Y$ for $UKTI = 1$ is the same as the distribution of $Y$ for $UKTI = 0$.

If the CIA holds, the matching process is similar to creating an experimental dataset, where conditional on certain characteristics, the selection is random. This assumption allows us to establish that any differences in outcomes between the treated and non-treated firms can be attributed to the effects of the programme. This method relies on the evaluator being able to observe all the variables affecting participation and outcomes; it also assumes that any selection on unobservable variables is trivial, in the sense that it does not affect any outcomes in the absence of treatment. The conditional independence assumption[25] requires that all variables relevant to the probability of treatment and outcomes, to be included in the vector of variables $X$.

Matching is thus only feasible where there is a robust understanding, based on theory and past empirical evidence, of the determinants of programme participation and the outcomes of interest. If this information is available, and the Conditional Independence Assumption (CIA) is plausible, then matching can be used. Usually a rich data set is required. CIA will not be met if certain variables that are likely to determine participation and outcomes are overlooked. This is a drawback compared to a genuine case of random assignment, where treated and non-treated populations are considered as similar, based on both observable and unobservable factors.

While the Propensity Score Matching (PSM) approach applied to observational studies (Rosenbaum and, 1983) offers a solution to the selection bias problem based on the `selection of observables', a limitation of using the PSM alone however, is the fact that the

[25] Another assumption of matching methods is that of common support. This condition requires and overlap in the distribution of covariates between treated and control groups to ensure a reliable matching. The assumption implies a positive probability of either $UKTI = 1$ or $UKTI = 0$.

results may be influenced by unobserved time-invariant selection bias. Even if we observe that supported firms perform better, this may not have been directly caused by the UKTI support itself (e.g. firms may have been better performers before they received support).

To deal with this possibility we then use a DID estimator on a sample of the treated and control group (derived using PSM) to minimise the effects of selection on unobservables. The DID estimator compares the pre and post-participation average performance for two groups of firms (treated (supported) and non-treated (control group)) to net out unobservable differences between the two that are constant over time.

The DID estimator can be computed by comparing performance *s* years after receiving UKTI support, with the corresponding value prior to the participation, which takes place in period *t*. In this research we look at performance one year after receiving support ($s = 1$).

$$\hat{\alpha}_{DID} = (\bar{y}_{t+s}^{UKTI} - \bar{y}_{t-1}^{UKTI}) - (\bar{y}_{t+s}^{NUKTI} - \bar{y}_{t-1}^{NUKTI}) \quad (5)$$

where $\bar{y}^{UKTI}{}_{t+s}$ is the mean performance (in outcome y) of firms receiving UKTI support $s$ years after the implementation of the program (in $t$ ); and $\bar{y}^{NUKTI}{}_{t+s}$ is the average of performance of the non-treated group over the same period.

The main advantage of applying a Difference-in-Differences approach to a sample of treated and a control groups is that we can control for pre-treatment growth performance of both groups of firms.

The availability of time series information on firm performance measures is essential for observing firms' behaviour before and after receiving the treatment (at least one period after and one period before). This comparison, however, is not likely to fully resolve the problems of non-random sample selection. Further differencing over time would be needed to eliminate the bias (Heckman, Ichimura and Todd, 1997).

Bryson et al (2002) review other advantages and disadvantages of this and other commonly-used evaluation techniques, assessing the credibility of the identifying assumptions underlying each of the techniques. We summarise here their assessment of the Propensity Score Matching estimator. The Propensity Score Matching estimator is regarded as a flexible tool for analysing programme effects on groups of particular interest. Its main strength lies in the ability of estimating mean programme effects for a population or a sub-group. It yields estimates of treatment on the treated. In relation to traditional regression techniques, its non-parametric nature means that it is not necessary to assume a functional form for the outcome equations, which can be an advantage when this is unknown. Data requirements associated to the implementation of the PSM technique however can be stringent and limit the reliability of its implementation.

PSM requires, on one hand, the inclusion of a sizable number of variables to estimate participation and outcome, and on the other hand, significant sample sizes, in terms of the number of participants and non-participants entering the matching process. Matching estimators highlight the problem of `common support', and this is another key condition for the correct implementation of the Propensity Score matching. The common support requirement means that there are enough observations (in our case firms) with identical characteristics that are observed in both states, that is, in participation and non - participation (Heckman, Ichimura and Todd, 1997). This condition is basic for identification as the PSM is computed by comparing the mean outcomes between participants and non-participants over the common (overlapping) region[26]. A decent sample size at each value of the propensity score is thus needed.

Small sample sizes can potentially bias the results when using PSM, or make it subject to large sampling errors yielding less precise estimates. Another data requirement of PSM relates to the availability of substantial amount of information on pre-treatment characteristics. These issue is not so critical in our research given the richness of our time series information.

Another limitation of PSM is that it can only provide estimates of mean effects, but cannot be used to obtain evidence in relation to distributional effects of a particular programme. Moreover, it cannot establish the impact of the programme beyond the eligible group (partial/general equilibrium effects cannot be recovered). Another issue that the PSM estimator does not tackle is the estimation of local average treatment effects; that is, the mean impact of a programme on those whose participation status change because of the change in policy.

To minimise the influence of a possible selection bias, the implementation of a Propensity Score Matching ensures that the characteristics of the treated units and those the control group are comparable, at least in a series of observable attributes. The complication arises because the selection bias can also be due to differences between participants and non-participants, that are not visible for the evaluator.

Bryson et al. (2002) argue that when there is not much evidence on the magnitude of the bias due to observable and unobservable factors, it is useful to apply matching methods to eliminate the bias due to observables, and then use other procedures (such as DID) to address the bias due to unobservable factors. The use of the latter, weakens the identifying assumption required by matching estimators, as the unobserved factors which are invariant over time are allowed to influence participation.

[26] The `common support' condition it rules out the phenomenon of being able to fully predict participation, given a set of characteristics; this essential `randomness' is key for correct identification of impacts.
$(overlap) \quad 0 < P(UKTI = 1)|\, X) < 1$
See Caliendo and Kopeinig (2008) for more details.

Bryson et al. (2002) also include an assessment of alternative methods, often used in the policy evaluation literature, to deal with selection on unobservables, such as the instrumental variable and Heckman selection estimators. The main drawback associated with the latter methods is that they usually require an instrument, that is, a variable that determines participation in the programme, but that does not influence outcomes. It is usually difficult to find variables that determine program participation but are not themselves determined by factors that affect the outcomes (Blundell and Costa Dias 2000). These circumstances can affect the credible application of these estimators.

*Empirical implementation of the Propensity Score Matching and Difference-in-Differences estimator*

We follow the method by Barba-Navaretti and Castellani (2010), and Meyer (1995) to implement the PSM-DID method empirically, adopting a two-step estimation procedure. We apply the PSM estimator to obtain our control or counterfactual group from our sample of non-supported companies. What we do here is to construct a control group drawn from the sample of non-supported firms, that resembles the sample of treated firms on a series of attributes. We firstly perform a simple one-to-one matching procedure, which means that each firm is matched only with one non-participant firm. The matching method attempts to mimic randomisation by selecting a sample of firms among those that did not receive the treatment, but are comparable on observable covariates to a sample of firms that did receive the treatment.

PSM employs a predicted probability of belonging to either group i.e. treatment vs. control group based on observed predictors, obtained from a Probit model. The matching procedure[27] is undertaken on a year-by-year basis; thus we avoid that a firm gets matched with another observation of the same firm in a different year. The matching strategy is performed on a cross-section basis, and once the matched firms are identified we pool all the observations to construct a panel of treated and control firms. An important issue is whether the appropriate `matching' variables are chosen, as otherwise the counterfactual would be flawed. We use a rich specification in order to perform the matching procedure, using information on size, age, turnover, IP activity, ownership, sector and region (all measured prior to treatment).

The choice of variables that predict participation is a critical one. It is useful to bear in mind, however, that this is a purely empirical exercise, and therefore we do not rely on any strand of economic theory to guide us on to which factors determine programme participation. It is not feasible to know with certainty which are the variables that affect the participation decision, and therefore need to be considered in the matching stage. We have followed previous empirical studies when selecting our list of variables. When in doubt, we opted for the inclusion of the broadest set of variables for which we have available information. For

[27] We use the psmatch2 module in Stata developed by Sianesi and Van Leuwen (2003).

instance, when considering the size of a firm, we included a number of different variables, such as the size of a firms' workforce, its total annual turnover and the size of its capital assets. In addition, we have considered other important firm activities, relating to trade and technological activities, as well as location and type of economic activity.

We also experiment with a more basic set of variables to undertake the matching so we reduce the cases for which we have missing information. In the presence of uncertainty, as highlighted above, it is better to include too many rather than too few variables, but it is also important to avoid over-parameterised models (Bryson et al, 2002).

Once we have defined a sample of matched and control firms, in a second step we estimate equation (6) outlined below (Meyer, 1995). The differential performance of the group of supported firms, relative to the one of the control group (DID) can be estimated using the following regression:

$$\Delta y_{it}^{j} = \gamma_{1t} d_t + \gamma d^j + \alpha_{DID}^{UKTI} d_t^j + x_{it}^{j'} \delta + \varepsilon_{it}^{j} \qquad (6)$$

where:

$j = (1,0)$ denotes the treatment and control groups.

$t = (0,1)$ denotes pre and post-support period.

$d_t = 1$ if $t = 1$ and 0 otherwise

$d^j = 1$ if j= $1$ and 0 otherwise

$d_t^j = 1$ if $t = 1$ and $j = 1$ ; 0 otherwise; note that $d_t^j = d^j * d_t$

In the left hand side of equation (6), $\Delta y_{it}^{j}$ represents the annual growth in outcome $y$ experienced by firm *i*, which is classified as being in the treated or control group, either during the post and/or pre-treatment period.

The OLS estimate of $\alpha_{DID}^{UKTI}$ is the DID estimator of the effect of receiving UKTI support**.** When we restrict ourselves to the post-support period only ($t = 1$) then we have the simple PSM estimator.

In our baseline results we use a nearest-neighbour matching estimator (with no caliper), where we pair each firm with one firm from the control group, the one with the closest propensity score[28].

[28] The use of other alternative matching methods (for example, *nth* nearest neighbours, where more than one firm is used in the matching process) did not produce different results. We also tried using a caliper which indicates a minimum distance for the propensity score, and again the results did not vary.

## 6.2 Empirical results: The impact of UKTI trade services on business performance

### 6.2.1 Baseline results

We start this part of the analysis by looking at the impact of UKTI support on a range of firm-level performance measures, denoted by $\Delta y$ in our model: growth in employment, growth in turnover, growth in total fixed assets and labour productivity. We then extend the analysis and look at the likelihood of survival and variables measuring the level of engagement in international markets.

Table 8 (upper panel) shows a summary of the results of estimating equation $(6)$ by Ordinary Least Squares for our baseline sample; that is, the sample of firms for which we have information on employment and turnover. We present the estimates of parameter $\alpha_{DID}^{UKTI}$, combined PSM-DID estimate, for a range of economic outcomes. For comparison, we also show the results of applying a simple PSM estimator.

When we apply a basic PSM estimator we obtain a positive and significant effect of UKTI support on growth in employment, growth in turnover, and growth in the value of assets for treated firms. The coefficient for employment is 0.0252, which is statistically significant at the 1% level. This estimate implies that UKTI support leads to higher employment growth in supported firms of 2.52% per annum, in the year after support is received. The estimated coefficients for turnover growth and asset growth are also positive and statistically significant (0.0390 in the case of turnover and 0.0308 in the case of assets). The coefficient on labour productivity growth, albeit positive, is not statistically significant.

When we implement the PSM-DID estimator, we find that the estimated treatment effect for employment growth is no longer statistically significant. The rest of the coefficients remain positive and significant; with the exception of labour productivity growth case, these coefficients are smaller than in the case of the simple PSM. The estimated effect on turnover growth is now 0.0145. Reflecting the result that the PSM-DID estimate of the treatment effect on employment growth is no different from zero, the estimated treatment effect for labour productivity (0.0185) is positive and significant at the 1% level.

Table 8 (lower panel) also presents the results for a sample where we exclude the top 5 % of observations in terms of assets. This makes our results more comparable to those in Breinlich et al (2012), who use Propensity Score Matching techniques to evaluate the impact of OMIS and other similar UKTI programmes over the period 2006-2008. Our PSM results are broadly in line with the results found by this study. When comparing the magnitude of the coefficients with the Breinlich et al's study we have to bear in mind that in their study the estimates refer to a two-year period; in our paper the estimates refer to a one year periods. Also, we cover a broader range of UKTI support.

We first compare the results of our basic PSM estimates (excluding the top 5% of firms in asset value) to Breinlich et al study, which is also based on the PSM approach. Their estimated coefficient for the employment variable over a two-year period is 0.037; ours is 0.0275 per annum. Their estimate for the growth of turnover is 0.061, ours is 0.042 per annum, which may reflect the shorter time period over which we evaluate the impacts. UKTI support is also found to have had a positive and significant influence on the growth of assets, but while their estimate over a two-year period is 0.090, our estimate is lower at 0.0316 per annum.

With regards the productivity results, the PSM estimation suggests positive coefficients in both ours and Breinlich et al's study, although these are not statistically significant.

What do these coefficients imply in terms of economic magnitudes? First, we take the coefficients from table 8. The estimated coefficient for **employment** derived from using a PSM estimator (after excluding top 5% firms) is 0.0252. We also know that the mean supported firm for this sample has 215 employees and the median firm 83 employees (See table 5). These figures suggests that the annual employment gains for the mean supported firm following participation in a UKTI service was about 5 jobs. For the median firm, the employment gains were lower: 2 jobs. These results are roughly consistent with findings reported previously. Breinlich et al.'s study found that over a two-year time frame nearly 7 jobs were created in the average firm using OMIS and roughly 3 jobs in the median firm[29].

We need to be cautious about the magnitude of these gains, as they do not stand up when we control for fixed unobservable differences between UKTI users and non-users using the PSM-DID approach. The main difference when combining PSM with DID is that we no longer find any evidence that UKTI support leads to immediate employment gains (see table 8, second row). The effect of UKTI support on employment growth in treated firms is now no different from zero; this is the case when we look at our main sample and when excluding the largest companies in terms of asset value.

When we look at the **turnover** results these appear more robust across the two econometric specifications. Our estimated coefficient with the PSM technique was 0.0390. The annual turnover for the average supported firm in our sample is £34,617,000 and the annual turnover for the median firm £11,960,000 (see table 5, excl. largest firms). These figures suggest an increase in annual turnover for the average firm of £1,350,000 and an annual increase of £466,440 for the median UKTI user. These estimates are comparable (although slightly larger) to those in Breinlich et al's study. They find that, over a two-year period, participation in OMIS led to a £1,500,000 increase in turnover for the average firm using OMIS, and a £611,000 increase in turnover for the median firm. As noted above, we cover participation in a broader range of UKTI services, including OMIS.

[29] The magnitudes estimated by Breinlich at al (2012) over two periods are slightly less than double our figures, which have been estimated over annual periods. This is the closest comparison we can establish between the figures in the two studies, as they have been estimated over a different timeframe.

The estimates for turnover using the PSM-DID approach are smaller in magnitude than those achieved using the PSM estimator. The coefficient for turnover growth is now 0.0145, which implies an annual increase in turnover of £501,946 for the average UKTI supported firm and an annual increase of £173,420 for the median firm. Using a PSM estimator we find a positive and significant effect of UKTI support on asset growth, but only when we exclude outliers. The estimates of PSM-DID are positive but no longer significant.

Table A.7 in the appendix contains the estimation results for two additional sub-samples. First, we estimate equation (6) for the sample of companies that file unconsolidated accounts only. Second, we exclude firms at the bottom and top percentiles of the distribution of productivity and profitability. Reassuringly the conclusions based on these samples are consistent with the conclusions obtained when analysing the baseline sample, although there are a few differences.

For firms filing unconsolidated accounts, the coefficient on asset growth when using PSM-DID (0.101) is now statistically significant at 5%; the coefficient on productivity is a little lower to our baseline estimate. When we exclude firms at the top and bottom of the distributions in terms of productivity and profitability, the estimated impact on asset growth is also positive and statistically significant when applying the PSM-DID estimator. The estimated effects on productivity are only significant when using the PSM-DID estimator.

Table 8. Effect of UKTI support on growth outcomes, 2005-2012.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| | *All companies* | | | |
| *Propensity Score Matching* | 0.0252*** | 0.0390*** | 0.0308*** | 0.0043 |
| | (0.00298) | (0.0037) | (0.00321) | (0.00392) |
| *Propensity Score Matching +DID* | -0.00286 | 0.0145*** | 0.00402 | 0.0185*** |
| | (0.0033) | (0.0042) | (0.00363) | (0.0055) |
| | *Excl. largest companies (top 5% in terms of assets)* | | | |
| *Propensity Score Matching* | 0.0275*** | 0.0421*** | 0.0316*** | 0.00288 |
| | (0.00308) | (0.00384) | (0.00344) | (0.00427) |
| *Propensity Score Matching +DID* | -0.00288 | 0.0145*** | 0.00519 | 0.0167*** |
| | (0.00353) | (0.00444) | (0.00398) | (0.00601) |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

## *Robustness: variations in the Propensity Score Matching estimator*

In this section we perform a series of robustness tests to ensure the validity of the matching results and estimated average treatment effects.

As we perform the matching exercise separately for each year, a concern may be that some firms that are treated in a particular year, may be included in the control group in another year. This is because our treatment indicator is time-varying. To avoid this problem, we now include in the control group only those firms that are never supported. We re-estimate the main equation (6) and report the results in table 9 below. The estimated coefficients are slightly higher, but the results are largely consistent with our baseline results reported in table 8. See appendix table A.8 for estimates using samples that exclude other sets of outliers.

Table 9. Effect of UKTI support on growth outcomes, 2005-2012 (control group only includes firms that are never supported).

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| | *All companies* | | | |
| *Propensity Score Matching* | 0.0267*** | 0.0435*** | 0.0355*** | 0.00516 |
| | (0.00301) | (0.00373) | (0.00326) | (0.00383) |
| *Propensity Score Matching +DID* | -0.00203 | 0.0191*** | 0.00943*** | 0.0191*** |
| | (0.00327) | (0.0042) | (0.00359) | (0.0054) |
| | *excl. largest companies (top 5% in terms of assets)* | | | |
| *Propensity Score Matching* | 0.0292*** | 0.0472*** | 0.0365*** | 0.004 |
| | (0.00312) | (0.00389) | (0.00349) | (0.00418) |
| *Propensity Score Matching +DID* | -0.00226 | 0.0196*** | 0.0108*** | 0.0173*** |
| | (0.00351) | -0.00448 | (0.00395) | (0.00591) |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Following Sianesi (2004) our model includes the variables of the propensity score model in lags (one period before treatment, *t-1*[30]), so that these are measured strictly before participation. We re-estimated equation 6, with the variables in time *t.* and the results are reported in Table 10. The results are consistent with the baseline results, although the coefficients tend to bit slightly smaller.

[30] The variables included in the PSM model are in lags, $p(UKTI|X_{t-1})$.

Table 10. Effect of UKTI support on growth outcomes, 2005-2012 (variables of the propensity score matching not in lags).

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| | *All companies* | | | |
| *Propensity Score Matching* | 0.0206*** | 0.0336*** | 0.0297*** | 0.00169 |
| | (0.00289) | (0.00376) | (0.00322) | (0.00385) |
| *Propensity Score Matching +DID* | -0.00496 | 0.0111*** | 0.00292 | 0.0127** |
| | (0.00318) | (0.00411) | (0.00354) | (0.00534) |
| | *Excl. largest companies (top 5% in terms of assets)* | | | |
| *Propensity Score Matching* | 0.0230*** | 0.0368*** | 0.0309*** | 0.000305 |
| | (0.003) | (0.00394) | (0.00345) | (0.00418) |
| *Propensity Score Matching +DID* | -0.00507 | 0.0110** | 0.00425 | 0.0106* |
| | (0.0034) | (0.00436) | (0.0039) | (0.00581) |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Only those variables that influence simultaneously the treatment status and the outcome variable should be included in the PSM. As the choice of variables included in the propensity score model can influence the probability of treatment we tried different specifications, some richer others more parsimonious. The main conclusions do not change.

