Offshore Outsourcing and Productivity[1]

Preliminary and Incomplete. Please do not quote

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Abstract

Offshoring of services, either to a foreign affiliate or an external overseas supplier, and its effects on developed economies is at the heart of policy discussion. Whilst macro evidence and case studies are not lacking, few studies have used microeconomic data to analyse this issue and they have only looked at the manufacturing sector. This study is the first to use establishment level data for both manufacturing and services sectors in the United Kingdom during the early 2000s to analyse the importance of offshoring and its relationship with firms' performance. We find that firms that offshore services are mainly firms with international links, i.e. exporters of services and multinationals, both domestic and foreign. We find that offshorers are on average larger, more capital intensive, use more ICT capital and pay higher wages than firms, which do not offshore. We explore in more detail the relationship between offshoring and productivity. We find that, controlling for the other dimensions of global engagement, industrial affiliation, regional location, capital intensity and age, a 10% point increase in offshoring intensity is associated with a 0.37% increase in total factor productivity. The effect comes mainly from firms that are domestic and non-globally engaged, i.e. do not export and are not part of a multinational firm. Secondly, we find a productivity ranking of firms in line with previous empirical papers and theoretical trade models: multinationals are the most productive, followed by exporting firms. Finally, we do not find any robust evidence that the positive association of offshoring is driven by particular types of services or partner countries.

Introduction

In recent years, thanks to trade liberalization and progress in Information and Communication technology (ICT), an increasing number of firms are trading a wide variety of services with a large number of countries. Before the ICT revolution most services (call-centers, IT consultancy, accounting services, etc.) were non–tradeable. This makes services trade, in particular the importing or "offshoring" of services (from low wage countries), a relatively new phenomenon, whose consequences are the subject of much debate for policy makers and the public opinion.

Attention has focused on the possibility that offshoring of services might lead to the migration of jobs to countries, such as India, where firms can pay qualified workers much less than in their home countries. In general, the discussion has concentrated on the negative effects of offshoring. However, offshoring is likely to bring benefits to developed economies through lower costs of services,

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restructuring and increased specialisation. Moreover, the largest exporters of services in absolute terms remain developed countries, such as the United States and United Kingdom. An increase in services trade implies for these countries not only an increase in imports but also an increase in exports and therefore a larger market where domestic firms can offer their services. This will also yield gains to firms in developed economies.

Several studies have analysed the effects of offshoring on developed economies. Most of them have used industry level data in particular to analyse the effects of international outsourcing on labour demand.[2] Fewer industry level studies focus on services offshoring and productivity:[3] these include Amiti and Wei, 2005 who look at US industry level data for all manufacturing industries between 1992 and 2000 and analyse the correlation of both services and materials offshoring with productivity. The results show that services offshoring is positively associated with productivity, while materials offshoring is not significantly correlated with labour productivity. A 1% point increase in their measure of services offshoring is associated with an 0.8% increase in productivity.

Most of the existing literature differs in the definition of "offshoring". In fact, a recent paper by Bhagwati, Panagariya and Srinivasan (2004), claims that there is a "set of serious muddles" concerning the definition of offshoring which lead to confusion in the public debate. The authors present a very tight and clear definition of offshore outsourcing as the "purchase of services abroad with the supplier and buyer remaining in their respective locations."[4]

Our paper follows this definition of services offshoring, and studies its relationship with productivity using plant level data for the manufacturing and services sector in the United Kingdom (UK).

The study contributes to the literature in several ways. Firstly, there are very few studies that analyse this relationship using plant level data.[5] Görg and Hanley, 2004 and Görg, Hanley and Strobl,

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[2] Ror example Feenstra and Hanson, 1996 and 1999 for the United States look at the effect of offshoring on the relative wages of skilled workers in the United States. Amiti and Wei, 2004 Hijzen, Görg and Hine, 2005 look at the United Kingdom.

[3] Egger and Egger, 2005 looks at the effect of outward processing (imports of total intermediate materials) on the labour productivity of low skilled workers in the EU. The authors find that even though there is a negative the short run (marginal) effect of offshoring on the labour productivity of low-skilled workers, the long-run parameter estimates reveal a positive impact. The authors claim that imperfections in European labor and goods markets, might be a plausible explanation of this result since they prohibit an immediate adjustment in the factor employment and the output structure.