There are several matching methods that can be applied. For the baseline results we have implemented a basic nearest-neighbour matching estimator. A number of neighbours can be used to calculate the matched outcomes. Nearest-neighbour matching evaluates absolute differences in the propensity score where a number of *k* nearest neighbours can be chosen (where $k = 1, 2, \dots, 3$). We have re-estimated the basic model using up to 3 nearest neighbours. When using nearest neighbour methods we find a match for each treated firm, but this means that some matches may be poor, as for some treated firms the nearest neighbour may have a very different propensity score.

Some options to deal with this problem include radius matching methods. Radius matching specifies a "caliper", that is, a maximum propensity score difference, where only those firms that lie within the caliper's radius are chosen as matches. The advantage of imposing a threshold on the maximum distance is that bad matches are more likely to be excluded. However a problematic issue is that the choice of caliper may be considered arbitrary, as a priori, it is clear what is the best choice of tolerance level. We have re-estimated the baseline models using a calliper of 0.01, which imposes a 1% tolerance level on the maximum propensity score distance allowed. The conclusions do not change when adding caliper options and more than one neighbour.

The *common support hypothesis* can be tested graphically[31]. For instance, we can inspect the densities of propensity scores of treated and non-treated firms. See figure A.7 in the appendix. If common support holds there should be an overlap of propensity scores of participants and non-participants, across the different propensity score levels. We can see that, for each of the years, we have enough number of observations along the different value of propensities scores, for both groups of UKTI participants and non-participants.

The main purpose of the PSM is to balance the covariates between the treated and the controls, to ensure that the two groups are not too dissimilar; checking the balancing properties should reinforce the validity of the average treatment effect estimation. First of all, we tested whether our matching procedure is able to balance the distribution of all relevant variables in the control and treatment groups[32]. We follow Rosembaum and Rubin (1985), which suggest a two-sample test for comparing the distributions of the covariates in the treated and matched control groups. We compare UKTI users and non-users, before and after the matching, and explore differences in the balancing of covariates after conditioning on the propensity score.

The tests are reported in set of tables A.15-A.16 in the appendix. We report these tests year by year. This is because we undertake the matching exercise for each year separately. Our results show that, before matching, there were significant differences between users and non-users; after matching, the differences are no longer significant in the majority of variables, which suggests good balancing.

In addition we provide a graphic summary of the covariate balancing test (See figures A.8 in the appendix). The dotcharts illustrate the standardised percentage bias for each covariate, for the matched and the unmatched samples.

Additional robustness test were carried out to ensure that the overall results are not driven by one particular UKTI service. Table 11 reports the results of re-estimating equation (6) for the different outcomes, now excluding one UKTI service at a time (and applying the PSM-DID estimator). In the first column we report the results of the model if we exclude records belonging to “Post significant assists”, which is the most prevalent scheme. When we exclude this service we still find a positive association between UKTI support and the following outcomes: turnover growth, and labour productivity growth. The magnitude of the coefficients are larger than for the overall sample with the largest effect found on turnover. The effects on employment growth are not statistically significant.

We re-estimated again the model excluding from the sample the observations belonging to several other UKTI services, one at a time. Along the columns of table 11 we show the results of re-estimating equation (6) after excluding the different sets of observations (using

[31] It is also possible to test this more formally using a non-parametric test.
[32] The Psmatch2 command in Stata also includes routines for common support graphing and covariate imbalance testing (*pstest).*

PSM and DID estimator). The excluded programmes are those that account for the largest number of records, and therefore are the ones most likely to have an important influence on the overall results (Post significant assists, English Regions Trade Advisors (ERTA), TAP group, OMIS, Passport, Post events, ER Events, Inward Missions, Sector events UK, Sector events abroad[33].)

The results are broadly consistent with the conclusions from the baseline results: we find positive effects on turnover. In all cases the coefficients on labour productivity are generally positive and statistically significant. For comparison we present the results of estimating the model using a PSM only in Appendix table A.9. As in our baseline model we find that UKTI support has more widespread positive effects, not only on turnover, but also on employment and assets. However these results are more likely to be driven by unobserved factors and can be less directly associated with the effects of the policy.

[33] **Post Significant assists** are "*one-to-one support provided by staff at British embassies/consulates overseas";* **English Regions trade Advisors** (ERTA) is *"support and/or advice given by international trade advisors working in the English regions"* ; **TAP group** (Tradeshow Access Program) refers to *"grant support for eligible SME firms to attend trade shows overseas"* ; **OMIS** (Overseas Market Introduction Service) refers to *"advice provided to firms about a market, including market strategy, identification of business partners etc";* **Passport** is *"a scheme aimed at helping businesses who are either new to exporting or fairly inexperienced exporters (readiness assessment and export plan, services aimed at helping firms to research and visit prospective overseas markets)";* **Post events**; **English Regions** Events (ER) are *"events arranged by UKTI's regional teams to provide advice on business opportunities overseas"*; **Inward missions** are meetings in the UK with overseas businesses; **Sectoral events UK; Sector events abroad**).

Table 11. Effect of UKTI support on growth outcomes, excluding one programme at a time (PSM-DID estimator).

| | *excluding. Post signif. assist* | *excluding. ERTA* | *excluding. TAP Group* | *excluding. OMIS* | *excluding. Passport* | *excluding. Post events* | *excluding. ER. Events* | *excluding. Inw. mission* | *excluding. Sec. events UK* | *excluding. Sec. events abroad* |
|---|---|---|---|---|---|---|---|---|---|---|
| *All companies* | | | | | | | | | | |
| Employment | -0.0056 | -0.00323 | -0.00384 | -0.00243 | -0.00253 | -0.00305 | -0.00339 | -0.00167 | -0.00115 | -0.00273 |
| | (0.00465) | (0.00414) | (0.00411) | (0.00411) | (0.00398) | (0.00404) | (0.0041) | (0.00407) | (0.00414) | (0.00403) |
| Turnover | 0.0174*** | 0.0148*** | 0.0118** | 0.0169*** | 0.0141*** | 0.0134** | 0.0148*** | 0.0164*** | 0.0110** | 0.0150*** |
| | (0.00592) | (0.00534) | (0.00535) | (0.00534) | (0.00514) | (0.0052) | (0.00527) | (0.00524) | (0.00537) | (0.0052) |
| Assets | 0.00385 | 0.0039 | 0.00496 | 0.00323 | 0.00479 | 0.00427 | 0.00194 | 0.0062 | 0.00432 | 0.00451 |
| | (0.00509) | (0.0046) | (0.00454) | (0.0046) | (0.00437) | (0.00447) | (0.00451) | (0.00451) | (0.00463) | (0.00447) |
| Labour productivity | 0.0200*** | 0.0219*** | 0.0187*** | 0.0187*** | 0.0187*** | 0.0182*** | 0.0208*** | 0.0170*** | 0.0168** | 0.0187*** |
| | (0.0073) | (0.00667) | (0.00658) | (0.00658) | (0.00658) | (0.00649) | (0.00656) | (0.00649) | (0.00665) | (0.00648) |
| *excl. largest companies (top 5% in terms of assets)* | | | | | | | | | | |
| Employment | -0.00544 | -0.00361 | -0.00441 | -0.00234 | -0.00247 | -0.00278 | -0.00379 | -0.00186 | -0.000406 | -0.00275 |
| | (0.00476) | (0.00423) | (0.00423) | (0.0042) | (0.00406) | (0.0041) | (0.0042) | (0.00417) | (0.00419) | (0.00409) |
| Turnover | 0.0145** | 0.0141** | 0.0113** | 0.0180*** | 0.0141*** | 0.0141*** | 0.0146*** | 0.0156*** | 0.0122** | 0.0159*** |
| | (0.00628) | (0.00565) | (0.00566) | (0.00559) | (0.00542) | (0.00547) | (0.00556) | (0.00555) | (0.00561) | (0.00546) |
| Assets | 0.00284 | 0.00572 | 0.00678 | 0.00377 | 0.00605 | 0.00524 | 0.00322 | 0.00744 | 0.006 | 0.00604 |
| | (0.00546) | (0.00491) | (0.00485) | (0.00488) | (0.00464) | (0.00473) | (0.00479) | (0.00479) | (0.0049) | (0.00473) |
| Labour productivity | 0.0177** | 0.0201*** | 0.0171** | 0.0147** | 0.0167** | 0.0165** | 0.0194*** | 0.0149** | 0.0137** | 0.0173*** |
| | (0.00751) | (0.00688) | (0.0068) | (0.00689) | (0.00659) | (0.00666) | (0.00677) | (0.00669) | (0.00687) | (0.00665) |

Robust bust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

## *Other outcomes: Internationalisation and firm survival*

Our results so far suggest that UKTI support has had a positive impact on several firm performance variables, with the largest effects found for turnover. This section explores the effect of UKTI support on other relevant firm outcomes, in particular those related to the international operations of UK companies. We may expect UKTI support to have a positive impact on the level of sales or turnover generated in overseas markets.

FAME has information on the level of overseas turnover; this variable may comprise exports but may also include the activity of foreign subsidiaries. It is not possible to distinguish between these two and it may be problematic as we are not able to isolate the effect of UKTI support on exports alone.

Another issue to bear in mind when using this variable is that the information is missing for a large number of firms. We therefore have had to assume that when firms do not report overseas turnover this is likely to be zero. This is an important limitation, as firms may actually be exporting but not reporting this information as they are not required to do so. Due to the nature of the data, there is a large concentration of observations at zero values. In order to deal with these discontinuities and model whether UKTI services have led to an increase in the presence of UK firms in international markets, we have created three dummy variables (we follow here Breinlich et al., 2102).

### - *A) Overseas turnover growth*

First, we have created a variable measuring whether firms experience a positive growth in overseas turnover following participation in UKTI support programmes, conditional on this information being non-missing in both periods. Based on this variable, we create a dummy variable taking a value of 1 if the firm experienced positive overseas turnover growth and 0 if it does not. More formally:

$D_{1t} = 1$ if $\Delta \ln(ovturn)_{t+1} > 0$

$D_{1t} = 0$ *Otherwise*

} Conditional on $ovturn_{t+1} > 0$ and $ovturn_t > 0$

### - *B) Export markets entry*

Second, we construct a dummy variable measuring whether firms entered export markets. We identify a firm as having `entered export markets' if it did not report overseas turnover

in the year of support, or report zero overseas turnover in that year, but did report positive overseas turnover one year later[34].

$D_{2t} = 1$ if $ovturn_t = 0$ and $ovturn_{t+1} > 0$

$D_{2t} = 0$ *Otherwise*

- *C) Share of overseas turnover over total turnover*

Third, we have created a variable that measures the share of overseas turnover as a percentage of total turnover of the firm (using the variables in nominal terms). We then define a dummy variable to capture whether an increase in this share has occurred following participation in UKTI programmes.

$$D_{3t} = 1 \quad if \quad (\frac{ovturn}{turn})_t - (\frac{ovturn}{turn})_{t-1} > 0$$

} Conditional on $ovturn_{t+1} > 0$ and $ovturn_t > 0$

$D_3 = 0$ *Otherwise*

- *D) Survival*

Another outcome analysed in this section is the likelihood of survival. We have information on the last year in which the firm has been active, therefore, for every year, we can derive the following dummy variable:

$S = 1$ if max active> t

$S = 0$ *Otherwise*

To model these outcomes we firstly use the PSM technique to obtain our sample of control firms. In the second stage we estimate Probit models. In table 12 below we summarise the results of estimating a) the probability that UKTI support has resulted in an increase in the likelihood of survival, b) the likelihood that firms increase their level of overseas turnover, and c) the likelihood of firms entering export markets after receiving UKTI guidance, and d) the likelihood that the overseas share of turnover has increased.

In the upper part of Table 12 we present the results for our full sample (for all companies including the top 5% firms in asset value). The results (reported in column (b) suggest that firms that have a higher chance of experiencing an increase in their international sales following UKTI treatment. As noted above, this analysis related solely to the sub-group of

[34] See discussion of data above for the circumstances under which firms are not required to report overseas turnover. This is a source of unavoidable measurement error in the data.

firms who reported information on overseas turnover in both years (zero or positive). The estimated coefficient is 0.086 (see upper panel of table 12), which is statistically significant at the 1% level. In column (d) we see that, after participation, there is also a higher probability that overseas turnover (measured as a share total turnover) increases. The coefficient attached to this variable is 0.0479, which is statistically significant at 1% level. Furthermore, in column (c) we observe a positive association between UKTI support and the likelihood of a firm reporting positive turnover in the subsequent period. This is what we call entry into export markets[35]. The coefficient on this variable is however of a smaller magnitude (0.0165). It should be noted that as for this analysis we are focusing on changes over just two consecutive time periods, we are not taking account of the possibility that firms may have reported overseas turnover in other years.

Finally in column (a) we report results for our analysis of whether UKTI support enhances the probability of survival for a firm which show that this appears to be the case. The coefficient of this variable (around 0.0172) is close to that estimated in Breinlich et al's study for OMIS users. This result suggests that in a given year, UKTI users are 1.6% more likely to remain in business during the following year, compared to non-users.

These results appear robust when estimating over different sub-samples, that is, when excluding the top 5% of observations in terms of assets (bottom panel table 12), when dropping observations at the bottom and top of the distribution of productivity/profitability and when dropping firms filing consolidated accounts (See appendix table A.10).

Table 12. Effect of UKTI support on internationalisation and survival; 2006-2012.

| Dep variable (dummy 1/0) | Probability of survival<br>(a) | Positive overseas turnover growth<br>(b) | Entry overseas<br>(c) | Overseas turnover as share of turnover<br>(d) |
|---|---|---|---|---|
| | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| | *All companies* | | | |
| Effect of UKTI support | 0.0172*** | 0.0863*** | 0.0165*** | 0.0479*** |
| | (0.00116) | (0.00299) | (0.00153) | (0.00422) |
| | *Excl. largest companies (top 5% in terms of assets)* | | | |
| Effect of UKTI support | 0.0163*** | 0.0808*** | 0.0150*** | 0.0471*** |
| | (0.00127) | (0.00307) | (0.00155) | (0.00449) |

Robust bust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

[35] Strictly speaking this should be entry into overseas markets as it also encompasses turnover generated by foreign subsidiaries of UK companies.

### 6.2.2 Multiple treatment

Next, we consider **the effect of multiple participation** on business performance. Our data comprises participation in 32 different UKTI service categories, with many firms using UKTI support more than once. Previous studies have generally not found strong evidence that the benefits of support were enhanced by using more than one UKTI service, although the range of services evaluated in those studies was more limited.

We classify firms as multiple treatment firms if they received more than one UKTI service, either in the same year (participating in different programmes), in different years, or both[36].

Table 13 shows the total number of observations pertaining to both multiple and single treatment firms. We show these figures for three samples: our matched sample, our broad sample (matched firms for which we have information on total assets) and the regression sample (firms for which in addition to asset information we have data on employment and turnover). Amongst the multiple users, we distinguish between those that take up support between two and than five times, and those than take it up more than five times (again within the same year and/or or in different years).

Of the total number of UKTI records that were matched to FAME (145,139), a total of 133,290 correspond to multiple use; of these, 94,832 correspond to firms that have received more than 5 treatments[37]. The number of distinct firms receiving between two and five treatments was 12,767, and the number of firms receiving more than five treatments was 7,211. In percentage terms, this indicates that the total number of firms receiving UKTI support in two or more occasions was 63%; while the number of firms receiving support on a one-off basis was lower at 11,849 (37%). These figures are largely consistent with those published in the latest PIMS report in relation to the incidence of multiple use[38].

Focusing on the regression sample (lower panel table 13), the number of firms receiving two to five treatments was 2,815 (4,904 records) and the number of firms receiving more than five treatments was 2,759 (10,720 records); the number of single users was 1,883. These

[36] Research finds that UKTI clients often re-use the same services. The most common sequences are four consecutive uses of "Post significant assists", four consecutive uses of the "Web Business Opportunities Service", and four consecutive uses of "TAP group". The most common sequences that involve different UKTI services relate to combinations of "Post significant assists", and "ER events", and combinations of "Post significant assists" and "Sector events UK". There were a total of 3,466 different sequences that applied to multiple companies, and a further 31,983 companies that followed a unique sequence. This implied a total of 35,440 unique customer journeys. See PIMS 32-35 Report for further details, September 2014 (PIMS 2014). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/380406/PIMS_32-35_report__Part_1__-_D2.pdf

[37] On average companies have used UKTI services on 4.7 occasions (PIMS 2014). Post significant assists are the most common entry point; 27.6% of all UKTI clients use this service first, but this has decreased in recent years.

[38] Covering the period ranging from October 2005 and December 2013, PIMS (2014) found that 2/3 of clients have obtained support on two or more separate occasions.

figures suggest that the percentage of firms receiving multiple treatment is a little higher than in the original (matched) sample.

Table 13. Number of observations by multiple and single status, 2005-2011.

| ***Matched sample*** | | | | |
|---|---|---|---|---|
| | *One-off treatment* | *Multiple treatment* | | *Total* |
| | | *two to five treatments* | *Over five treatments* | |
| Number of records | 11,849 | 38,458 | 94,832 | 145,139 |
| Number of firms | 11,849 | 12,767 | 7,211 | 31,827 |
| ***Broad sample*** | | | | |
| | *One-off treatment* | *Multiple treatment* | | *Total* |
| | | *Two to five treatments* | *Over five treatments* | |
| Number of records | 11,827 | 25,667 | 37,375 | 74,869 |
| Number of firms | 11,827 | 12,765 | 7,216 | 31,808 |
| ***Regression sample*** | | | | |
| | *One-off treatment* | *Multiple treatment* | | *Total* |
| | | *Two to five treatments* | *Over five treatments* | |
| Number of records | 1,883 | 4,904 | 10,720 | 17,507 |
| Number of firms | 1,883 | 2,815 | 2,759 | 7,457 |

The results of estimating our main equation (6) for the two definitions of multiple treatment are shown in tables 14 and 15. Table 14 looks at the effect on business performance of firms that receive between two and five treatments, relative to non-users. Table 15 looks at firms receiving more than five treatments. In order to keep consistency with other sections, we show in the appendix tables A.11 and A.12 the results for different sub-samples: for firms filing unconsolidated accounts, and after we exclude extreme observations.

When we estimate equation (6) using the PSM estimator and the PSM-DID estimator we find a positive and significant effect of UKTI support on employment growth, turnover and asset growth (to a lesser extent), as found in our baseline results (Table 8).

The magnitudes of the coefficients suggest that multiple-treatment firms perform slightly better in terms of growth of employment and asset growth (and to a lesser extent turnover growth). For multiple users, the coefficients for all outcome variables are higher in the case of firms who have received more than 5 services (table 15). But, statistically, the impact of using between two and five treatments (table 14), and more than 5 treatments (table 15) are little different to one another and little different to our baseline estimates (table 8).

We find that participation in multiple programmes increases the chance of reporting positive turnover growth, entry into overseas markets and the share of overseas turnover in aggregate turnover. The results also indicate that using multiple UKTI services enhances the likelihood of survival. This result is consistent with the results of the Breinlich et al's study. Those firms that receive more than five treatments have better internationalisation

outcome than those with five treatments or less. The exception seem to be entry in overseas markets, where we do not find evidence that the number of treatments has an impact on the likelihood of entering international markets.

Table 14. Multiple treatment - Firms receiving between two and five treatments: the effect of UKTI support on growth outcomes, 1995-2012.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *All companies* | | | | |
| *Propensity Score Matching* | 0.0269*** | 0.0393*** | 0.0330*** | 0.00323 |
| | (0.00317) | (0.00398) | (0.00342) | (0.00497) |
| *Propensity Score Matching +DID* | -0.00232 | 0.0139** | 0.00472 | 0.0156** |
| | (0.00418) | (0.00539) | (0.00461) | (0.00661) |
| *Excl. largest companies (top 5% in terms of assets)* | | | | |
| *Propensity Score Matching* | 0.0292*** | 0.0426*** | 0.0335*** | 0.000619 |
| | (0.00319) | (0.00416) | (0.00369) | (0.00514) |
| *Propensity Score Matching +DID* | -0.00231 | 0.0140** | 0.00614 | 0.0120* |
| | (0.00426) | (0.00569) | (0.0049) | (0.00679) |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 15. Multiple treatment – More than five treatments: the effect of UKTI support on growth outcomes, 1995-2012.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *All companies* | | | | |
| *Propensity Score Matching* | 0.0285*** | 0.0441*** | 0.0357*** | 0.00625 |
| | (0.00373) | (0.00462) | -0.00393 | (0.00688) |
| *Propensity Score Matching +DID* | -0.0000927 | 0.0196*** | 0.00766 | 0.0165** |
| | (0.00494) | (0.00621) | (0.00536) | (0.0077) |
| *Excl. largest companies (top 5% in terms of assets)* | | | | |
| *Propensity Score Matching* | 0.0316*** | 0.0474*** | 0.0364*** | 0.00697 |
| | (0.00369) | (0.00489) | (0.00426) | (0.00704) |
| *Propensity Score Matching +DID* | 0.00029 | 0.0192*** | 0.00947 | 0.0139* |
| | (0.005) | (0.00662) | (0.00576) | (0.00786) |

Robust bust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: In the multiple treatment group we include those firms with at least 5 treatments over the whole period analysed.

Table 16. Effect of UKTI support on internationalisation and survival; Multiple treatment - Firms receiving between two and five treatments, 2006-2012.

| | Probability of survival (a) | Positive overseas turnover growth (b) | Entry overseas (c) | Overseas turnover as share of turnover (d) |
|---|---|---|---|---|
| | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| *All companies* | | | | |
| *Effect of UKTI support (α)* | 0.0180*** | 0.0907*** | 0.0171*** | 0.0503*** |
| | (0.00119) | (0.00319) | (0.00162) | (0.00445) |
| *Excl. largest companies (top 5% in terms of assets)* | | | | |
| *Effect of UKTI support (α)* | 0.0169*** | 0.0850*** | 0.0153*** | 0.0496*** |
| | (0.00132) | (0.00328) | (0.00165) | (0.00474) |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 17. Effect of UKTI support on internationalisation and survival; Multiple treatment - more than five treatments, 2006-2012.

| | Probability of survival (a) | Positive overseas turnover growth (b) | Entry overseas (c) | Overseas turnover as share of turnover (d) |
|---|---|---|---|---|
| | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| *All companies* | | | | |
| *Effect of UKTI support (α)* | 0.0231*** | 0.0982*** | 0.0175*** | 0.0583*** |
| | (0.00119) | (0.00386) | (0.00192) | (0.00529) |
| *Excl. largest companies (top 5% in terms of assets* | | | | |
| *Effect of UKTI support (α)* | 0.0223*** | 0.0907*** | 0.0153*** | 0.0579*** |
| | (0.00135) | (0.004) | (0.00196) | (0.00572) |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

We find that the multiple use of UKTI services leads to an improvement in outcomes such as asset growth and employment growth relative to single use. However these differences are not statistically large. We do not find strong evidence that multiple use leads to additional benefits in terms of turnover growth, especially for those using UKTI services a reduced number of times, as compared with the impact of single service use.

We distinguish users that use UKTI services a reduced number of times (two up to five times) from those that receive the services more than five times. We find that, those firms than use UKTI services more than five times experience on average higher turnover, employment, and asset growth, although the differences are not very large. Although the results suggest that repeated use of UKTI services may lead to higher business benefits for firms, we need to be cautious in interpreting these results and statistical validity needs to be considered.

### 6.2.3 High intensity programmes

In this section we investigate whether **participation in high-intensity UKTI services** enhances benefits for UK businesses. Published PIMS reports identify as 'high intensity support' most of the UK based advisory services, all of which appear to have relatively high impact as measured by the PIMS[39] "improved business performance"[40] measure. Based on this measure as our criterion, we also identify services in the PIMS 'Tradeshows and Missions'[41] service categories. We have additionally included the 'OMIS' service in this group on the grounds that it is the tailored advisory service provided by the UKTI overseas network, and shows relatively high impact for the overseas services (as compared with 'Posts Significant Assists' or Events); see table 18. We run our regressions restricting the sample to firms participating in high-intensity services[42], as an attempt to identify whether the estimated coefficients differ significantly in comparison to those based on the whole set of UKTI service categories.

[39] PIMS – Performance and Impact Monitoring Survey is used to assess the quality and impact of services provided by UKTI.

[40] "Improved business performance" metric captures the percentage figures reporting that they have achieved sustainable (i.e. longer-term) improvements in productivity and profitability, after they have secured additional sales as a result of support from UKTI. A more detailed explanation can be found in section 11.1 of the annual PIMS report.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/380407/PIMS_32-35_report_Part_2_-_D2.pdf

[41] PIMS Quarterly Reports, Summary Results, slide 7. Tradeshows and Missions include the Tradeshow Access Programme (Solo, Group, and non-funded), Outward Missions, and Market Visit Support. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/327878/Summary_Results_PIMS_35_-_D1.pdf

[42] While the impact of these programmes may change over time we hold the definition of high intensity constant throughout the period of analysis.

Table 18. High intensity services (improved business performance, PIMS)

| *Program* | *Improved business performance (%)* |
|---|---|
| Passport | 74% |
| GGG | 70% |
| EMRS | 78% |
| ECR | 73% |
| Market Visit Support | 76% |
| TAP Solo | 76% |
| TAP Group | 79% |
| TAP Non-funded | 79% |
| Outward Missions | 71% |
| OMIS | 58% |

Table 19. shows the results of estimating equation (6) for the different sub-samples defined in previous sections. We present again the results of applying both a simple PSM estimator and a PSM-DID estimator.

Looking at the results of the PSM estimator, we see that the estimated coefficients for growth in employment, growth in turnover and growth in assets are again positive and statistically significant. The coefficient for employment is larger in magnitude than those from the sample that includes all UKTI services. The coefficient on employment is now 0.0272 (which is higher than the coefficient 0.0252 from table 8). The coefficient on turnover and asset growth is slightly below now. However the coefficients are not statistically very different.

The average employment for the sample of firms that participate in these intensive programmes (excl. the largest companies) is 158, which is lower than for the total equivalent sample (215). This means that the annual increase in jobs for the average firm would be of around 4.3 jobs. In terms of median (71 employees), it would be just under 2 jobs. In terms of turnover, the mean turnover for this sample is £23,922 and the median is £10,127. This indicate an increase in the annual turnover of £870,000 and a median of £368,622.

Finding that the coefficients on employment, turnover and asset growth are not overall more favourable for the high-intensity programmes may reasonable given the fact that these are short-term changes in business performance, evaluated year-on year. The results suggest that over this time framework, the participation on high-intensity programmes does not bring significantly better outcomes for firms than the participation in the rest of programmes. While this result might appear to conflict with the evidence from PIMS, this is not necessarily the case, as the PIMS 'Improved Business Performance' measure refers to the *proportion of firms* reporting this benefit, while our analysis refer to the *magnitude of impact* and does not address the issues of *distribution of benefit.* In addition, our high-intensity regression sample represents a small part of the overall sample, which limits our ability of find significant results.

When applying the PSM-DID estimator to our analysis of the impact of high-intensity services, we find that the coefficient for turnover growth stays positive and significant and of a similar magnitude to the results from the PSM. The results for employment growth are no longer significant. The results for high-intensity programmes do not suggest that labour productivity is strongly improved by UKTI support (reflecting the estimated increase in employment growth). These results hold across the different sub-group analyses. The results reported in table 20 on internationalisation outcomes are comparable to those in table 12, suggesting a similar impact of high intensity programmes and UKTI support more broadly defined on the probability of survival and export performance.

Table 19. High-intensity programmes: Effect of UKTI support on growth outcomes, 2005-2012.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *All companies* | | | | |
| *Propensity Score Matching* | 0.0272*** | 0.0356*** | 0.0281*** | -0.00338 |
| | (0.00472) | (0.00569) | (0.00529) | (0.00778) |
| *Propensity Score Matching +DID* | 0.00141 | 0.00822 | 0.000209 | 0.0191* |
| | (0.0064) | (0.00784) | (0.00709) | (0.0103) |
| *Excl. largest companies (top 5% in terms of assets)* | | | | |
| *Propensity Score Matching* | 0.0289*** | 0.0364*** | 0.0274*** | -0.00562 |
| | (0.00465) | (0.00612) | (0.00569) | (0.00789) |
| *Propensity Score Matching +DID* | 0.00145 | 0.00692 | 0.00142 | 0.0164 |
| | (0.00623) | (0.00839) | (0.0075) | (0.0103) |

Robust bust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 20. High-intensity programmes: Effect of UKTI support on internationalisation and survival, 2005-2012.

| Dep variable (dummy 1/0) | Probability of survival | Positive overseas turnover growth | Entry overseas | Overseas turnover as share of turnover |
|---|---|---|---|---|
| | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| | *All companies* | | | |
| Effect of UKTI support (α) | 0.0162*** | 0.0844*** | 0.0142*** | 0.0484*** |
| | (0.00129) | (0.00472) | (0.00232) | (0.0067) |
| | *Excl. largest companies (top 5% in terms of assets)* | | | |
| Effect of UKTI support (α) | 0.0158*** | 0.0778*** | 0.0137*** | 0.0483*** |
| | (0.0014) | (0.00477) | (0.00238) | (0.00706) |

Robust bust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

### 6.2.4 By size group

In this section we investigate whether the effect of UKTI support varies by firm size group, as the baseline results for the overall sample are likely to hide some degree of variation in this respect. We distinguish three groups of firms: "1-49 employees", "50-249 employees" and ">=250 employees". The total number of observations of firms between 1 and 49 employees is 333,489; the total number of observations of firms with employees between 50 and 249 employees is 158,936, and the number of observations belonging to firms with at least 250 employees is 72,298.

The results of estimating our growth model (6) by group size are reported in Table 21. When applying a Propensity Score Matching estimator the coefficients for the employment variable are positive and significant for all groups, and are found to increase with size. The coefficients are larger for those firms with more at least 250 employees. When applying the PSM-DID, the results for employment are no significant for firms with less than 50 employees. This results is equivalent to the result for the overall sample, as the companies with less than 50 employees account for the largest part of the full estimation sample. However, the coefficient is positive and significant for larger firms, with the largest effects for those firms with at least 250 employees.

The results for the turnover variable indicate, as for the overall sample, a positive and significant impact of UKTI support. The magnitude of the impact, however, is larger for firms with less than 50 employees, both when using PSM or PSM-DID. With regards asset growth, we generally find a positive and significant coefficient when using Propensity Score Matching only. This result is consistent with what we found for the full sample (See table 8 of the report). The magnitude of this effect, as in the case of turnover, is highest for the firms with less than 50 employees. When we apply a Propensity Score Matching in conjunction with the Difference-in differences estimator, the coefficients are positive but no longer significant, with one exception, the group of the largest firms; for this group we still find a positive and significant impact of UKTI support.

These results point to the existence of some differences in performance across size groups. We find stronger impacts on turnover and asset growth for the smallest group of firms; however only for the largest companies we find evidence of significant short-term employment gains.

Table 21. Effect of UKTI support on growth outcomes, by employment size, 2005-2012.

| Dep variable | **Employment growth** | **Turnover growth** | **Assets growth** | **Labour productivity growth** |
|---|---|---|---|---|
| | | ***All companies*** | | |
| UKTI support (α) | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| *1-49 employees* | 0.0302*** | 0.0696*** | 0.0423*** | 0.0153 |
| | (0.00619) | (0.00982) | (0.00803) | (0.0116) |
| *50-249 employees* | 0.0296*** | 0.0215*** | 0.0191*** | -0.0149*** |
| | (0.00363) | (0.00457) | (0.00445) | (0.00574) |
| *250+ employees* | 0.0319*** | 0.0255*** | 0.0308*** | -0.00104 |
| | (0.0063) | (0.0064) | (0.00469) | (0.00852) |
| | *Propensity Score Matching +DID* | *Propensity Score Matching +DID* | *Propensity Score Matching +DID* | *Propensity Score Matching +DID* |
| *1-49 employees* | 0.00756 | 0.0323** | 0.00459 | 0.0136 |
| | (0.00918) | (0.014) | (0.0111) | (0.0164) |
| *50-249 employees* | 0.0200*** | 0.0150** | -0.000824 | -0.00727 |
| | (0.00506) | (0.00635) | (0.00587) | (0.00792) |
| *250+ employees* | 0.0358*** | 0.0236*** | 0.0157** | -0.00198 |
| | (0.0072) | (0.00772) | (0.00653) | (0.0108) |
| | | ***Excl. largest companies (top 5% in terms of assets)*** | | |
| UKTI support (α) | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| *1-49 employees* | 0.0302*** | 0.0688*** | 0.0416*** | 0.0165 |
| | (0.00604) | (0.00987) | (0.00809) | (0.0116) |
| *50-249 employees* | 0.0295*** | 0.0218*** | 0.0199*** | -0.0155*** |
| | (0.00367) | (0.00447) | (0.00435) | (0.00573) |
| *250+ employees* | 0.0391*** | 0.0344*** | 0.0355*** | -0.00416 |
| | (0.00691) | (0.00696) | (0.00598) | (0.00964) |
| | *Propensity Score Matching +DID* | *Propensity Score Matching +DID* | *Propensity Score Matching +DID* | *Propensity Score Matching +DID* |
| *1-49 employees* | 0.00415 | 0.0286** | 0.00497 | 0.0132 |
| | (0.00884) | (0.014) | (0.0111) | (0.0162) |
| *50-249 employees* | 0.0207*** | 0.0162*** | 0.000499 | -0.00992 |
| | (0.00508) | (0.00613) | (0.00568) | (0.00791) |
| *250+ employees* | 0.0376*** | 0.0215** | 0.0174** | -0.0025 |
| | (0.00806) | (0.00909) | (0.00811) | (0.0115) |

# 7. Decomposition of productivity

In this section we address the research question (see also executive summary):

*VII. What is the likely effect of UKTI support on UK firms on the UK economy, beyond the effects on the participant firms?*

Section 6 provides evidence on the effects of UKTI support on business performance. We identify the effects on supported firms relative to those that do not receive the support, after controlling for several factors likely to determine firm performance.

We have found that UKTI support had a positive impact on turnover growth and a more modest impact on labour productivity growth; the effects on employment do not appear statistically significantly. We have also found that UKTI support is positively linked with firm survival.

Beyond the effects on the supported firms, UKTI can also have indirect impacts on the aggregate economy, mainly through *dynamic competition* effects. Support may either enhance the advantage of more productive firms who see an increase their market share, or instead help less efficient firms to remain in the market. By affecting survival of firms, support may have a significant effect on the composition of the business population. Identifying the extent of these impacts across the wider economy is however a challenging exercise.

One problem arises because of the limited scope for using the FAME database to capture developments in the aggregate UK economy. The company accounts information provided in FAME is selective rather than being drawn as a (stratified) random sample making extrapolation to the wider economy more difficult.

In this section we do two things. First, we investigate the role of UKTI users in the context of the wider economy, by examining to what extent productivity changes in the sample we use arise from changes within the treatment group (`within effects'), but also exploring the compositional effects between the *treated* and *non-treated* groups (`between' effects). When drawing conclusions, we need to bear in mind that the results will only apply to the sample of companies that we are able to observe in these data, and therefore the results are only meant to be indicative of these effects. This is not an estimate of the impacts of UKTI treatment on the wider economy, but rather provides descriptive information as to the mechanisms underlying productivity growth amongst the two different groups. Second, we interpret our estimates of the impact of UKTI support on treated firms from previous sections in the context of this framework.

*Productivity growth decomposition*

First of all we implement a decomposition of productivity based on a well-known methodology (Griliches and Regev, 1995; Foster et al, 2001; Levinsohn and Petrin, 2012). We adapt a traditional *decomposition of productivity* framework to capture the importance of *within* effects and *between* effects of two different sub-sets of firms: *supported and non-supported firms*.

This sort of methodology has previously been used in the literature to measure the contribution of exporters and inward investors to overall productivity growth (Harris and Moffat, 2013). We follow the approach by Criscuolo (2005) who uses this approach to measure the contribution of two groups of firms, "foreign-owned" and "domestic firms", to overall productivity growth in the UK. We follow a simple specification by Criscuolo (2005) in order to quantify the contribution of supported and non-supported firms durAing the period of our analysis.

Our aim is, on the one hand, to quantify the overall contribution of the group of supported firms to aggregate labour productivity growth; on the other hand, to explain these contributions in terms of `within group' effects *vis-à-vis* `dynamic competition' effects, which involves reallocation of market shares. We thus want to understand whether the aggregate contribution during this period has dominated by the gains accrued by supported plants becoming on average more productive over time, or by a market selection process.

Overall labour productivity can be expressed as the weighted sum of UKTI supported firms' and non-supported firms' productivity growth rates:

$$\frac{1}{k} * \frac{\Delta LP}{LP_{t-k}} = \sum_{i=UKTI,NUKTI} \frac{w_{it}LP_{it} - w_{it-k}LP_{it-k}}{LP_{t-k}} * \frac{1}{k}$$

where LP is labour productivity calculated as the ratio of output (gross value added) at constant prices to labour input (number of employees); Δ denotes change; $k$ indicates the number of years over which we compute labour productivity growth.

The left hand side is aggregate (annualised) labour productivity growth; $w_{UKTI_t} = \frac{EMP_{UKTI_t}}{EMP_t}$ is the market share of the group of supported firms[43]; $w_{NUKTI_t} = \frac{EMP_{NUKTI_t}}{EMP_t}$ is the employment share of the group of non supported firms.

The *contribution of supported firms* can be expressed as the sum of a `within' and a `between' effect, as in:

[43] We use employment shares to measure market shares following Criscuolo (2005). An alternative would be to use output shares.

$$\frac{1}{k} * \frac{\left(\frac{EMP_{UKTI_t}}{EMP_t}\right) * LP_{UKTI,t} - \left(\frac{EMP_{UKTI_{t-k}}}{EMP_{t-k}}\right) * LP_{UKTI_{t-k}}}{LP_{t-k}}$$
$$= \underbrace{\frac{1}{k} * \frac{\Delta LP_{UKTI_{t^*}}}{LP_{t-l}} * \overline{w}_{UKTI}}_{within\ effect} + \underbrace{\Delta w_{UKTI_t} * \frac{1}{k} * \frac{\overline{LP}_{UKTI}}{LP_{t-k}}}_{between\ effect}$$

Where $\Delta LP$ is the change in labour productivity between the periods *t* and *t-k*; $\overline{w}$ is the average share of employment during the period 2006-2011; $\Delta w$ is the change in the employment share and $\overline{LP}$ is the average level of labour productivity across the years considered.

The contribution to labour productivity growth by UKTI users over the period 2006-2011 comes from *labour productivity growth within the group of supported firms* (`within' effect) and *the switches of labour resources between UKTI users and the rest of firms in the economy* (`between' effect).

The within effect can be negative if productivity growth amongst UKTI users is negative on average. The between term can be negative if there is a negative change in the market employment shares of UKTI users.

The overall contribution to labour productivity growth can be negative if: a) the contribution of both terms is negative; b) if either the within effect or the between effect are negative and larger in absolute value than the other (positive) term.

In the tables below we show the relative weight of the within and between components in the labour productivity growth of supported and non-supported firms during the period of analysis.

Table 22 below shows that the within effect was slightly negative for UKTI users during the period analysed (2006-2011), while the within component was positive for the other companies. In contrast, the sign of the between term was positive for UKTI users and negative for the non-users.

Table 22. Contributions to labour productivity growth of UKTI users and non-UKTI users: `Within' and `between' effects, 2006-2011.

| | *All companies* | |
|---|---|---|
| | UKTI users | Non-UKTI users |
| Within effect | -0.007 | 0.0212 |
| Between effect | 0.016 | -0.0101 |

Table 23 reports the variables determining the sign of the contribution of the within and between effects. We can see an increase in the employment shares from the group of non-supported towards the group of supported firms. The average level of labour productivity is positive in both sub-groups although larger for users.