[4] This is In Mode 1 trade in services in the WTO terminology

[5] Papers such as Tomiura, 2004 and Swenson, 2000 use microlevel data to study the firm's decision to offshore. Tomiura finds that in the Japanese manufacturing sector, firms that more productive firms tend to be more active in foreign outsourcing (where foreign outsourcing include procurement of specialized components, processing of products and finally assembly, but not outsourcing of non-production overhead services).

2004 use Irish data covering the 1990-1998 period to study the effect of materials and services offshoring on productivity. We use micro level data from the UK from 2000 to 2003. The UK represents a very interesting case: according to recent data is one of the largest traders in services (the second largest exporter, after the United States, and the fourth largest importer, after the United States, Germany and Japan according to data from the World Bank[6]); moreover, services represent 74% of UK GDP,[7] and thus one of the countries where "offshoring" has generated more concerns. Also the period analysed - early 2000s - is when services trade has become more sizeable and thus the effects of this phenomenon on the economy more noticeable.

Secondly, we look at both the manufacturing and services sectors, while previous studies mainly concentrated on manufacturing industries or on very few sectors.

Thirdly, we are able to control for the level of global engagement of the firm: we do not only know if the firm is part of a Multinational Enterprise (MNE), foreign or domestic, but also we know if the firm is an exporter of services and the intensity of this exporting activity. This is important since importing services might be part of a global network strategy of the firm, and estimates of the effect of services offshoring that do not control for the global engagement of the firm are likely affected by omitted variable bias.

Finally, this is the first study that is able to distinguish the types of services imported and the partner country with which the firms trade.[8]

We can do this thanks to a unique dataset from three sources: the first of these sources is the ARD (Annual Respondents Database), the second is the ITIS (International Trade in Services Inquiry). Finally we use information on ownership and multinationality of firms from the AFDI (Annual Foreign Direct Investment Inquiry) register. The data is particularly suitable for our analysis because it contains detailed information on the importing and exporting of services, on outputs and inputs, and on ownership of firms. Thus, we can highlight differences between offshorers and non-offshorers in terms of output, input usage and ownership status; and we can study the effects of offshoring on productivity.

Firstly, we find that, controlling for the other dimensions of global engagement, industrial affiliation, regional location, capital intensity and age, a 10% point increase in offshoring intensity[9] is

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[6] Source: OECD Statistics on International Trade in Services Volume II (2004), the number reported can be found in Table 1, the statistics refer to 2002 data.

[7] Source OECD, STAN Indicators, STAN Database, May 2005; National Accounts of OECD countries, Vol II, 2005. The data refers to 2002 and shows that only in Luxembourg and in the US the services sector represent a larger share of GDP, at 82.6% and 76.9%, respectively, while the average in the rest of the OECD is 67%.

[8] This is of particular interest since recent theoretical models in the trade literature (e.g. Antras and Helpman, 2004) have made predictions on the cross-sectional differences in productivity of offshorers; predictions that we test with our data in a companion paper.

associated with a 0.37% increase in total factor productivity. The effect comes mainly from firms that are domestic and non-globally engaged, i.e. do not export and are not part of a multinational firm. These results are robust to controlling for fixed effects, to using alternative measures of offshoring and adopting a value added specification of the production function. Secondly, we devise a ranking of firms according to productivity in line with previous empirical papers and theoretical trade models: multinationals are the most productive firms, followed by exporters, importers and finally by non-globally engaged firms. Finally, we do not find any robust evidence that the positive association of offshoring is driven by particular type of services or partner countries.

The results suggest that an increase in the offshoring intensity of the median offshorer to the level of the 75th percentile of the distribution, i.e. increased from 9% to 28% offshoring intensity, is associated - keeping everything else fixed – with a 0.7% increase in productivity.[10]

The rest of the paper is organised as follows. Section 2 outlines the relevant litarature. Section 3 describes the data and the measures of offshoring used. Section 4 sets out the estimation approach and describes the results. Section 5 concludes. The Appendix reports details on the cleaning procedures and additional results.

Related Literature

The Data

The Annual Respondents Database (ARD)

The Office of National Statistics (ONS) Annual Respondents Database (ARD) is described in detail in Criscuolo, Haskel and Martin (2003), so only a brief description is included here. Since 1997 The ARD consists of the replies to the mandatory *Annual Business Inquiry* (ABI).