Table 23. Components of within and between effects, 2006-2011.

| | *All companies* | | | |
|---|---|---|---|---|
| | *Within* | | *Between* | |
| | $\Delta LP$ | $\overline{w}$ | $\Delta w$ | $\overline{LP}$ |
| UKTI users | -0.239 | 0.1585 | 0.066 | 1.2185 |
| Non-UKTI users | 0.1263 | 0.8405 | -0.055 | 0.9236 |

Table 24 below shows the results of the decomposition when focusing on the years of the economic crisis (thus excluding 2010 and 2011). Here we can see more clearly that the within effect was negative during the period 2006-2009 for both users and non-users. This suggests that overall productivity growth was negative during the period in the UK. The between effect was positive for the group of supported firms and negative for non-supported firms.

Table 24. Contributions to labour productivity growth of UKTI users and non-UKTI users: Within and between effects; 2006-2009.

| | *All companies* | |
|---|---|---|
| | UKTI users | Non-UKTI users |
| Within effect | -0.0266 | -0.104 |
| Between effect | 0.0671 | -0.0314 |

Table 25 below shows in detail the components of within and between effects during the period 2006-2009. We can see that there was an increase of market shares towards supported firms, which are on average more productive than the non-supported.

Table 25. Components of within and between effects, 2006-2009.

| *All companies* | | | | |
|---|---|---|---|---|
| | *Within* | | *Between* | |
| | $\Delta LP$ | $\overline{w}$ | $\Delta w$ | $\overline{LP}$ |
| UKTI users | -0.40 | 0.1985 | 0.135 | 1.2185 |
| Non-UKTI users | -0.39 | 0.8005 | -0.135 | 0.698 |

## *Computing a counterfactual aggregate labour productivity*

In the decomposition analysis we provide an overall picture of labour productivity growth performance (and its components), of the group of firms that have been supported and the group of firms that have not been supported in our sample, over the period of analysis. The scope of this exercise is purely descriptive and aims to put into context the contribution of supported firms during 2006-2011, a period characterised by the 2008-2009 global financial crisis and the subsequent economic slowdown.

We can interpret our impact coefficients from the previous sections in a similar context, as a means of gauging the contribution of UKTI support to aggregate level productivity. We compare an actual aggregate productivity figure to a counterfactual figure, derived from our impact estimates, that proxies for what would have happened at the aggregate level had UKTI support not taken place. In this approach we can derive how firm-level estimates translate into productivity gains at the aggregate level (Criscuolo et al, 2006), for our sample of firms.

To illustrate these types of aggregate effects we consider the case of the continuing firms only, and focus on the productivity effects within the supported firms. In section 6 we found some evidence that UKTI support had a positive effect on labour productivity growth and no significant effect on employment growth.

For each treated firm we calculate, for each year, what productivity would have been in absence of support (the counterfactual), using the estimate for the average treatment effect of productivity from (6) (see table 8).

$$\Delta lp^{cf} = \Delta lp - \alpha_{lp}$$

Too move from the counterfactual at the firm-level to the aggregate sample productivity counterfactual we compute a weighted average of the counterfactual firm-level productivities. The weights are the individual firms' employment shares; note that the weights are only valid for this sample of firms. Denoting the firm level weights by $w_{it}$ the counterfactual aggregate productivity is estimated as:

$$\sum_i w_{it} \Delta LP_{it}^{cf}$$

We measure the impact on the sample aggregate labour productivity growth as:

$$\sum_i w_{it}\, \Delta LP_{it} - \sum_i w_{it} \Delta LP_{it}^{cf}$$

We thus obtain an aggregate estimate of labour productivity growth of 0.005 (annual average). This estimate reflects the share of UKTI firms in the sample and the estimated impact of labour productivity of treated firms. A wider economy estimate is likely to be smaller (because the share of UKTI firms in the wider economy will be smaller than the share of UKTI firms in the sample).

With regards to the importance of between effects we have found in the decomposition analysis that there is reallocation of market shares towards the group of UKTI supported firms as a whole (we find a positive effect of UKTI support on firm survival). Because UKTII users appear slightly more productive than other firms this will tend to raise aggregate productivity.

The calculation of an aggregate sample effect from the micro estimates now becomes more complicated; not only the changes in the individual productivities, but also the changes in the composition of firms needs to be taken into account in the calculation of the counterfactual. The aggregate productivity counterfactual figure has to be based on different employment shares and will need to take account of the survival probabilities.

Overall this exercise is intended to provide an illustration of how one might interpret estimates of the impact of UKTI support on UKTI users in a wider context. However, obtaining aggregate economy impact estimates, to the extent this is feasible, is beyond the scope of this study.

## 8. Conclusions

The descriptive part of this analysis has shed light on the characteristics of firms entering UKTI programmes. UKTI users tend to be larger, older and more productive than non-UKTI users. They are also more likely to report overseas turnover and be part of a UK multinational group. UKTI users are more likely to be engaged in IP activities and belong to the UKTI manufacturing sector, in comparison to non-users. Contrary to prior expectations, we find that, within a sector, foreign-owned companies are less likely to receive support than domestic-owned firms.

While a higher number of supported firms are located in London and the South East, these regions turn out to be under-represented in our sample of UKTI users; this finding is apparent when looking at the regional distribution of non-supported firms, drawn from a larger population of UK firms. Other areas including the North East, the North West,

Yorkshire and the Humber, the East and West Midlands, and Scotland are instead over-represented in our sample of UKTI users.

Multiple-use firms are found to be larger, more productive and with a higher probability of engaging in IP activities than firms receiving one-off services from UKTI. Multiple and single UKTI users, however, do not significantly differ in terms of age and multinational status. Multiple users are less likely to be foreign owned than single users.

Our econometric analysis has shown that UKTI support has had a positive effect on several business outcomes of UK firms; these findings are in line with findings from previous studies. In particular, our results are consistent with those reported in other UKTI studies, which also use a similar econometric technique (Propensity Score Matching estimator). When using a more sophisticated estimator (PSM in combination with Difference in Differences), which further controls for permanent differences between UKTI users and non-users, we also find that performance improves in the aftermath of receiving support. However the magnitude of the effects is lowered. This estimation method yields smaller estimates for turnover and asset growth, and in the case of employment gains these are no longer found to be significant. We find that labour productivity is enhanced by support, but this result is not always significant.

After excluding potential outliers we obtain the same clear-cut result: UKTI support primarily enhances turnover, and to a lesser extent growth in the value of assets. It also enhances the probability of firms increasing their level of overseas turnover and facilitates entry to export markets. It is also associated with an increase in the probability of survival.

We experiment with different definitions of our treatment variable. In this research we find indication that “multiple support firms” do experience enhanced business benefits; the evidence that the participation in some “high-intensity” programmes results in improved results in the short term is however weaker, at best. Caution always needs to be taken in comparing the estimates of UKTI support for different sub-samples of firms, and the results do not always appear statistically significant.

The aggregate analysis has investigated the notion that UKTI support may not only have an effect on the firms that receive UKTI support, but also has widespread effects across the economy. The results suggest that the group of supported firms may have gained market share during the period of analysis, reflecting the positive effects on firm survival. As the group of supported firms as whole is slightly more productive, the overall productivity increases. The nature of our data, however, seriously limits our ability to draw firm conclusions for the aggregate UK economy.

*References*

Arnold, J. and B. Javorcik (2009), "Gifted kids or pushy parents? Foreign Direct Investment and Plant Productivity in Indonesia," Journal of International Economics, vol. 79(1), pp. 42-53, September.

Barba Navaretti, G., Castellani, D. and A.C. Disdier (2010), "How Does Investing in Cheap Labour Countries Affect Performance at Home? Firm-level Evidence from France and Italy", Oxford Economic Papers, 62(2), pp. 234-260.

Barba Navaretti, G., and A. J. Venables (2004), Multinational Firms in the World Economy, Princeton, NJ: Princeton University Press.

Barba Navaretti, G. and D. Castellani (2004), "Investments Abroad and Performance at Home: Evidence from Italian Multinationals", CEPR Discussion Paper No. 4284.

Belloc, M. and M. Di Maio (2011), "Survey of the Literature on Successful Strategies and Practices for Export Promotion by Developing Countries", International Growth Centre Working Paper No 11/0248.

Blundell, R. and M. Costa Dias (2000), "Evaluation Methods for Non-experimental data", Fiscal Studies, Vol. 21, pp. 427-468.

Breinlich, H., Mion, G., Nolan, P. and D. Novy (2012), "Intellectual Property, Overseas Sales, and the Impact of UKTI Assistance in Entering New Overseas Markets", Report to UKTI.

Bryson, A., Dorsett, R. and S. Purdon (2002), "The Use of Propensity Score Matching in the Evaluation of Active Labour Market Policies", Working Paper Number 4, Department of Work and Pensions.

Caliendo, M. and S. Kopeinig (2008), "Some Practical Guidance for the Implementation of Propensity Score Matching", Journal of Economic Surveys, 22, pp. 31–72.

Caliendo, M., and S. Künn (2011), "Start-Up Subsidies for the Unemployed: Long-Term Evidence and Effect Heterogeneity, Journal of Public Economics, 95(3-4), pp. 311-331.

Castellani, D. and A. Zanfei (2004), "Cherry-picking' and Self-selection: Empirical Evidence on Ex-ante Advantages of Multinational Firms in Italy", *Applied Economics Quarterly*, 50, 1, 2004.

Castellani, D., and A. Zanfei (2006), Multinational Firms, Innovation and Productivity, Edward Elgar, Cheltenham, UK.

Castellani, D., and A. Zanfei (2007), "Internationalisation, Innovation and Productivity: How do Firms Differ in Italy?", The World Economy, 30, 1, 156-176.

Criscuolo, C. (2005), "The Contribution of Foreign Affiliates to Productivity Growth: Evidence from OECD Countries", OECD Science, Technology and Industry Working Papers, 2005/8, OECD Publishing.

Criscuolo, C. and R. Martin (2009), "Multinationals and US Productivity Leadership: Evidence from Great Britain", The Review of Economic and Statistics, vol.9, No.2, pp.263-281, May.

Criscuolo, C., Martin, R. Overman, and J. Van Reenen (2006), "Longitudinal Micro-data Study of Selected Business Support Schemes", Final Report Stage 2, Centre for Economic Performance.

Disney, R.F., Haskel, J., and Y. Heden (2003), "Restructuring and Productivity Growth in UK Manufacturing", Economic Journal, 113: pp. 666-694.

Driffield, N., Du, J., Hart M., Love J. H. and E. Tapinos (2010), "A Comparative Evaluation of the Impact of UK Trade & Investment's R&D Programme and other UKTI Support that Impacts R&D. Report for UKTI 2010[44].

Foster, L., Haltiwanger, J. and C.J. Krizan (2002), "The Link Between Aggregate and Micro Productivity Growth: Evidence from Retail Trade", NBER Working Papers 9120, National Bureau of Economic Research, Inc.

Gil, S., R.Llorca and J. A Martínez Serrano, J, (2008), 'Measuring the Impact of Regional Export Promotion: The Spanish Case', *Papers in Regional Science*, Vol 87, no 1, 139-147.

Giles, J.A. and C.L. Williams (2000), "Export-Led Growth: A Survey of the Empirical Literature and Some Non-causality Results Part I", *Econometrics Working Papers 0001*, Department of Economics, University of Victoria.

González-Val, R., & Lanaspa, L. and F. Pueyo (2009), "Trade Policies, Concentration, Growth and Welfare," Economic Modelling, Elsevier, vol. 26(6), pages 1355-1364, November.

Gorg,H., Girma, S. and M. Pisu (2005), "Quantitative analysis and linked micro-data study of UKTI services, University of Nottingham.

Greenaway, D. and R. Kneller (2003), "Exporting, Productivity and Agglomeration: A Matched Difference in Difference Analysis of Matched Firms", *GEP Research Paper*, 03/45, Leverhulme Centre for Research on Globalisation and Economic Policy, University of Nottingham.

Griliches, Z., and H. Regev (1995), "Productivity and Firm Turnover in Israeli Industry: 1979-1988", Journal of Econometrics, 65 (1), pp. 175-203.

Harris, R. and C. Robinson (2003), "Foreign Ownership and Productivity in the United Kingdom Estimates for UK Manufacturing Using the ARD", Review of Industrial Organization, 22, Issue 3, pp 207-223.

Harris, R. and J. Moffat (2013), "The Direct Contribution of FDI to Productivity Growth in Britain, 1997-2008", the World Economy.

Harrison, A. and Andres Rodríguez-Clare (2009), "Trade, Foreign Investment, and Industrial Policy for Developing Countries", *NBER Working Papers*, 15261.

44 http://www.ukti.gov.uk/fr_fr/uktihome/aboutukti/ourperformance/evaluation/comparativeandcrosscutting.html

Hayakawa, K., Lee, H. and D. Park (2011), "Do Export Promotion Agencies Increase Exports?", IDE Discussion Papers 313, Institute of Developing Economies, Japan External Trade Organization (JETRO).

Heckman, J., Ichimura, H. and P. Todd (1997), "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme", Review of Economic Studies, Wiley Blackwell, vol. 64(4), pages 605-54, October.

Helmers C., Rogers, M. and P. Schautschick (2011), "Intellectual Property at the Firm-Level in the UK", Oxford University, Department of Economics Working Paper No. 546.

Helpman, E. and P. Krugman (1985), "Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International economy", The MIT press.

International Study Group on Exports and Productivity (ISGEP) (2008) "Understanding Cross-Country Differences in Exporter Premia: Comparable Evidence for 14 Countries," Review of World Economics (Weltwirtschaftliches Archiv), 144(4) 596-635.

Kneller, R. and D. Greenaway (2008), "Exporting, Productvity and Agglomeration", European Economic Review, 52(5), pp. 919-939.

Levinsohn, J. and A. Petrin (2012), "Measuring Aggregate Productivity Growth Using Plant-Level Data", Rand Journal of Economics, 43, issue 4. pp. 705-725, Winter.

London Economics (2013), "Secondary Analysis of 24 waves of PIMS", Final Report to UK Trade and Investment.

London Economics (2012), "Evaluation of the Impact and Cost effectiveness of UKTI's Regional Network Support"[45].

Love, J. and S. Roper (2014), "SME innovation, Exporting and Growth", ERC White Paper No. 5.

Mayer, T. and G.I.P Ottaviano (2007), "The Happy Few: The Internationalisation of European Firms", Bruegel Blueprint.

Lechner, M. and M. Eichler (2002), "An Evaluation of Public Employment Programmes in the East German State of Sachsen-Anhalt", IZA D.P. No. 94.

Lechner, M. (1999), "Earnings and Employment Effects of Continuous Off-the-Job Training in East Germany after Unification", Journal of Business and Economic Statistics, 17.

Meyer, B. (1995), "Natural and Quasi-experiments in Economics", NBER Working Technical Paper No. 170".

Rogers, M. and C. Helmers (2007), "Analysis of linked Passport and FAME Data for UKTI, Stage 1 Report (May 2007[46])

[45] http://www.ukti.gov.uk/uktihome/aboutukti/ourperformance/evaluation/specifictradeservices.html

[46] http://www.ukti.gov.uk/uktihome/aboutukti/ourperformance/evaluation/specifictradeservices.html

Rogers, M. and C. Helmers (2008), "Intellectual Property and UKTI Passport Firms, Stage 2 Report (March 2008), UKTI.

Rogers, M and C. Helmers (2010), "Intellectual Property, Exporting, and UKTI support for Export Capability Building", Report to UKTI, May 2010.

Rosenbaum, P.R. and D.B. Rubin (1983), "The Central Role of the Propensity Score in Observational Studies for Causal Effects", Biometrika 70 (1), S.1-55.

Sena, V., Rogers, M. and N. Smith, "The role of Foreign Direct Investment in the UK IP and the impact of UKTI support", December 2011[47].

Volpe, C. and J. Carballo (2010), "Is Export Promotion Effective in Developing Countries? Firm-Level Evidence on the Intensive and Extensive Margins of Exports," IDB Publications 36763, Inter-American Development Bank.

Wagner, J. (2007), "Exports and Productivity: A Survey of the Evidence from Firm-level Data", The World Economy, Wiley Blackwell, vol. 30(1), pages 60-82, 01.

Wagner, J. (2013) "Are Low-Productive Exporters Marginal exporters? Evidence from Germany," Economics Bulletin, Access Econ, vol. 33(1), pp. 467-481.

http://www.ukti.gov.uk/uktihome/aboutukti/ourperformance/evaluation/comparativeandcrosscutting.html

[47] http://www.ukti.gov.uk/uktihome/aboutukti/ourperformance/evaluation/inwardinvestmentsupport.html

# 9. APPENDIX TABLES AND GRAPHS

A1A. Abbreviations (List of service categories).

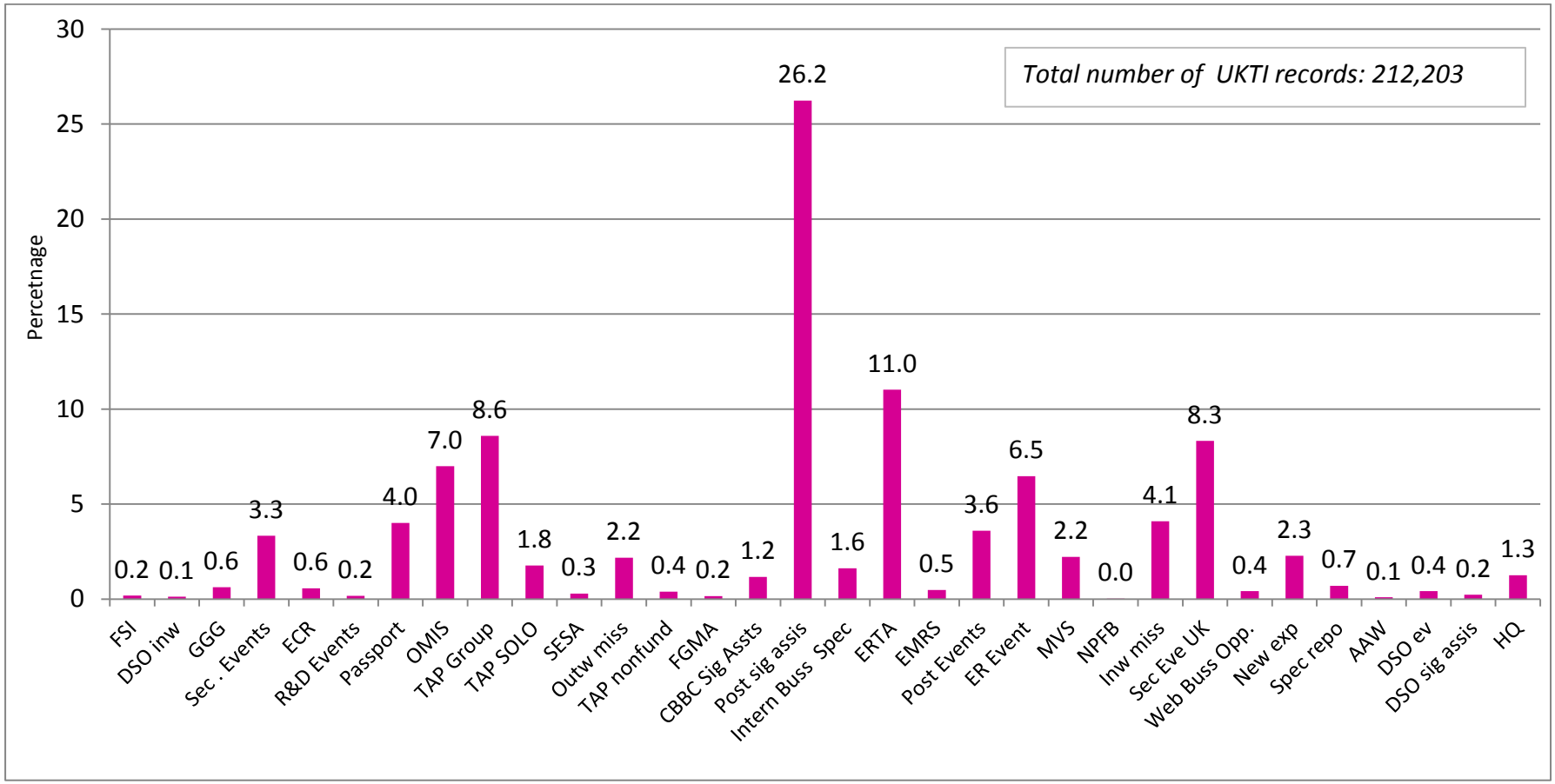
| Service category | Description |
|---|---|
| *Event categories* | |
| FSI | Fiscal Stimulus Initiative (FSI) Events (discontinued) |
| Sec Events | Sector Events Abroad |
| R&D Events | R&D Events |
| Posts Events | Posts Events |
| DSO Events | DSO Events |
| ER Events | English Regions Events |
| Sec Eve UK | Sector Events UK |
| HK Events | HQ Events |
| AAW | Aid Agency Workshops |
| *Advisory services* | |
| GGG | Gateway Global Growth |
| ECR | Exports Communication Review |
| EMRS | Export Marketing Research Scheme |
| Passport | Passport |
| ERTA | English Regions Trade Advisors (ERTA) Significant Assists |
| FGMA | Fast Growing Markets Advisors (FGMA) Significant Assists discontinued) |
| CBBC Sig. Assts | China-Britain Business Council (CBBC) Significant Assists |
| Post Sig. Assists | Posts Significant Assists |
| Intern Bus Spec | International Business Specialists |
| New exp | New to Export Assists (discontinued) |
| DSO sig assis | DSO Significant Assists |
| *Tradeshows and missions* | |
| DSO inw | DSO Inward Missions |
| TAP Group | Tradeshow Access Program Group |
| TAP Solo | Tradeshow Access Program SOLO |
| SESA | Outward Missions (SESA) |
| Outw Miss | Outward Missions |
| TAP nonfund | Tradeshow Access Program (TAP) Non funded |
| MVS | Market Visit Support (MVS) |
| Inw miss | Inward Missions |
| *Other services* | |
| Web Buss Opp. | Web Business Opportunities Service |
| Spec repo | Special Reports |
| NPFB | New Products From Britain (discontinued) |

## A1B. Other abbreviations

| Name | Description |
|---|---|
| UKTI | UK Trade and Investment |
| PIMS | Performance and Impact Monitoring Survey |
| FAME | Financial Analysis Made Easy |
| IPO | Intellectual Property Office |
| PSM | Propensity Score Matching |
| DID | Difference in Differences |

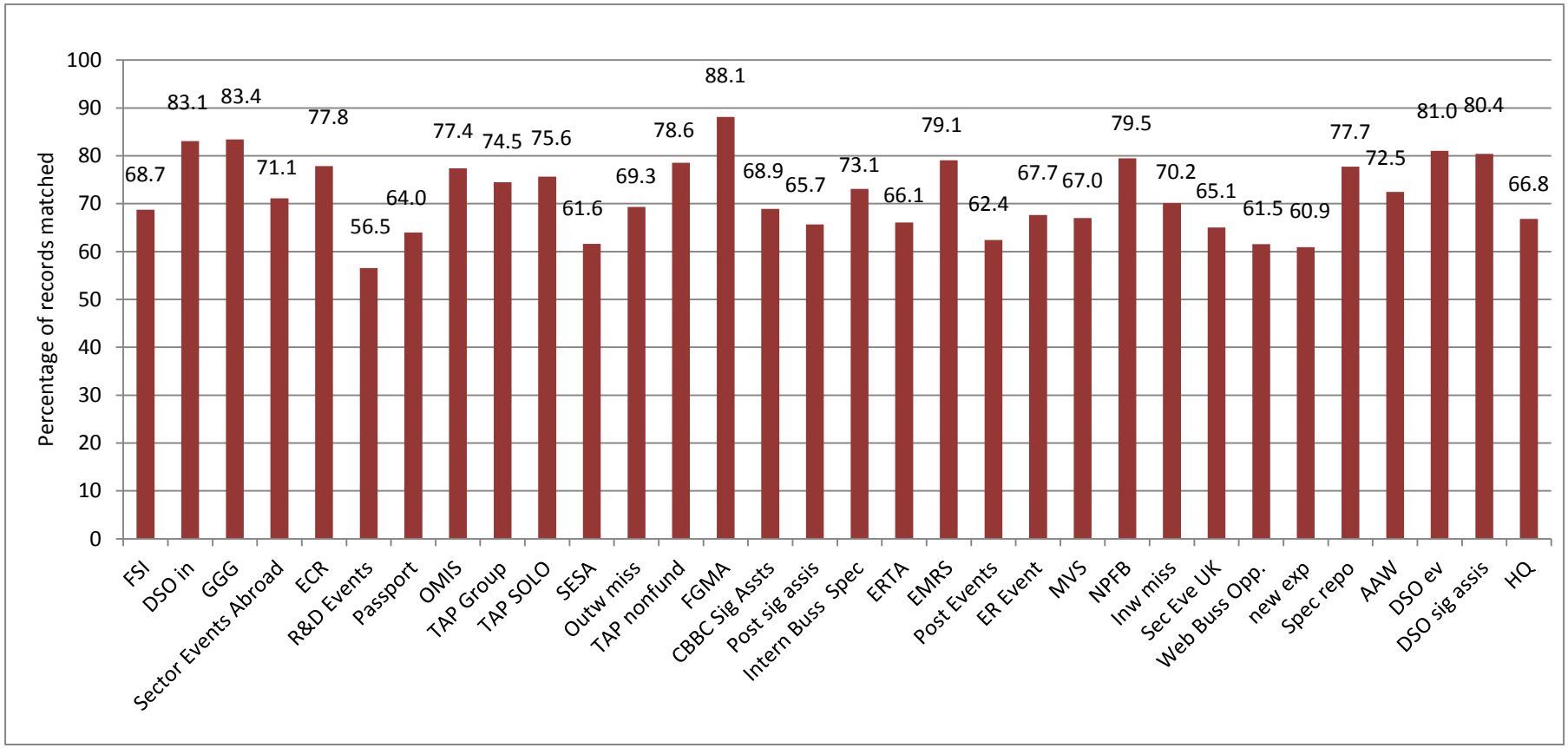
APPENDIX

Figure A.1. Distribution of UKTI support across programme: All records.




Note: See table A.1 for explanation of the UKTI support programmes.

Figure A.2. Match rate by UKTI support programme

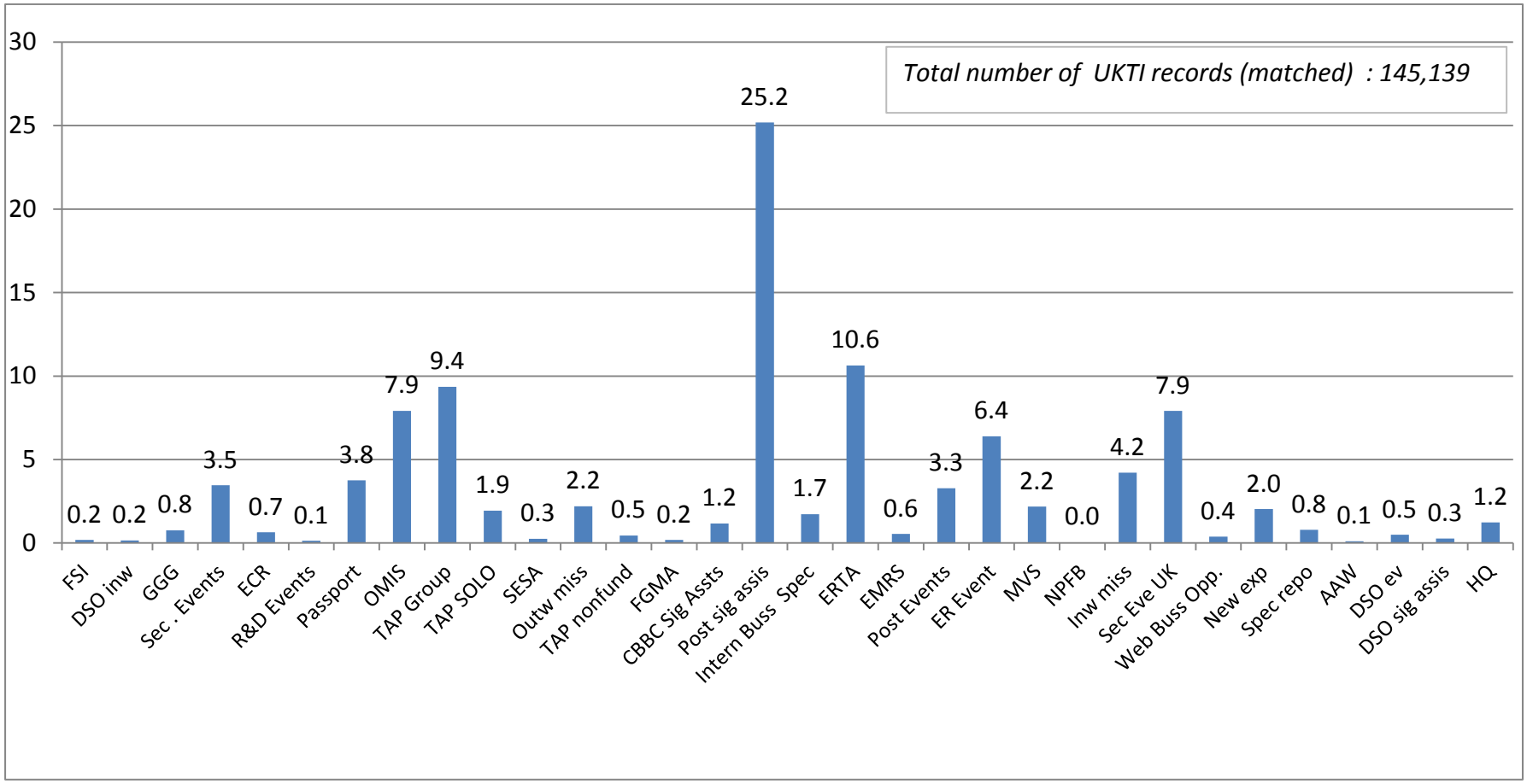



Note: See table A.1 for explanation of the UKTI support programmes.

Table A.2. Match rate by programme and PIMS wave.

| Programme/Wave | PIMS 3-6 | PIMS 7-10 | PIMS 11-14 | PIMS 15-18 | PIMS 19-22 |
|---|---|---|---|---|---|
| Fiscal Stimulus Initiative (FSI) Events | . | . | . | 67% | 67% |
| DSO Inward Missions | . | . | . | 81% | 82% |
| GGG | . | . | . | . | 81% |
| Sector Events Abroad | 67% | 67% | 68% | 63% | 63% |
| ECR | 73% | 71% | 75% | 78% | 75% |
| R&D Events | . | . | 57% | 52% | . |
| Passport | 59% | 58% | 60% | 61% | 64% |
| OMIS | 73% | 72% | 74% | 72% | 74% |
| TAP Group | 71% | 68% | 70% | 71% | 72% |
| TAP SOLO | 74% | 72% | 75% | 73% | 69% |
| Outward Missions (SESA) | 58% | . | . | . | . |
| Outward Missions | 69% | 69% | 70% | 61% | 62% |
| TAP Non funded | . | . | 81% | 72% | 80% |
| Fast Growing Markets Advisors (FGMA) Significant Assists | . | . | 86% | 75% | . |
| CBBC Significant Assists | . | 56% | 64% | 65% | 70% |
| Posts Significant Assists | 51% | 57% | 59% | 58% | 60% |
| International Business Specialists | 61% | 67% | 72% | 66% | 68% |
| English Regions Trade Advisors (ERTA) Significant Assists | 60% | 67% | 64% | 62% | 60% |
| EMRS | 71% | 80% | 75% | 76% | 79% |
| Posts Events | . | . | 58% | 52% | 57% |
| ER Events | . | 64% | 63% | 63% | 65% |
| Market Visit Support (MVS) | 65% | 63% | 65% | 64% | 67% |
| New Products From Britain (NPFB) | 73% | . | . | . | . |
| Inward Missions | 64% | 63% | 64% | 63% | 69% |
| Sector Events UK | 61% | 62% | 65% | 59% | 57% |
| Web Business Opportunities Service | . | . | . | . | 57% |
| New to Export Assists | 54% | 61% | . | . | . |
| Special Reports | . | 71% | 76% | 68% | 75% |
| Aid Agency Workshops | . | 68% | 79% | . | . |
| DSO Events | . | . | . | 81% | 76% |
| DSO Significant Assists | . | . | . | 78% | 80% |
| HQ Events | . | . | . | 64% | 63% |

Figure A.3. Distribution of UKTI support across support programme: Matched records




Note: See table A.1 for explanation of the UKTI support programmes.

Figure A.4. Breakdown of UKTI schemes by firms' economic activity.

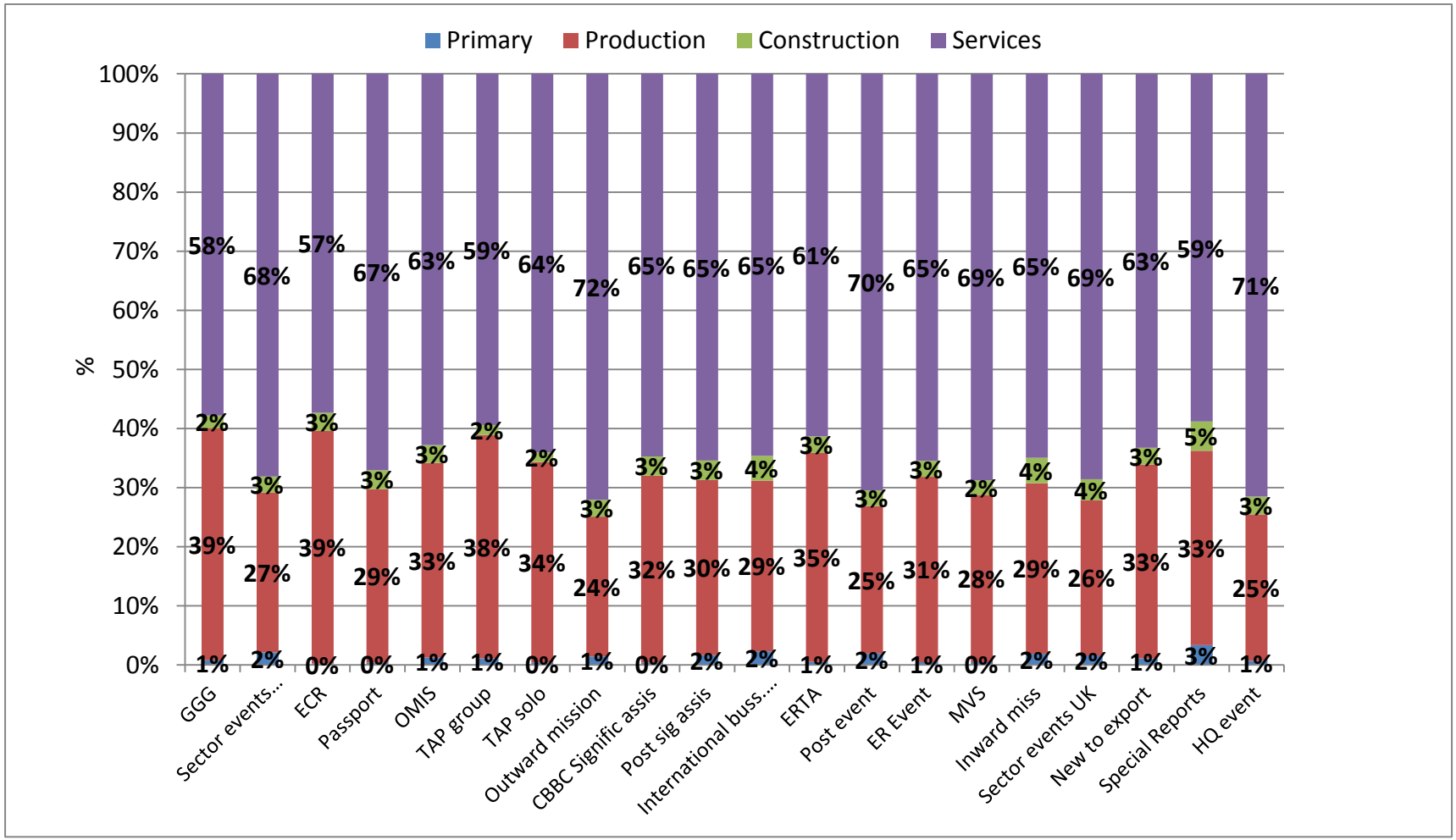


Figure A.5. Breakdown of support schemes by firms' size (number of employees)