The ABI is the major source of establishment level data in the UK and underlies the construction of aggregate output and investment in the national accounts. The ABI forms request information on inputs and outputs: gross output,[11] value added, employment, investment, intermediates and wage costs. Information is also collected on plants' industry, region, and nationality of ownership. Each unit that replies is assigned a unique identification number, which allows units to be linked over time. The

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[9] This would be roughly equivalent to a shift of a non offshorers to the offhsoring intensity level of the median offshoring firm.

[10] keeping in mind that the average annual TFP growth of the UK economy over the 1995-2003 period was 1.37%, the estimated coefficient is not economically insignificant.

[11] The ABI contains gross output at current values. The ONS provides PPI deflators with base year 2000 for the manufacturing sector (MM17). For a limited number of service sector industries the ONS provides a set of experimental deflators. For all the other industries in the service sector a common service sector deflator is used.

ONS also assigns a second identification number corresponding to the entity that owns the unit so units under common ownership share the same firm identifier.

The ABI asks firms on their purchases of goods, materials and services. Since 2000 the ABI forms include a question which asks firms to report the amounts of services traded with other countries (imports and exports of services). The question explicitly excludes the value of imported and exported goods. The values reported should include, according to the notes of the surveys, "*all transactions with individuals, enterprises and other organizations domiciled in a country rather than the UK*". This definition includes subsidiaries and parents that are operating abroad. This means that the value of imported/exported services reported includes both inter- and intra-firm trade.

These services include industrial and non-industrial services. Industrial services include repair of construction equipment and computers; non industrial services include among others: consultancy services (market research, advertising, accountancy and R&D); telecommunications services; computer services (excluding hardware).

The ARD provides information on investment but does not contain information on firms' capital stock. We use capital stock built using the information on investment from the ABI using a perpetual inventory method, details of which can be found in Martin (2000). We also use a measure of ICT (hardware and software) capital stock built also according to the perpetual inventory method using ONS IT surveys. Details on the methodology and data sources are in Bloom, Sadun and Van Reenen (2005).

The Inter Departmental Business Register (IDBR), the register from which the ABI sample is drawn, identifies foreign owned firms. The main source of information is Dun and Bradstreet's Who owns Whom database. To obtain information on which UK firms are outward direct investors we need to match into the dataset information from the AFDI register. Details of the AFDI register data and the procedure followed to merge the AFDI and the ARD can be found in Criscuolo and Martin (2004).

This study uses ARD data from 2000 to 2003, and covers both manufacturing and services sectors.

The International Trade in Services Inquiry (ITIS)

The Annual and Quarterly Inquiry into International Trade in Services (ITIS) collect data on UK private sector resident companies' international transactions in services. This study is the first to use the microlevel responses to the survey. Thus, in this section we describe the ITIS in detail.

The inquiries began in 1996 and have always been statutory. The results from the ITIS have been used as component of the Trade in Services account of the Balance of Payments and the expenditure measure of GDP, but also as input to industrial and non-industrial service product breakdowns of Input-Output data and used by the DTI's export promotion desks.

For each transaction over £10 000, the inquiries ask enterprises which service was traded (39 different types of service are provided), the value of the transaction and the country of origin or destination (depending on whether the service was imported or exported). ITIS cover firms with 10 or

more employees in most of the economy.[12] Like the ABI, enterprises are sampled from the IDBR. The quarterly survey is addressed to companies with the largest transactions in services, i.e. those who have total transactions of over 10 million pounds (identified from the previous year's results) and the annual survey to the remaining firms in the sample. Since 2001 the annual survey sampled 20 000 firms (previously 10 000) by sector and size-band, approximately split by 9000 for production industries and 11 000 for non-production industries. The quarterly survey samples around 650 firms. Response rates since 1999 are above 80% for the annual inquiry and range between 60 and 85% for the quarterly inquiries.

To ensure that the sample captures firms that trade in services various sampling methods are used. First known traders, identified from the previous year are selected. In addition, firms are selected if they give positive answers to filter questions on the ABI,[13] which identify the firms that are trading in services. Finally there is stratified random sampling from the IDBR in "High Propensity Industries" - sectors with a higher likelihood of trading overseas, such as computer services and wholesaling. Additional industries -called "mop ups" - have been included after the expansion of the survey in 2001 to ensure full coverage of the economy.

A large proportion of responses are "nils", that is, contributors who had no international transactions. For example, in 2001 this proportion was fifty-nine percent.

One concern regarding the ITIS might be measurement. How accurate are the answers to the survey? How exhaustive is the list of services provided in the questionnaire? How clear is the definition of services in the survey?