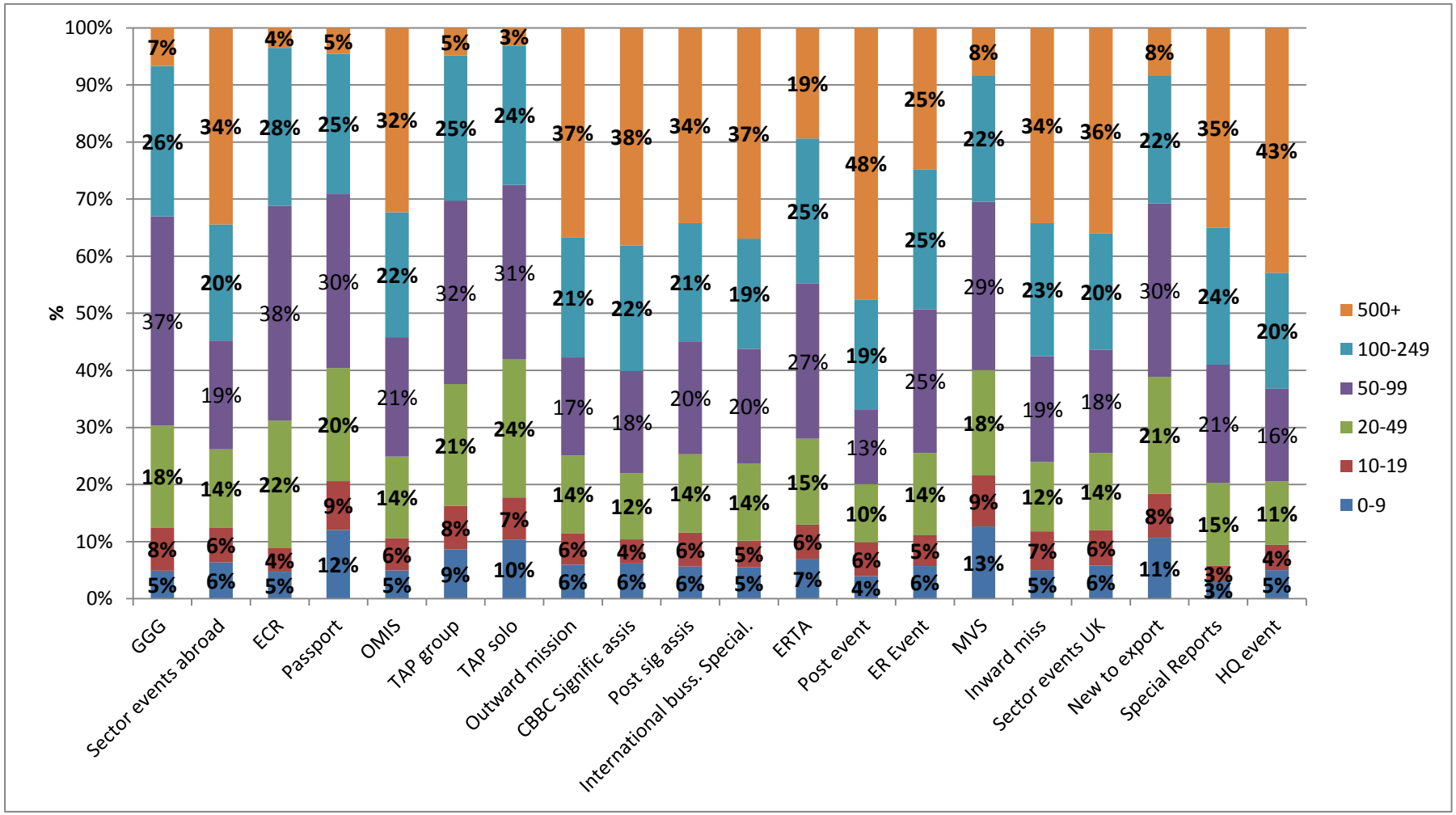


Figure A.6. Breakdown of UKTI schemes by participant firm's age

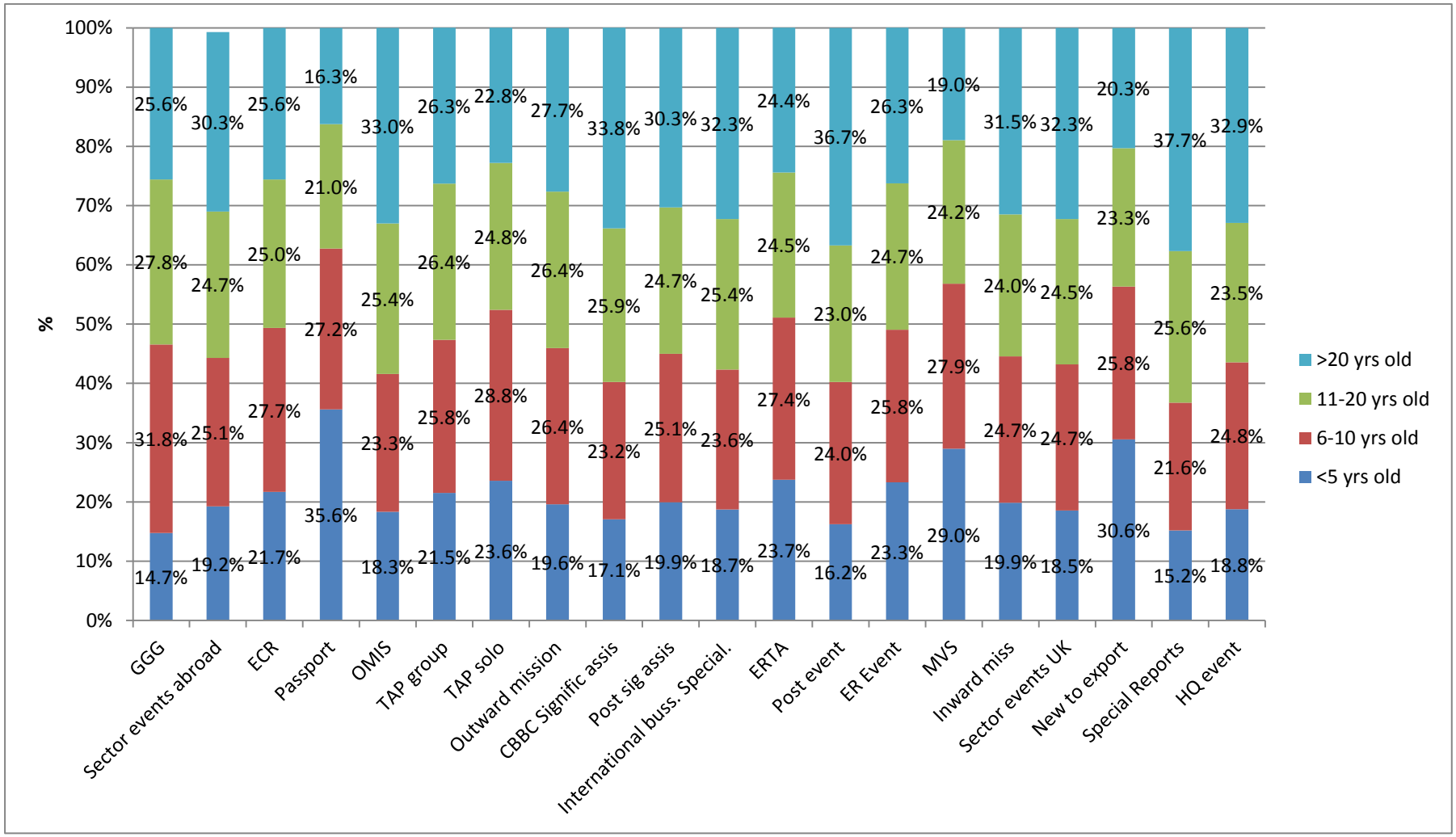


Table A.3a. Correspondence between support periods and years.

| | **All except Passport & GGG** | **Passport & GGG** |
|---|---|---|
| PIMS 3 | Oct-Dec 2005 | May-Jul 2005 |
| PIMS 4 | Jan-Mar 2006 | Aug-Oct 2005 |
| PIMS 5 | Apr-Jun 2006 | Nov-Jan 2005/6 |
| PIMS 6 | Jul-Sep 2006 | Feb-Apr 2006 |
| PIMS 7 | Oct-Dec 2006 | May-Jul 2006 |
| PIMS 8 | Jan-Mar 2007 | Aug-Oct 2006 |
| PIMS 9 | Apr-Jun 2007 | Nov-Jan 2006/7 |
| PIMS 10 | Jul-Sep 2007 | Feb-Apr 2007 |
| PIMS 11 | Oct-Dec 2007 | May-Jul 2007 |
| PIMS 12 | Jan-Mar 2008 | Aug-Oct 2007 |
| PIMS 13 | Apr-Jun 2008 | Nov-Jan 2007/8 |
| PIMS 14 | Jul-Sep 2008 | Feb-Apr 2008 |
| PIMS 15 | Oct-Dec 2008 | May-Jul 2008 |
| PIMS 16 | Jan-Mar 2009 | Aug-Oct 2008 |
| PIMS 17 | Apr-Jun 2009 | Nov-Jan 2008/9 |
| PIMS 18 | Jul-Sep 2009 | Feb-Mar 2009 |
| PIMS 19 | Oct-Dec 2009 | Apr-Jun 2009 |
| PIMS 20 | Jan-Mar 2010 | Jul-Sep 2009 |
| PIMS 21 | Apr-Jun 2010 | Oct-Dec 2009 |
| PIMS 22 | Jul-Sep 2010 | Jan-Mar 2010 |

A.3b. Correspondence between PIMS waves and financial years (FAME). All programmes, except Passport and GGG .

| PROGRAM PIMS | FINANCIAL YEAR |
|---|---|
| 3,4 | 2005-***2006*** |
| 5,6,7,8 | 2006-***2007*** |
| 9,10,11,12 | 2007-***2008*** |
| 13,14,15,16 | 2008-***2009*** |
| 17,18,19,20 | 2009-***2010*** |
| 21,22 | 2010-***2011*** |

Note: Financial Year goes from 1th April to 31th March.

Table A.3c. Correspondence between PIMS waves and financial years (FAME). Passport and GGG programme .

| PROGRAM PIMS | FINANCIAL YEAR |
|---|---|
| 3,4,5,6 | 2005-***2006*** |
| 7,8,9,10 | 2006-***2007*** |
| 11,12,13,14 | 2007-***2008*** |
| 15,16,17,18 | 2008-***2009*** |
| 19,20,21,22 | 2009-***2010*** |

Note: Financial Year goes from 1th April to 31th March.

Note: For Passport and GGG the correspondence between the PIMS period and the financial year is not exact. PIMS 6, PIMS 10, PIMS 14 and PIMS 18 fall in two different financial years. We have allocated these to the financial year that accounts for a larger number of months. E.g. PIMS 6 (February to April 2006) takes place across financial years 2005/2006 and 2006/2007. While two of the months fall into the financial year 2005/2006, only one month fall into the financial year 2006/2007. Therefore we have allocated it to the financial year 2005-2006.

Table A.4. Characteristics of supported and non-supported firms for the broad sample (firms for which there is information on the value of assets), 2005-2011 (Assessing the influence of outliers).

| | *Companies filing unconsolidated accounts* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Supported* | | | *Non-Supported* | | | *Single supported* | | |
| | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* |
| Employees | 455 | 79 | 13,364 | 143 | 18 | 446,966 | 302 | 69 | 5,295 |
| Turnover | 97,408 | 11,779 | 13,242 | 30,695 | 2,747 | 433,866 | 61,218 | 10,642 | 5,247 |
| Labour productivity | 57 | 42 | 13,078 | 65 | 32 | 391,233 | 54 | 40 | 5,179 |
| Assets('£000) | 278,067 | 7,948 | 13,347 | 53,783 | 2,305 | 445,428 | 173,173 | 6,788 | 5,292 |
| Age (years) | 24.4 | 20 | 13,364 | 19.5 | 13 | 446,883 | 25.6 | 20 | 5,295 |
| | *Percentage* | | *Obs.* | *Percentage* | | *Obs.* | *Percentage* | | *Obs.* |
| Foreign owned | 31.1% | | 13,364 | 23.7% | | 446,966 | 34.1% | | 5,295 |
| Part of a UK multinational | 10.6% | | 13,364 | 2.7% | | 11,829 | 8.9% | | 5,295 |
| Patents | 5.4% | | 13,364 | 0.6% | | 446,966 | 4.3% | | 5,295 |
| | *Excluding firms at bottom (1%) and top (99%) of distributions of productivity and profitability* | | | | | | | | |
| | *Supported* | | | *Non-Supported* | | | *Single supported* | | |
| | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* | *Mean* | *Median* | *Obs.* |
| Employees | 1,569 | 100 | 16,924 | 292 | *30* | 526,556 | 667 | 81 | 613 |
| Turnover | 388,901 | 14,760 | 16,774 | 53,092 | 4,721 | 512,350 | 108,834 | 12,582 | 6,352 |
| Labour productivity | 56 | 42 | 16,611 | 53 | 33 | 471,643 | 54 | 41 | 6,286 |
| Assets('£000) | 729,812 | 10,080 | 16,907 | 131,808 | 3,547 | 525,162 | 21,875 | 8,113 | 6,410 |
| Age (years) | | | | | | | | | |
| | Percentage | | *Obs.* | Percentage | | *Obs.* | Percentage | | *Obs.* |
| Foreign owned | 26.4% | | 16,924 | 19.4% | | 526,431 | 25.6% | | 6,413 |
| Part of a UK multinational | 17.0% | | 16,924 | 4.4% | | 526,556 | 14.0% | | 6,413 |
| Patents | 5.4% | | 16,924 | 0.6% | | 526,556 | 4.3% | | 6,413 |

Table A.5. Results of estimation of probability of receiving UKTI support; companies filing unconsolidated accounts, 2005-2011.

| *Dependent variable (support=1 if firm receives UKTI support, and support=0 if it does not receive support)* | | |
|---|---|---|
| | *All companies*<br><br>*(1)* | *excl. largest firms (top 5% in terms of assets)*<br>*(2)* |
| Age 2-5 yrs | 0.0232* | 0.0221 |
| Age 6-10 yrs | 0.0222* | 0.0209* |
| Age 11-20 yrs | 0.0215* | 0.0204* |
| Age >20 yrs | 0.0192** | 0.0184** |
| | | |
| 10-19 employees | 0.00480*** | 0.00471*** |
| 20-49 employees | 0.00809*** | 0.00797*** |
| 50-99 employees | 0.0113*** | 0.0114*** |
| 100-249 employees | 0.0113*** | 0.0114*** |
| >250 employees | 0.0126*** | 0.0124*** |
| | | |
| Ln (Turnover) | 0.000124 | -0.0000159 |
| Ln (Assets) | 0.000509*** | 0.000580*** |
| Ln (Labour productivity) | 0.00114*** | 0.00127*** |
| Ln (Overseas turnover) | 0.000131*** | 0.000126*** |
| Foreign ownership dummy | -0.00243*** | -0.00238*** |
| UK multinational dummy | 0.00622*** | 0.00538*** |
| Patent dummy | 0.0152*** | 0.0157*** |
| | | |
| Year dummies | Yes | Yes |
| Region dummies | Yes | Yes |
| Sector dummies | Yes | Yes |
| | | |
| Pseudo R2: | 0.1988 | 0.1992 |
| Observations | 306,919 | 296,724 |
| NOTES: Continuous variables are measured in logs; coefficients represent marginal effects; omitted size category is 0-9 employees; omitted age category is <2 years old. | | |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.6. Estimation of a multinomial logit; companies filing unconsolidated accounts, 2005-2011.

| *Dependent variable (0= no support 1=single support 2=multiple support)* | | | | |
|---|---|---|---|---|
| | All companies | | Excl. largest companies (top 5% in terms of assets) | |
| | No support (1) | Multiple support (2) | No support (3) | Multiple support (4) |
| | base category (single support) | base category (single support) | base category (single support) | base category (single support) |
| Ln(Age) | -0.0714** | 0.0122 | -0.0622* | 0.028 |
| | (0.0335) | (0.0355) | (0.0347) | (0.0369) |
| Ln(Employees) | -0.182*** | 0.139*** | -0.214*** | 0.128*** |
| | (0.0154) | (0.0163) | (0.0173) | (0.0185) |
| Ln(Labour productivity) | -0.202*** | 0.122*** | -0.219*** | 0.146*** |
| | (0.0309) | (0.0328) | (0.0342) | (0.0364) |
| Ln(Overseas turnover) | -0.0146*** | 0.00941*** | -0.0146*** | 0.00929*** |
| | (0.00152) | (0.00161) | (0.00157) | (0.00167) |
| Foreign Ownership dummy | -0.103* | -0.668*** | -0.0855 | -0.672*** |
| | (0.0608) | (0.0647) | (0.0625) | (0.0667) |
| UK multinational dummy | -0.416*** | 0.199* | -0.425*** | 0.173 |
| | (0.105) | (0.109) | (0.114) | (0.119) |
| Patent dummy | -0.283 | 0.656*** | -0.279 | 0.740*** |
| | (0.193) | (0.194) | (0.21) | (0.212) |
| Constant | 6.880*** | 1.059** | 7.150*** | 1.326** |
| | (0.412) | (0.497) | (0.508) | (0.544) |
| Year dummies | Yes | Yes | Yes | Yes |
| Region dummies | Yes | Yes | Yes | Yes |
| Sector dummies | Yes | Yes | Yes | Yes |
| Pseudo R2: | 0.1598 | 0.1598 | 0.16 | 0.16 |
| Observations | 272,600 | 272,600 | 263,543 | 263,543 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

## *Appendix regression tables*

Table A.7. Effect of UKTI support on growth outcomes; excluding additional outliers; 2005-2012.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| | *Companies filing unconsolidated accounts* | | | |
| *Propensity Score Matching* | 0.0254*** | 0.0391*** | 0.0340*** | 0.0043 |
| | (0.00309) | (0.00405) | (0.00382) | (0.00392) |
| *Propensity Score Matching +DID* | -0.00094 | 0.0143*** | 0.0101** | 0.0152** |
| | (0.00357) | (0.00473) | (0.00436) | (0.00653) |
| | *Excl. companies at the bottom (1%) and top (99%) of the distribution of productivity and profitability* | | | |
| *Propensity Score Matching* | 0.0252*** | 0.0368*** | 0.0305*** | 0.00295 |
| | (0.00302) | (0.0034) | (0.00314) | (0.00394) |
| *Propensity Score Matching +DID* | 0.000909 | 0.0161*** | 0.00637* | 0.0153*** |
| | (0.0035) | (0.00393) | (0.00355) | (0.00556) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.8. Effect of UKTI support on growth outcomes, 2005-20122012 (control group only includes firms that are never supported), 2005-2013; excluding additional outliers.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *Companies filing unconsolidated accounts* | | | | |
| *Propensity Score Matching* | 0.0271*** | 0.0443*** | 0.0394*** | 0.00348 |
| | (0.00314) | (0.00412) | (0.00388) | (0.00455) |
| *Propensity Score Matching +DID* | -0.000292 | 0.0193*** | 0.0160*** | 0.0158** |
| | (0.00355) | (0.00472) | (0.00432) | (0.00642) |
| *Excl. companies at the bottom (1%) and top (99%) of the distribution of productivity and profitability* | | | | |
| *Propensity Score Matching* | 0.0271*** | 0.0421*** | 0.0350*** | 0.00352 |
| | (0.00305) | (0.00347) | (0.00318) | (0.00386) |
| *Propensity Score Matching +DID* | 0.00295 | 0.0241*** | 0.0185*** | 0.0119 |
| | (0.00395) | (0.00519) | (0.00497) | (0.00737) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.9. Effect of UKTI support on growth outcomes, excluding one programme at a time (PSM estimator only) .

| | *excluding. Post signif. assist* | *excluding. ERTA* | *excluding. TAP Group* | *excluding. OMIS* | *excluding. Passport* | *excluding. Post events* | *excluding. ER. Events* | *excluding. Inw. mission* | *excluding. Sec. events UK* | *excluding. Sec. events abroad* |
|---|---|---|---|---|---|---|---|---|---|---|
| *All companies* | | | | | | | | | | |
| Employment | 0.0216*** | 0.0246*** | 0.0248*** | 0.0259*** | 0.0249*** | 0.0254*** | 0.0251*** | 0.0253*** | 0.0266*** | 0.0250*** |
| | (0.00349) | (0.00312) | (0.00312) | (0.00308) | (0.00302) | (0.00307) | (0.0031) | (0.00306) | (0.00312) | (0.00304) |
| Turnover | 0.0364*** | 0.0394*** | 0.0367*** | 0.0415*** | 0.0382*** | 0.0395*** | 0.0397*** | 0.0390*** | 0.0375*** | 0.0382*** |
| | (0.00429) | (0.00392) | (0.00392) | (0.00392) | (0.00379) | (0.00383) | (0.00386) | (0.00381) | (0.00396) | (0.00381) |
| Assets | 0.0271*** | 0.0302*** | 0.0322*** | 0.0297*** | 0.0311*** | 0.0314*** | 0.0305*** | 0.0315*** | 0.0318*** | 0.0301*** |
| | (0.00383) | (0.00343) | (0.00335) | (0.00344) | (0.00329) | (0.00334) | (0.00335) | (0.00335) | (0.00342) | (0.00333) |
| Labour productivity | 0.00308 | 0.00712 | 0.0047 | 0.00327 | 0.00424 | 0.00438 | 0.00569 | 0.00165 | 0.0024 | 0.00373 |
| | (0.00545) | (0.00497) | (0.00491) | (0.00497) | (0.00478) | (0.00484) | (0.0049) | (0.00484) | (0.005) | (0.00483) |
| *excl. largest companies (top 5% in terms of assets)* | | | | | | | | | | |
| Employment | 0.0234*** | 0.0266*** | 0.0273*** | 0.0285*** | 0.0272*** | 0.0278*** | 0.0270*** | 0.0272*** | 0.0289*** | 0.0275*** |
| | (0.00352) | (0.00314) | (0.00313) | (0.0031) | (0.00304) | (0.00307) | (0.00313) | (0.0031) | (0.0031) | -0.00304 |
| Turnover | 0.0378*** | 0.0421*** | 0.0396*** | 0.0455*** | 0.0413*** | 0.0429*** | 0.0431*** | 0.0411*** | 0.0408*** | 0.0418*** |
| | (0.00452) | (0.0041) | (0.0041) | (0.00405) | (0.00395) | (0.00399) | (0.00402) | (0.00403) | (0.0041) | (0.00396) |
| Assets | 0.0267*** | 0.0312*** | 0.0334*** | 0.0304*** | 0.0319*** | 0.0319*** | 0.0314*** | 0.0321*** | 0.0325*** | 0.0312*** |
| | (0.00413) | (0.0037) | (0.00361) | (0.00368) | (0.00353) | (0.00358) | (0.0036) | (0.0036) | (0.00367) | (0.00357) |
| Labour productivity | 0.00209 | 0.00548 | 0.003 | 0.0017 | 0.00279 | 0.00322 | 0.00474 | -0.0000669 | 0.000289 | 0.00226 |
| | (0.00564) | (0.00517) | (0.00509) | (0.00516) | (0.00496) | (0.005) | (0.00509) | (0.00502) | (0.00518) | (0.00499) |

Robust bust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A.10. Effect of UKTI support on international activities and survival, 2006-2012; excluding additional outliers.

| Dep variable (dummy 1/0) | Probability of survival | Positive overseas turnover growth | Entry overseas | Overseas turnover as share of turnover |
|---|---|---|---|---|
| | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| | *Companies filing unconsolidated accounts* | | | |
| Effect of UKTI support (α) | 0.0199*** (0.00136) | 0.0786*** (0.00309) | 0.0134*** (0.00155) | 0.0500*** -0.00481 |
| *Excl. companies at the bottom (1%) and top (99%) of the distribution of productivity and profitability* | | | | |
| Effect of UKTI support (α) | 0.0181*** (0.00116) | 0.0866*** (0.00298) | 0.0168*** (0.00152) | 0.0516*** (0.00426) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.11. Multiple treatment - Firms receiving between two and five treatments: the effect of UKTI support on growth outcomes, 1995-2012; excluding additional outliers.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *Companies filing unconsolidated accounts* | | | | |
| *Propensity Score Matching* | 0.0266*** | 0.0394*** | 0.0357*** | 0.00203 |
| | (0.00319) | (0.00433) | (0.0041) | (0.00585) |
| *Propensity Score Matching +DID* | -0.000486 | 0.0138** | 0.0103* | 0.0126 |
| | (0.00433) | (0.00592) | (0.0053) | (0.00774) |
| *Excl. companies at the bottom (1%) and top (99%) of the distributions of productivity and profitability* | | | | |
| *Propensity Score Matching* | 0.0264*** | 0.0375*** | 0.0321*** | 0.00156 |
| | (0.00312) | (0.00364) | (0.00335) | (0.00493) |
| *Propensity Score Matching +DID* | 0.00104 | 0.0157*** | 0.00633 | 0.0122* |
| | (0.00402) | '(0.00483) | (0.00441) | (0.00654) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

.