The ONS conducted a respondents' survey.[14] The survey covered time to complete the form, at what level in the company the form was completed, details on questions and notes in the survey. Answers to survey revealed that 76 per cent of respondents found the information required was readily available from their accounts. 91 per cent said that the products on the form covered their trade in services. 94 per cent of responders were happy that the definition on the form/notes of what is considered a "service" was clear and concise.[15]

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[12] Notable exceptions being the Banking and Financial Services Industry, Transport, Higher Education and the majority of Legal Services. The Film and Television Industry, which is not analysed in this paper, receives a much less detailed survey form, specifically asking for information on royalties and licences traded.

[13] The monetary values provided in the ABI are used as a benchmark for comparison with the grossed annual ITIS values.

[14] The survey was mainly conducted via post but twenty firms were telephoned and two were visited. The contributors were selected randomly to cover all types and sizes of businesses and response to the survey covered a good section of the sample.

[15] Further information on the ITIS Inquiries can be found in the Trade in Services publications and the Report on the Triennial Review if the International Trade in Services Inquiry (2003), all available on the ONS website.

Measuring offshoring

In this study we define offshoring as import of services. The ABI defines imported services as all transactions with individuals, enterprises and other organizations domiciled in a country rather than the UK. In the following descriptive and regression analysis we normalise our offshoring measure relative to the total services purchased by the firm.[16]

Several issues arise when using this measure. Firstly, the figure reported is a ratio between values, not quantity: if the price of the services imported is lower than if the service was provided domestically, we would be underestimating the amount of services actually imported. Secondly, due to data limitations, we only know the intensity of services offshoring but not that of materials offshoring, if the two are correlated, and this is likely especially in the manufacturing sector, our estimates of the services offshoring coefficient in the production function might be affected by omitted variable bias, and this bias is likely to be upward. Thirdly, our measure of offshoring is a catch all measure which ignores heterogeneity in the services imported and heterogeneity across the countries where the services are imported from. While we cannot control for the first two issues because of lack of necessary data, we can try to investigate the third issue exploiting the information from the ITIS and try to distinguish among the service type and the country partner dimensions.[17]

The regression analysis will also present robustness checks using alternative measures of offshoring. Firstly, we limit the imports and purchase of services to non-industrial services, i.e. we exclude repair of construction equipment and computers, as we assume that this type of service differs from the others in that it requires the shipment of the items requiring repair.

Secondly, we follow Görg et al and use as an alternative measure offshoring of services relative to the establishment's total wage bill. Görg et al. choose this measure because they see international outsourcing as "a substitute for in-house production and may therefore, at least in the short run, lead to a reduction in the total wage bill." Although we do not use this as our favourite measure since we think that the current establishment's wage bill does not reflect the cost of offshoring, we report the results obtained using this measure to compare our results to Görg et al., 2004.

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[16] This definition follows Bhagwati et al., 2004. Details on the debate on the definition and the history of offshoring can be found in Amiti and Wei, 2005. Services purchased include: road transport services; telecommunication services; computer services; advertising and marketing services; payments to employment agencies; industrial services purchased; other services - a catch all variable including professional services, legal services etc. Services purchased exclude energy; water; sewerage charges; payments for hiring and leasing plant/machinery and vehicles; commercial insurance premiums paid and payments to subcontractors.

[17] Note that this definition differs from the one employed by Görg et al. who include in the offshoring measure the ratio of materials imported over total wages and the ratio of services imported over total wages. They use total wages as denominator of the ratio to capture the opportunity cost of the services if they were produced in house.

Descriptive evidence

Table 1 shows the number of plants that import services in our full sample and their relevance in terms of employment and value added over the period 2000-2003. We define "offshorers" firms who reported having imported a positive value of services in the ABI survey.

Table 1: Presence and importance of outsourcers 2000-2003

	1	2	3	4	5
	Number of plants in the sample		***Share Offshorers***		
	Non-Offshorers	Offshorers	Number of plants	Employment	Value Added
2000	32814	3590	9.86	21.76	24.82
2001	35227	3533	9.12	18.15	24.66
2002	34255	2976	7.99	15.74	23.01
2003	33405	2933	8.07	18.94	23.57

Notes: Figures reported are annual averages. The sample includes businesses in the ARD which reply to the offshoring questions.
Source: Authors' calculations using ARD data for 2000-2003.

Column 1 reports the number of plants in the sample that report not having imported services (non-offshorers). Column 2 shows the number of plants who report having offshored services. As shown in column 3, less than 10% of the total number of firms in the sample are "offshorers". This confirms that offshoring of services is not yet a widespread practice.[18] Column 4 reports how much these firms represent in terms of employment. The proportion is now between 15 and 22%, this proportion is higher because as shown below in

Table 2 offshorers are on average larger. Column 5 presents the share of offshorers in terms of value added: the figure is now between 23 and 25%; higher than both the share of firms and of employment suggesting that in our sample offshorers are on average not only larger but also more productive.

This is confirmed in row 1 of table 2 - which reports averages and standard deviations for relevant variables distinguishing between "offshorers" and "non-offshorers" - where the average real value added per employee among offshorers is almost 50% higher than for non-offshoring firms (40,870 vs 27,400 in 2000 pounds).

Row 3 to 7 report differences in the use of inputs: offshorers are on average larger (row 3) have higher intermediates -to-labour (both materials, row 5 and services, row 6) and capital-to-labour ratios

[18] Note that these statistics refer to the ARD sample, not the total population of UK businesses. It is likely that these are upper estimate of the presence of offshorers in the whole population since larger firms are both more likely to offshore and overrepresented in the ARD sample.

than other plants, as shown in row 4 and 7 respectively. Row 8 and 9 report that offshoring firms also have more ICT capital, both hardware and software.[19]

Row 10 report differences in average wage. The figure show that offshorers pay on average almost 80% more than non offshorers. This might suggest that offshorers employ higher skilled workers; however it could also reflect the fact that offshoring firms are larger – larger firms pay higher wages (Brown and Medoff, 1998) – are more likely to be part of a multinational corporation or are more concentrated in high paying industries or regions.[20]

Row 11 reports the average offhoring intensity in the whole sample and among offshorers: the figure in the whole sample is 2%, reflecting the fact that less than 10% in the sample are involved in offshoring. However, among offshorers, the average offshoring intensity increases to almost 20% indicating that offshorers import on average a fifth of the services they outsource.

Finally, the last 5 rows of the table (12 to 16) show that offshoring is likely part of a more general "global engagement strategy". Row 12 shows that 60% of offshorers are also exporters of services against figures of only 5% for non-offshorers.[21] Rows 14 to 16 show that offshorers are more likely to be part of a multinational corporation (MNE). Row 15 and 16 show that we are four times more likely to find a UK MNE and a 6 times more likely to find a foreign MNE among outsourcers than among non offshoring plants.

The question that arises is then: how much of these differences in inputs usage and output is due to the fact that a greater percentages of outsourcers are exporters and multinational corporations.

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[19] Note that these statistics are calculated on a reduced sample of 9,896 observations, 4,119 in manufacturing and 5,777 in services, for which ICT capital stocks measures are available.

[20] We investigate these hypotheses by running regressions of average wage on an offshoring dummy, global engagement variables (export and multinational), size, region and 4-digit industry dummies. The coefficient on the offshoring dummy are still positive and significant after controlling for all the other factors, thus suggesting that offshoring firms likely employ more high skilled workers.

[21] We need to note that there are a handful of manufacturing firms that export services. This seems counterintuitive. However we have at least three possible explanations of this phenomenon: first, it might be that these manufacturing firms also provide services, as a secondary activity, which they export. The second hypothesis is that these firms are exporting goods and the services related to these goods, so that export of services in this case is a proxy for exporting goods. Thirdly, it is possible that these firms are misclassified as manufacturing firms but should be classified as services sector firms.

Table 2: Summary Statistics in the 2000-2003: pooled sample; non-offshorers vs offshorers