Table A.12. Multiple treatment - Firms receiving more than five treatment: the effect of UKTI support on growth outcomes, 1995-2012; excluding additional outliers.

| Effect of UKTI support (α) | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *Companies filing unconsolidated accounts* | | | | |
| *Propensity Score Matching* | 0.0272*** | 0.0422*** | 0.0371*** | 0.00625 |
| | (0.00365) | (0.00511) | (0.00469) | (0.00688) |
| *Propensity Score Matching +DID* | 0.00178 | 0.0217*** | 0.0143** | 0.0142 |
| | (0.00507) | (0.00694) | (0.00609) | (0.00912) |
| *Excl. companies at the bottom (1%) and top (99%) of the distributions of productivity and profitability* | | | | |
| *Propensity Score Matching* | 0.0274*** | 0.0416*** | 0.0351*** | 0.00402 |
| | (0.00365) | (0.00424) | (0.00381) | (0.00688) |
| *Propensity Score Matching +DID* | 0.0022 | 0.0213*** | 0.00973* | 0.0124 |
| | (0.00471) | (0.00559) | (0.00507) | (0.00763) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.13. Effect of UKTI support on growth outcomes, 2005-2012. High-intensity programmes; excluding additional outliers.

| Dep variable | Employment growth | Turnover growth | Assets growth | Labour productivity growth |
|---|---|---|---|---|
| *Companies filing unconsolidated accounts* | | | | |
| *Propensity Score Matching* | 0.0269*** | 0.0372*** | 0.0289*** | -0.00794 |
| | (0.0046) | (0.00628) | (0.0064) | (0.00926) |
| *Propensity Score Matching +DID* | 0.00449 | 0.0153* | 0.0044 | 0.0168 |
| | (0.00637) | (0.00878) | (0.00818) | (0.012) |
| *Excl. companies at the bottom (1%) and top (99%) of the distributions of productivity and profitability* | | | | |
| *Propensity Score Matching* | 0.0270*** | 0.0336*** | 0.0295*** | -0.00511 |
| | (0.00471) | (0.00522) | (0.00527) | (0.00779) |
| *Propensity Score Matching +DID* | 0.00477 | 0.0132* | 0.00616 | 0.0155 |
| | (0.00612) | (0.00714) | (0.00689) | (0.0102) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.14. Effect of UKTI support on additional growth outcomes, 2005-2012. High-intensity programmes; excluding additional outliers.

| Dep variable (dummy 1/0) | Probability of survival | Positive overseas turnover growth | Entry overseas | Overseas turnover as share of turnover |
|---|---|---|---|---|
| | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* | *Propensity Score Matching* |
| *Companies filling unconsolidated accounts* | | | | |
| Effect of UKTI support (α) | 0.0169*** | 0.0798*** | 0.0114*** | 0.0481*** |
| | (0.00154) | (0.00506) | (0.00245) | (0.0077) |
| *Excl. companies at the bottom (1%) and top (99%) of the distribution of productivity and profitability* | | | | |
| Effect of UKTI support (α) | 0.0161*** | 0.0844*** | 0.0148*** | 0.0504*** |
| | (0.0013) | (0.0048) | (0.00237) | (0.00681) |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.15. T-test for the equality of covariates before ("Unmatched") and after matching ("Matched") - Employment outcome.

| | | | | |
|---|---|---|---|---|
| Variable | Matched/Unmatched | Treated | Control | t-test (p>t) |
| | | | | |
| **2006** | | | | |
| | | | | |
| Turnover | Unmatched | 510,000.00 | 69,199.00 | 0.000 |
| | Matched | 510,000.00 | 270,000.00 | 0.30 |
| | | | | |
| Employment | Unmatched | 1,764.20 | 372.59 | 0.000 |
| | Matched | 1,764.20 | 1,880.70 | 0.82 |
| | | | | |
| Labour productivity | Unmatched | 49.3470 | 73.1950 | 0.25 |
| | Matched | 49.3470 | 38.1150 | 0.15 |

| | | | | |
|---|---|---|---|---|
| Assets | Unmatched | 340,000.00 | 90,053.00 | 0.000 |
| | Matched | 340,000.00 | 340,000.00 | 0.95 |
| | | | | |
| Age | Unmatched | 26.3920 | 20.8840 | 0.000 |
| | Matched | 26.3920 | 27.4380 | 0.25 |
| | | | | |
| Foreign ownership | Unmatched | 0.2182 | 0.2619 | 0.000 |
| | Matched | 0.2182 | 0.2208 | 0.86 |
| | | | | |
| Subsidiaries | Unmatched | 0.1388 | 0.0455 | 0.000 |
| | Matched | 0.1388 | 0.1428 | 0.75 |
| | | | | |
| Patents | Unmatched | 0.0687 | 0.0085 | 0.000 |
| | Matched | 0.0687 | 0.0667 | 0.83 |
| | | | | |
| **2007** | | | | |
| | | | | |
| Turnover | Unmatched | 570,000.00 | 69,419.00 | 0.000 |
| | Matched | 570,000.00 | 300,000.00 | 0.18 |
| | | | | |
| Employment | Unmatched | 1,882.60 | 361.43 | 0.000 |
| | Matched | 1,882.60 | 1,745.80 | 0.78 |
| | | | | |
| Labour productivity | Unmatched | 61.3510 | 76.5120 | 0.32 |
| | Matched | 61.3510 | 47.5760 | 0.27 |
| | | | | |
| Assets | Unmatched | 690,000.00 | 130,000.00 | 0.000 |
| | Matched | 690,000.00 | 850,000.00 | 0.60 |
| | | | | |
| Age | Unmatched | 25.8970 | 20.9900 | 0.000 |
| | Matched | 25.8970 | 27.9330 | 0.01 |
| | | | | |
| Foreign ownership | Unmatched | 0.2493 | 0.2615 | 0.000 |
| | Matched | 0.2493 | 0.2409 | 0.53 |
| | | | | |
| Subsidiaries | Unmatched | 0.1444 | 0.0503 | 0.000 |
| | Matched | 0.1444 | 0.1414 | 0.79 |
| | | | | |
| Patents | Unmatched | 0.0549 | 0.0085 | 0.000 |
| | Matched | 0.0549 | 0.0534 | 0.84 |

| | | | | |
|---|---|---|---|---|
| **2008** | | | | |
| | | | | |
| Turnover | Unmatched | 460,000.00 | 72222 | 0.000 |
| | Matched | 460000 | 250000 | 0.139 |
| | | | | |
| Employment | Unmatched | 1515.4 | 376.34 | 0.000 |
| | Matched | 1515.4 | 1259.7 | 0.41 |
| | | | | |
| Labour productivity | Unmatched | -5.975 | 74.103 | 0.000 |
| | Matched | -5.975 | 5.6206 | 0.853 |
| | | | | |
| Assets | Unmatched | 660000 | 150000 | 0.000 |
| | Matched | 660000 | 640000 | 0.941 |
| | | | | |
| Age | Unmatched | 26.1960 | 21.3180 | 0.000 |
| | Matched | 26.1960 | 29.0070 | 0.000 |
| | | | | |
| Foreign ownership | Unmatched | 0.2882 | 0.2731 | 0.000 |
| | Matched | 0.2882 | 0.2832 | 0.7 |
| | | | | |
| Subsidiaries | Unmatched | 0.1777 | 0.0606 | 0.000 |
| | Matched | 0.1777 | 0.1861 | 0.453 |
| | | | | |
| Patents | Unmatched | 0.0588 | 0.0082 | 0.000 |
| | Matched | 0.0588 | 0.0559 | 0.663 |
| | | | | |
| **2009** | | | | |
| | | | | |
| Turnover | Unmatched | 450,000.00 | 74232 | 0.000 |
| | Matched | 450,000.00 | 320000 | 0.277 |
| | | | | |
| Employment | Unmatched | 1,731.40 | 371.28 | 0.000 |
| | Matched | 1,731.40 | 1273.1 | 0.156 |
| | | | | |
| Labour productivity | Unmatched | 73.88 | 80.252 | 0.832 |
| | Matched | 73.88 | -62.015 | 0.145 |
| | | | | |
| Assets | Unmatched | 780,000.00 | 160000 | 0.000 |
| | Matched | 780,000.00 | 890000 | 0.729 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Age | Unmatched | 26.1030 | 21.4730 | 0.000 |
| | Matched | 26.1030 | 28.0100 | 0.002 |
| | | | | |
| Foreign ownership | Unmatched | 0.3033 | 0.2902 | 0.124 |
| | Matched | 0.3033 | 0.3268 | 0.048 |
| | | | | |
| Subsidiaries | Unmatched | 0.1835 | 0.0652 | 0.000 |
| | Matched | 0.1835 | 0.1903 | 0.491 |
| | | | | |
| Patents | Unmatched | 0.0519 | 0.0079 | 0.000 |
| | Matched | 0.0519 | 0.0447 | 0.19 |
| | | | | |
| **2010** | | | | |
| Turnover | Unmatched | 400000 | 84190 | 0.000 |
| | Matched | 400000 | 240000 | 0.154 |
| | | | | |
| Employment | Unmatched | 1698.7 | 370.62 | 0.000 |
| | Matched | 1698.7 | 1280.9 | 0.187 |
| | | | | |
| Labour productivity | Unmatched | 66 | 53.041 | 0.498 |
| | Matched | 66 | 61.676 | 0.839 |
| | | | | |
| Assets | Unmatched | 680000 | 130000 | 0.000 |
| | Matched | 680000 | 530000 | 0.441 |
| | | | | |
| Age | Unmatched | 26.7820 | 21.8150 | 0.000 |
| | Matched | 26.7820 | 29.0490 | 0.000 |
| | | | | |
| Foreign ownership | Unmatched | 0.2879 | 0.3076 | 0.019 |
| | Matched | 0.2879 | 0.2919 | 0.723 |
| | | | | |
| Subsidiaries | Unmatched | 0.1846 | 0.0666 | 0.000 |
| | Matched | 0.1846 | 0.1877 | 0.751 |
| | | | | |
| Patents | Unmatched | 0.0544 | 0.0079 | 0.000 |
| | Matched | 0.0544 | 0.0517 | 0.62 |
| | | | | |
| **2011** | | | | |
| Turnover | Unmatched | 500000 | 60372 | 0.000 |
| | Matched | 500000 | 400000 | 0.565 |
| | | | | |
| Employment | Unmatched | 1817.2 | 319.38 | 0.000 |

| | | | | |
|---|---|---|---|---|
| | Matched | 1817.2 | 1156 | 0.084 |
| | | | | |
| Labour productivity | Unmatched | 61.206 | 62.661 | 0.971 |
| | Matched | 61.206 | 71.548 | 0.329 |
| | | | | |
| Assets | Unmatched | 1000000 | 150000 | 0.000 |
| | Matched | 1000000 | 510000 | 0.084 |
| | | | | |
| Age | Unmatched | 28.2760 | 21.6300 | 0.000 |
| | Matched | 28.2760 | 29.1450 | 0.24 |
| | | | | |
| Foreign ownership | Unmatched | 0.2682 | 0.2528 | 0.094 |
| | Matched | 0.2682 | 0.2519 | 0.205 |
| | | | | |
| Subsidiaries | Unmatched | 0.1915 | 0.0584 | 0.000 |
| | Matched | 0.1915 | 0.1992 | 0.506 |
| | | | | |
| Patents | Unmatched | 0.0587 | 0.0070 | 0.000 |
| | Matched | 0.0587 | 0.0557 | 0.659 |

Table A.16. T-test for the equality of covariates before ("Unmatched") and after matching ("Matched") - Turnover outcome.

| | | | | |
|---|---|---|---|---|
| Variable | Matched/Unmatched | Treated | Control | t-test (p>t) |
| **2006** | | | | |
| | | | | |
| Turnover | Unmatched | 510,000.00 | 69,275.00 | 0.000 |
| | Matched | 510,000.00 | 270,000.00 | 0.30 |
| | | | | |
| Employment | Unmatched | 1,765.30 | 373.01 | 0.000 |
| | Matched | 1,765.30 | 1,859.50 | 0.86 |
| | | | | |
| Labour productivity | Unmatched | 48.8080 | 73.3060 | 0.24 |
| | Matched | 48.8080 | 50.8930 | 0.67 |
| | | | | |
| Assets | Unmatched | 340,000.00 | 90,152.00 | 0.000 |

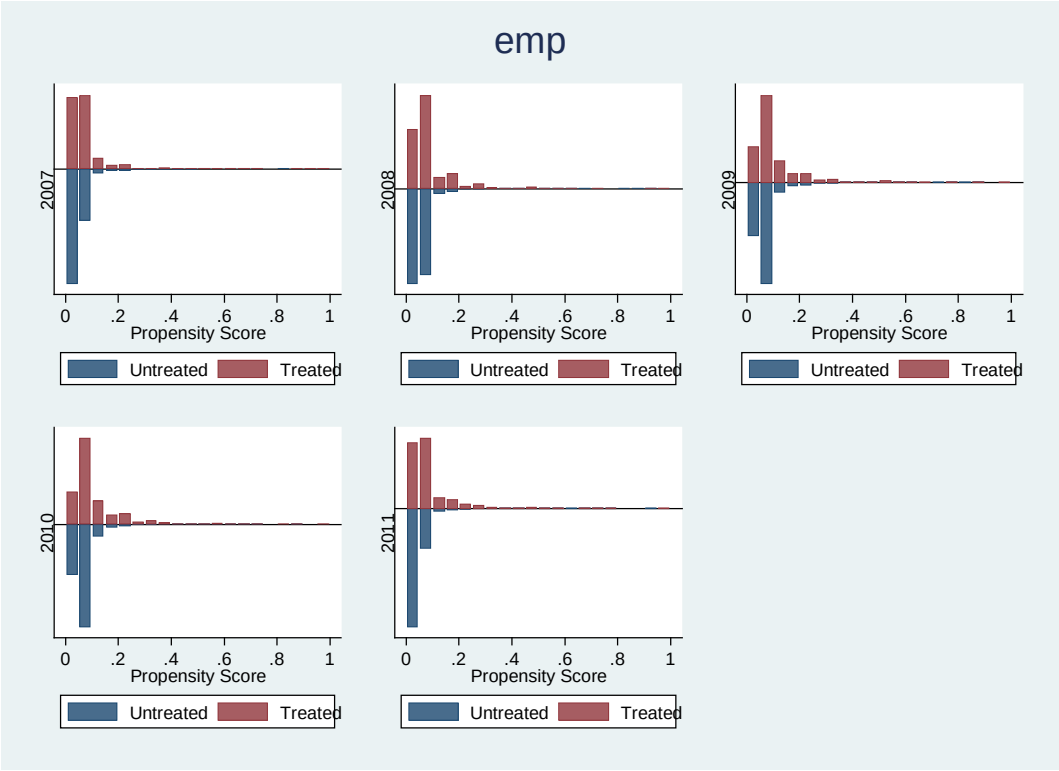
| | | | | |
|---|---|---|---|---|
| | Matched | 340,000.00 | 290,000.00 | 0.60 |
| | | | | |
| Age | Unmatched | 26.3870 | 20.8930 | 0.000 |
| | Matched | 26.3870 | 27.7450 | 0.13 |
| | | | | |
| Foreign ownership | Unmatched | 0.2176 | 0.2620 | 0.000 |
| | Matched | 0.2176 | 0.2190 | 0.93 |
| | | | | |
| Subsidiaries | Unmatched | 0.1389 | 0.0456 | 0.000 |
| | Matched | 0.1389 | 0.1422 | 0.79 |
| | | | | |
| Patents | Unmatched | 0.0688 | 0.0085 | 0.000 |
| | Matched | 0.0688 | 0.0641 | 0.61 |
| | | | | |
| **2007** | | | | |
| | | | | |
| Turnover | Unmatched | 570,000.00 | 69441 | 0.000 |
| | Matched | 570000 | 280000 | 0.149 |
| | | | | |
| Employment | Unmatched | 1882.6 | 361.77 | 0.000 |
| | Matched | 1882.6 | 1672.3 | 0.673 |
| | | | | |
| Labour productivity | Unmatched | 61.3510 | 76.6100 | 0.319 |
| | Matched | 61.3510 | 59.9100 | 0.817 |
| | | | | |
| Assets | Unmatched | 690000 | 120000 | 0.000 |
| | Matched | 690000 | 830000 | 0.662 |
| | | | | |
| Age | Unmatched | 25.8970 | 21.0000 | 0.000 |
| | Matched | 25.8970 | 27.7490 | 0.018 |
| | | | | |
| Foreign ownership | Unmatched | 0.2493 | 0.2617 | 0.214 |
| | Matched | 0.2493 | 0.2235 | 0.054 |
| | | | | |
| Subsidiaries | Unmatched | 0.1444 | 0.0504 | 0.000 |
| | Matched | 0.1444 | 0.1385 | 0.588 |
| | | | | |
| Patents | Unmatched | 0.0549 | 0.0085 | 0.000 |
| | Matched | 0.0549 | 0.0574 | 0.733 |
| | | | | |
| **2008** | | | | |
| | | | | |
| Turnover | Unmatched | 450,000.00 | 72141 | 0.000 |