		All Firms	Non-Offshorers	Offshorers
1	Real value Added per employee	28.60	27.40	40.87
		(26.62)	*(25.81)*	*(31.33)*
2	Real gross output per employee	117.49	111.65	177.44
		(1291.31)	*(1334.96)*	*(698.47)*
3	Employment	200.23	178.57	425.74
		(2230.82)	*(2001.20)*	*(3878.23)*
4	Intermediates per employee	87.81	83.12	135.91
		(1271.06)	*(1313.57)*	*(697.21)*
5	Purchased Materials per employee	66.87	64.43	91.86
		(1254.89)	*(1297.59)*	*(675.42)*
6	Purchases Services per employee	20.95	18.69	44.05
		(179.99)	*(183.06)*	*(142.79)*
7	Capital per employee	79.45	73.42	140.08
		(2499.21)	*(2617.50)*	*(393.25)*
8	Hardware Capital per employee	0.95	0.85	1.34
		(1.79)	*(1.64)*	*(2.23)*
9	Software Capital per Employee	0.51	0.48	0.70
		(0.94)	*(0.89)*	*(1.20)*
10	Real average Wages	16.39	15.34	27.15
		(15.00)	*(14.34)*	*(17.26)*
11	Import Intensity (services imported/services purchased)	0.02		0.19
		(0.09)		*(0.23)*
12	Export Intensity (services exported/total sales)	0.02	0.01	0.08
		(0.09)	*(0.08)*	*(0.18)*
13	Proportion of firms that export services (%)	9.58	5.01	60.12
14	Proportion of MNEs (%)	12.32	9.89	37.95
15	Proportion of UK MNEs (%)	4.65	4.02	11.25
16	Proportion of Foreign MNEs (%)	7.67	5.87	26.71

Notes: Figures are unweighted averages over the sample period. Standard deviations in parentheses and italics. Figures for value added, intermediates, material inputs, services capital, Hardware, Software and wages are in thousands of pounds. Figures for value added; gross output and wages are deflated using deflators with 2000 as base year. Figures for employment are head counts. Finally the figures reported in the last six rows are percentages. The total number of observations is 123,222.

Source: Authors' calculations using ARD data over the 2000-2003 period.

hat are part of a multinational

Table 3 answers this question by recognizing the heterogeneity in the group of outsourcing firms and dividing the firms in the sample in the following groups:

- Domestic firms that neither import nor export services and are not part of a multinational
- Domestic firms that import services but do not export and are not part of a multinational
- Domestic firms that both import and export services and are not part of a multinational
- Firms that are part of a multinational

Table 3: Summary Statistics in the 2000-2003 pooled sample: breakdown of globally engaged firms

		Domestic non-traders	Domestic importers (only)	Domestic importers and exporters	Multinationals
1	Value Added per employee	25.03 *(23.58)*	33.28 *(27.01)*	40.02 *(29.88)*	44.75 *(34.25)*
2	Gross output per employee	95.28 *(1237.82)*	142.51 *(383.27)*	126.45 *(229.88)*	258.07 *(1930.62)*
3	Employment	96.18 *(895.84)*	229.01 *(1105.72)*	308.67 *(4557.10)*	853.10 *(5433.69)*
4	Intermediates per employee	70.35 *(1291.13)*	108.89 *(374.65)*	87.31 *(228.94)*	203.86 *(1572.73)*
5	Purchased Materials per employee	54.53 *(1285.40)*	78.26 *(340.94)*	37.98 *(125.19)*	159.66 *(1502.84)*
6	Purchased Services per employee	15.82 *(107.19)*	30.63 *(86.00)*	49.33 *(188.69)*	44.20 *(420.15)*
7	Capital per employment	65.62 *(2828.98)*	93.67 *(189.82)*	128.20 *(422.81)*	150.04 *(543.87)*
8	Hardware Capital per employee	0.61 *(1.19)*	0.78 *(1.48)*	1.56 *(2.30)*	1.29 *(2.25)*
9	Software Capital per Employee	0.43 *(1.18)*	0.5 *(0.9)*	0.74 *(1.22)*	0.73 *(1.34)*
10	Average Wage	13.50 *(12.73)*	20.87 *(14.86)*	27.32 *(17.31)*	29.18 *(17.33)*
11	Offshoring intensity (among offshorers		0.18 *(0.23)*	0.23 *(0.26)*	? ?
12	Proportion of firms that import services				?
13	Proportion of firms that export services				24.83
14	Export Intensity among exporters (services exported/total sales)				? *?*

Notes: Figures are unweighted averages over the sample period. Standard deviations in parentheses and italics. Figures for value added, intermediates, material inputs, services capital, Hardware, Software and wages are in thousands of pounds. Figures for employment are head counts. Finally the figures reported in the last six rows are percentages. The total number of observations is 123,222.

Source: Authors' calculations using ARD data over the 2000-2003 period.

The table shows that multinational firms are the most (labour) productive firms in our sample followed by (services) exporting firms, (services) importers and non importers. This ranking is in line with previous evidence for the UK on MNEs (Doms and Jensen, 1998 and Criscuolo and Martin, 2004) and on exporters (Bernard and Jensen, 1999) and with theoretical predictions from recent trade models (Helpman et al., 2004; Antras and Helpman, 2004). Similar rankings hold for output, employment, intermediates and capital. ICT capital intensity is not significantly different between exporters and multinationals, suggesting that firms that are globally engaged (exporters or MNES) are ICT capital intensive.

The matched ARD-ITIS sample

In the second part of the paper we try to investigate whether we can find particular effects from a type of service or a partner country. To do so we have matched the ITIS to the ARD for the years 1997 to 2003. However in the analysis that follows we only use data over the period 2000 to 2003. Even though this implies a loss in terms of years covered it allows covering a much larger cross-section of firms for the four year period. The ARD asks firms whether they have offshored or exported services, this allows us to identify "non-trading" plants and include them in the matched sample. Therefore in what we define "ARD-ITIS matched sample" we have firms that are in both the ARD and ITIS – the successfully merged observations- plus firms in the ARD that do not trade in services.[22]

In the Appendix we report summary statistics for the ARD-ITIS matched sample. The figures presented show similar trends and rankings as the statistics from the whole ARD. The main difference lies in the proportion of offshorers (table 11): only between 4 and 6% in the ARD-ITIS sample (vs the 8-10% in the whole ARD) and the average size of offshorers that is much larger in the matched sample (table 12); this is related to the way we constructed the sample since we only kept the offshorers that are in both the ARD and ITIS and firms which are larger are more likely to be in both surveys.

In unreported analysis, we looked at the ITIS and we found that on average firms reported having imported three types of services (both manufacturing and services sectors firms). Manufacturing firms reported having imported services from about 10 countries while services sector firms imported from about 20.

As shown also in the official aggregate statistics (ONS, UK Trade in Services, 2003) we find the largest trading partners are the United States, the EU (Germany and France) and Japan and that the most relevant services imported are business services and computer services.

The econometric framework

We assume that firms produce output according to a production technology:

$$Y = A_{it}^{\psi}[F_t(L_{it}, K_{it}, M_{it}, S_{it})]^{\gamma}$$

where gross output Y is a function of inputs: labour, L, physical capital, K, and intermediates, materials (M) and services (S); $F_t(.)$ is a linear homogeneous general differentiable function common to all plants, γ is the returns to scale coefficient and A is the plant's specific technology shifter.

[22] One possible issue with the data is that the ITIS tend to survey mainly "big" traders; this could imply a selection bias in the sample. We intend to investigate this issue further and use propensity score matching to solve it.

Following Klette, 1999 one can use the multivariate generalized mean value theorem to express the production function above in terms of logarithmic deviations of the output and each of the inputs from a point of reference. Here we choose as the point of reference the level of the 4-digit industry-year mean firm's value.[23] Rewriting the production function in terms of logarithmic deviations from the representative firm, we obtain:

$$\hat{y}_{it} = \psi \hat{a}_{it} + \alpha_{it}^{L} \hat{l} + \alpha_{it}^{M} \hat{m} + \alpha_{it}^{S} \hat{s} + \alpha_{it}^{L} \hat{k} \qquad \textbf{(2)}$$

where the lower case letters with the hat indicate the logarithmic deviation from the mean firm's value and $\alpha_{it}^{j} = \gamma \frac{\partial f_t(.)}{\partial j} \cdot \frac{\tilde{j}_{it}}{f(., \tilde{j}_{it})}$; i.e. α_{it}^{j} is the partial derivative of the log production function, *f*, relative to factor *j* evaluated at an internal point between the establishment's value and the reference point.

We assume that offshoring of services affects productivity by shifting the technology parameter A:, i.e. we assume that:

$$\psi = \alpha_0 + \beta OFF_{it} + \xi Z_{it} \qquad \textbf{(3)}$$

where OFF is a measure of the offshoring intensity and Z is a vector of firms characteristics such as its global engagement, location, age etc. Offshoring could affect productivity via the technology parameter through several channels: firms that import services from abroad have access to a larger variety of services than those employing only domestic services; they can get access to more advanced technologies or to services of the same quality but at a lower cost.

OFF, the offshoring variable, is defined as the ratio of imported services over the total amount of services purchased.[24]

As highlighted in equation 2, beside offshoring, there are other factors that might lead to a shift of the production function and are correlated with offshoring. In particular, the descriptive statistics show that almost half of the firms that import services from abroad also export services from abroad and that among offshoring plants a high proportion are part of a multinational corporation. Many papers have shown that firms that are globally engaged are more productive than purely domestic firms. Thus, omitting these controls (exporting and ownership status) is likely to lead to an upward biased estimate of the offshoring coefficient.