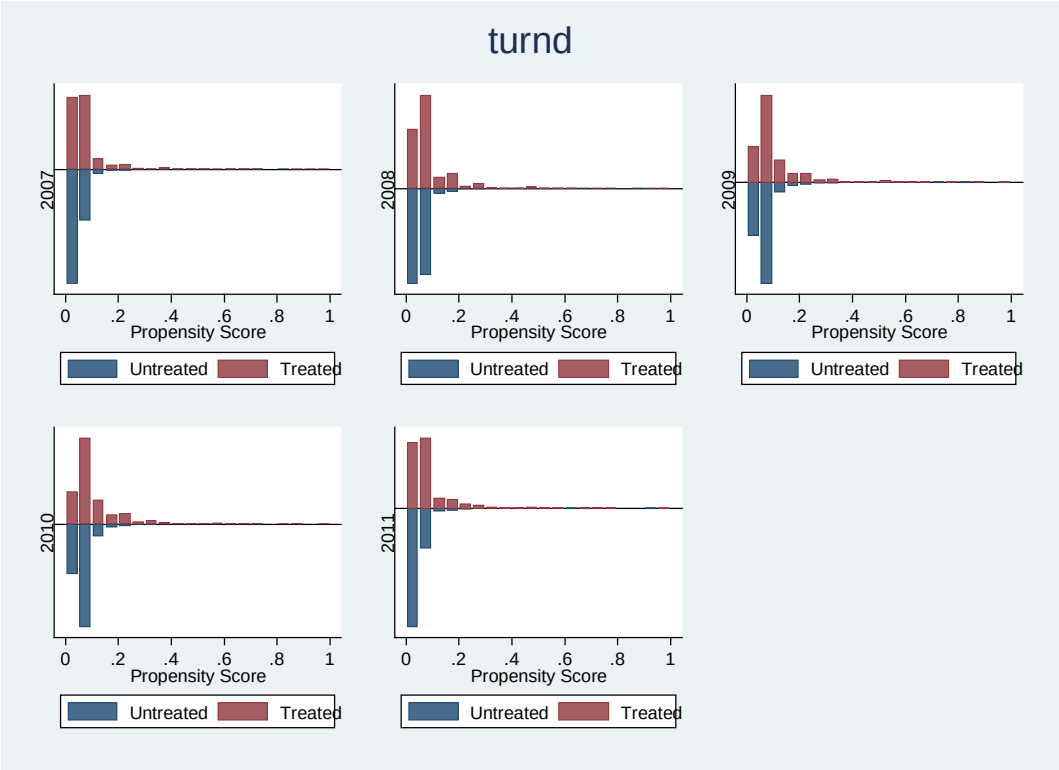
| | | | | |
|---|---|---|---|---|
| | Matched | 450,000.00 | 260000 | 0.175 |
| | | | | |
| Employment | Unmatched | 1,511.50 | 376.53 | 0.000 |
| | Matched | 1,511.50 | 1249.3 | 0.428 |
| | | | | |
| Labour productivity | Unmatched | -6.0071 | 75.99 | 0.000 |
| | Matched | -6.0071 | 47.95 | 0.375 |
| | | | | |
| Assets | Unmatched | 610,000.00 | 150000 | 0.000 |
| | Matched | 610,000.00 | 430000 | 0.358 |
| | | | | |
| Age | Unmatched | 26.2060 | 21.3200 | 0.000 |
| | Matched | 26.2060 | 27.7130 | 0.034 |
| | | | | |
| Foreign ownership | Unmatched | 0.2884 | 0.2732 | 0.108 |
| | Matched | 0.2884 | 0.2959 | 0.566 |
| | | | | |
| Subsidiaries | Unmatched | 0.1774 | 0.0606 | 0.000 |
| | Matched | 0.1774 | 0.1913 | 0.217 |
| | | | | |
| Patents | Unmatched | 0.0589 | 0.0082 | 0.000 |
| | Matched | 0.0589 | 0.0530 | 0.377 |
| | | | | |
| **2009** | | | | |
| Turnover | Unmatched | 450000 | 73861 | 0.000 |
| | Matched | 450000 | 280000 | 0.175 |
| | | | | |
| Employment | Unmatched | 1729.8 | 371.56 | 0.000 |
| | Matched | 1729.8 | 1071.7 | 0.038 |
| | | | | |
| Labour productivity | Unmatched | 74.02 | 82.706 | 0.769 |
| | Matched | 74.02 | 76.816 | 0.83 |
| | | | | |
| Assets | Unmatched | 730000 | 150000 | 0.000 |
| | Matched | 730000 | 500000 | 0.324 |
| | | | | |
| Age | Unmatched | 26.1180 | 21.4760 | 0.000 |
| | Matched | 26.1180 | 28.9080 | 0.000 |
| | | | | |
| Foreign ownership | Unmatched | 0.3033 | 0.2904 | 0.131 |
| | Matched | 0.3033 | 0.3235 | 0.088 |
| | | | | |

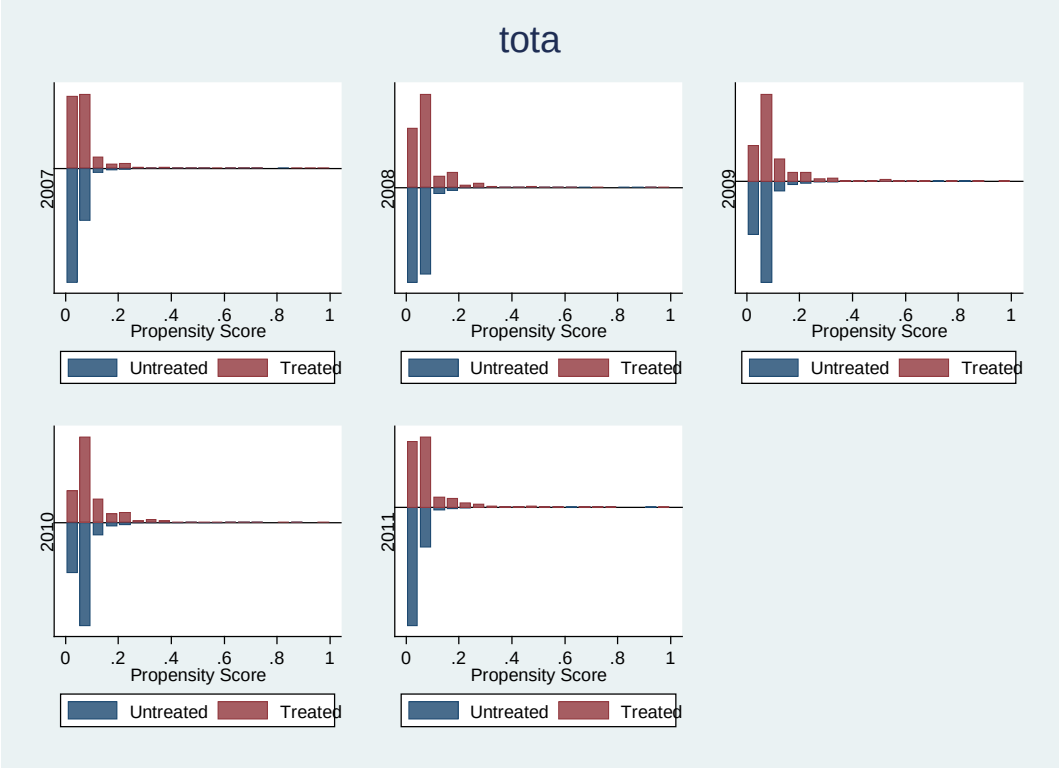
| | | | | |
|---|---|---|---|---|
| Subsidiaries | Unmatched | 0.1830 | 0.0651 | 0.000 |
| | Matched | 0.1830 | 0.1817 | 0.895 |
| | | | | |
| Patents | Unmatched | 0.0520 | 0.0079 | 0.000 |
| | Matched | 0.0520 | 0.0503 | 0.772 |
| | | | | |
| **2010** | | | | |
| Turnover | Unmatched | 400000 | 84277 | 0.000 |
| | Matched | 400000 | 230000 | 0.13 |
| | | | | |
| Employment | Unmatched | 1699.3 | 370.99 | 0.000 |
| | Matched | 1699.3 | 1277.9 | 0.181 |
| | | | | |
| Labour productivity | Unmatched | 66.054 | 53.347 | 0.506 |
| | Matched | 66.054 | 52.989 | 0.343 |
| | | | | |
| Assets | Unmatched | 680000 | 130000 | 0.000 |
| | Matched | 680000 | 500000 | 0.375 |
| | | | | |
| Age | Unmatched | 26.7890 | 21.8180 | 0.000 |
| | Matched | 26.7890 | 29.4420 | 0.000 |
| | | | | |
| Foreign ownership | Unmatched | 0.2880 | 0.3076 | 0.000 |
| | Matched | 0.2880 | 0.2712 | 0.13 |
| | | | | |
| Subsidiaries | Unmatched | 0.1844 | 0.0666 | 0.000 |
| | Matched | 0.1844 | 0.1886 | 0.657 |
| | | | | |
| Patents | Unmatched | 0.0541 | 0.0079 | 0.000 |
| | Matched | 0.0541 | 0.0501 | 0.47 |
| | | | | |
| **2011** | | | | |
| Turnover | Unmatched | 500000 | 60424 | 0.000 |
| | Matched | 500000 | 390000 | 0.517 |
| | | | | |
| Employment | Unmatched | 1817.2 | 319.62 | 0.000 |
| | Matched | 1817.2 | 1099.8 | 0.057 |
| | | | | |
| Labour productivity | Unmatched | 61.206 | 66.876 | 0.877 |
| | Matched | 61.206 | 29.089 | 0.088 |
| | | | | |
| Assets | Unmatched | 1000000 | 150000 | 0.000 |
| | Matched | 1000000 | 370000 | 0.019 |

| | | | | |
|---|---|---|---|---|
| Age | Unmatched | 28.2760 | 21.6320 | 0.000 |
| | Matched | 28.2760 | 29.5860 | 0.077 |
| | | | | |
| Foreign ownership | Unmatched | 0.2682 | 0.2529 | 0.096 |
| | Matched | 0.2682 | 0.2408 | 0.032 |
| | | | | |
| Subsidiaries | Unmatched | 0.1915 | 0.0583 | 0.000 |
| | Matched | 0.1915 | 0.1975 | 0.605 |
| | | | | |
| Patents | Unmatched | 0.0587 | 0.0071 | 0.000 |
| | Matched | 0.0587 | 0.0527 | 0.372 |

Figure A.7. Illustration of the common support hypothesis (employment, turnover, total assets, and labour productivity).




tota
2007
2008
2009
2010
2011
0 .2 .4 .6 .8 1
Propensity Score
Untreated
Treated

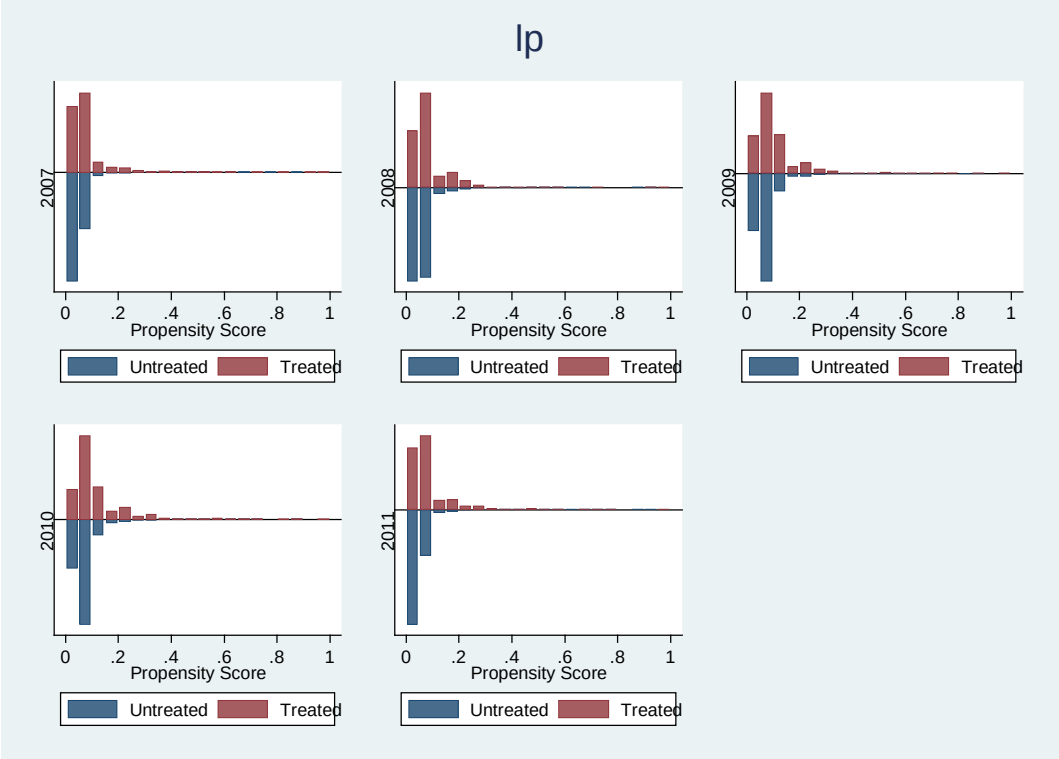

lp
2007
2008
2009
2010
2011
0 .2 .4 .6 .8 1
Propensity Score
Untreated
Treated

Figure A.8a. Balancing test graphs, employment growth outcome.

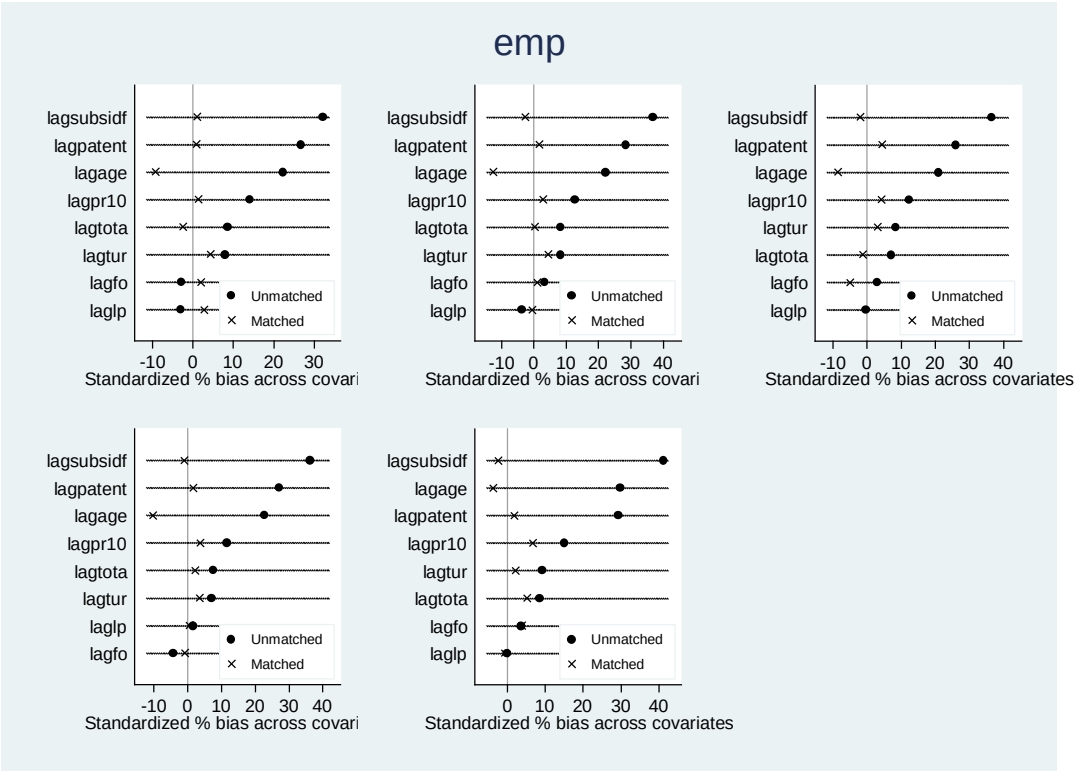



Figure A.8b. Balancing test graphs, turnover growth outcome.

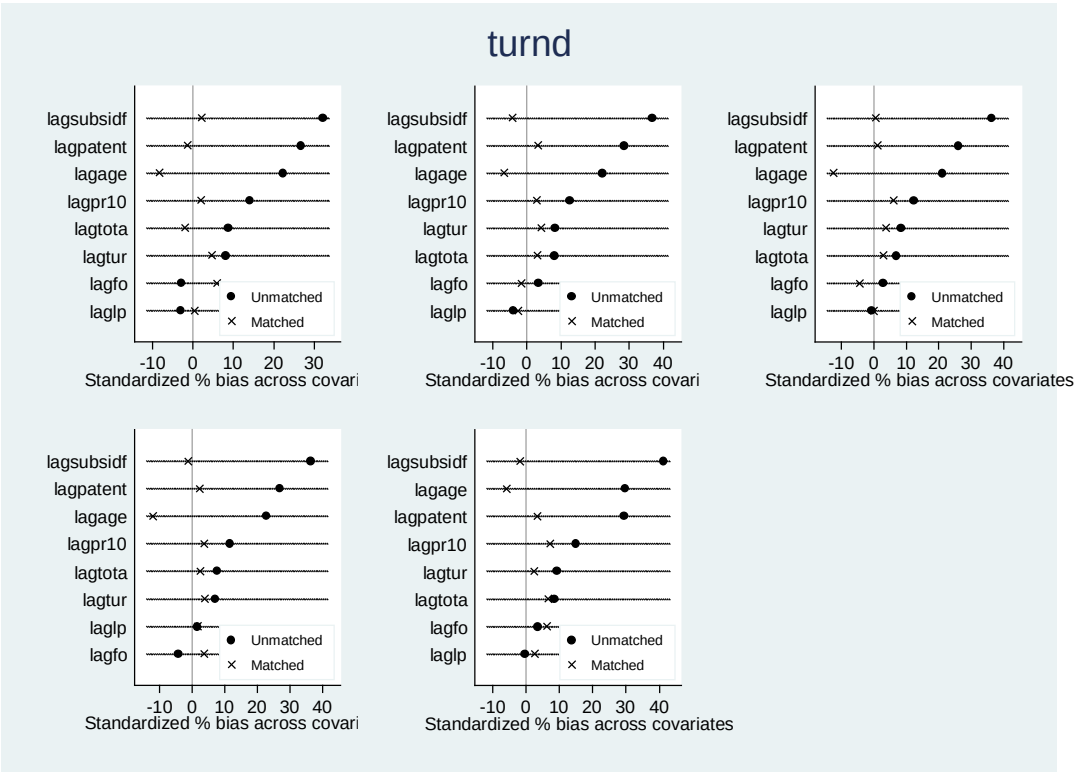


Figure A.8c. Balancing test graphs, assets growth outcome.

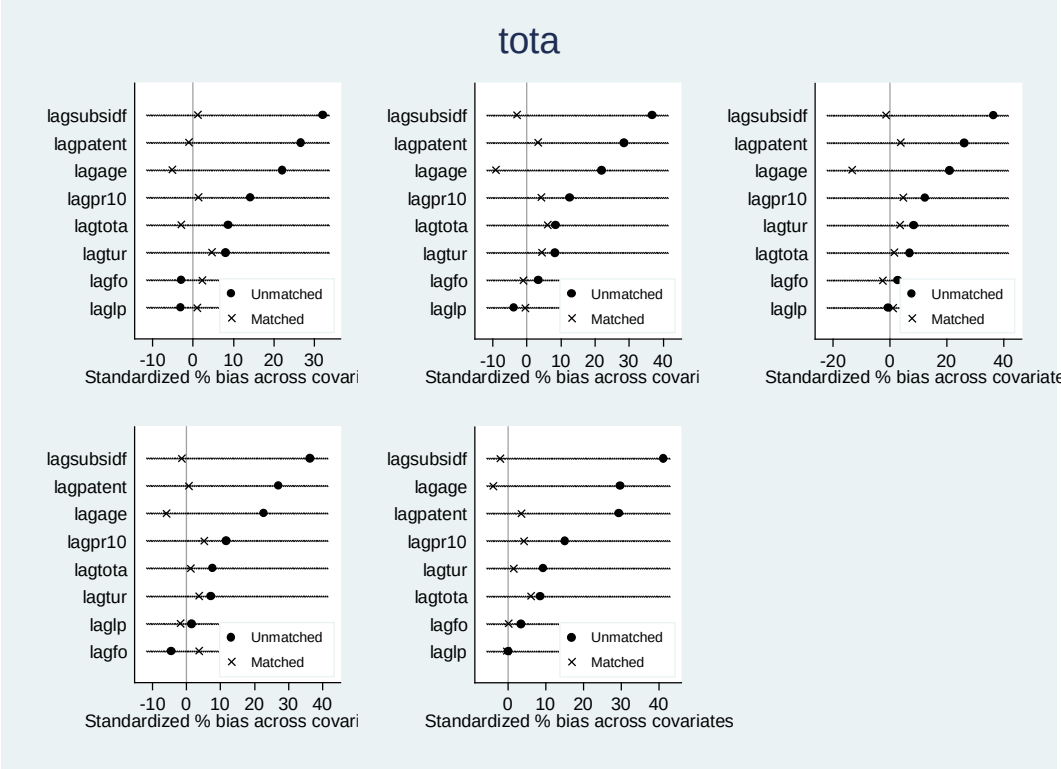



Figure A.8d. Balancing test graphs, labour productivity growth outcome.