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[23] An alternative is to use rather than the mean the median as Klette, 1999. This approach has for us the additional advantage of not needing deflation since we express outputs and inputs relative to the 4-digit industry mean. This allows us to overcome data limitations on deflators for the services sector and intermediates (services and materials). We tested the robustness of our results to this choice.

[24] It is important to note that, contrary to previous papers, our analysis does not capture the role of the imports of materials but only that of services imports. This choice is dictated by data availability.

Our preferred specification is obtained from combining equations 2 and 3 and expressing everything in per employee terms.

$$\hat{y}_{it} - \hat{l}_{it} = \alpha_0 + \alpha_K(\hat{k}_{it} - \hat{l}_{it}) + \alpha_M(\hat{m}_{it} - \hat{l}_{it}) + \alpha_S(\hat{s}_{it} - \hat{l}_{it}) + \alpha_{CR}\hat{l}_{it} + \beta OFF_{it} + \gamma Exporter_{it} + \delta_1 UKMNE_{it} + \delta_2 Foreign\_US_{it} + \delta_3 Foreign\_other_{it} + \theta_1 age_{it} + \theta_2 age_{it}^2 + \theta_3 age\_cens_{it} + \lambda_I + \tau_t + \zeta_R + \eta_i + \omega_{it}$$

where $\alpha_{CR} = \sum_{j=K,M,S} \alpha_j - 1$ and Export, UKMNE, FOREIGN_US and FOREIGN_other are dummy variables equal to one if a firm exports services, is part of a UK MNE, a US MNE or a foreign non US MNE, respectively. We also include a quadratic polynomial in age and a dummy variable to correct for left censoring in 1980 for firms in the manufacturing sector and 1997 for firms in the services sector. Finally we include four-digit sector dummies, regional dummies and time dummies to control for industry, location and time effects. η represents the time invariant firm specific effect and ω the time varying productivity shocks. We start by estimating this model using OLS.

This approach presents several limitations. We will mention each in turn and try to deal with them where possible in the next section.

Firstly, we choose a static specification, thus we do not model the correlation of productivity shocks over time. This choice is driven by the loss of observations that we would incur if we were to have a dynamic specification. Given the nature of the ARD data, by having a dynamic specification we lose about 75% of the original sample and we mainly exclude small and medium sized firms that are not surveyed every year. Thus the sample is biased towards larger exporting and multinational firms. As will become clear in the next section, since the positive association between offshoring and productivity mainly comes from domestic non exporting firms, the "dynamic sample" composition is likely to bias the results against finding a relationship between offshoring and productivity. However in the robustness checks, we present the results of a dynamic specification.

Secondly, these OLS regressions report correlations. However, if we are in search of a causal relationship between offshoring and productivity, OLS estimates are not likely to give us the right answer as the error term and the explanatory variables, in particular the production inputs, are correlated.

We assume that we can divide the productivity shocks in two components: a firm specific time invariant component and an idiosyncratic time varying productivity shock. If inputs choices are only correlated with the time invariant plant specific effect, taking first differences or estimating a fixed effect model would solve the endogeneity problem.[25] However, inputs are also potentially correlated with the time varying productivity shock. To solve this endogeneity problem in the estimation of the production function, the literature proposes two possible alternatives to OLS: the linear generalized

[25] We prefer fixed effects to first differences estimation not only because of the structure of the data, but also because first differencing can exacerbate measurement error problems (Griliches and Hausman, 1986).

methods of moments (GMM) estimator as proposed by Blundell and Bond (1998) and the semiparametric approach or Proxy estimator proposed by Olley and Pakes (1996) and modified by Levinsohn and Petrin (2003) and others.

According to the traditional version of this latter model one estimates TFP in a first stage production function and then regress it on the offshoring variable. However, this two-step procedure would lead to biased estimates, in that if offshoring intensity increases productivity and is correlated with the other production inputs, the first step estimate of TFP will suffer from omitted variable bias.[26]

TO DO: In the robustness check, we decided to present results of linear generalized methods of moments (GMM) estimator as proposed by Blundell and Bond (the "system GMM" method) where we assume that all factors of production (capital, labour, material and services) as well as offshoring and exporting are endogenous and therefore are instrumented using their second and third lags as instruments for the equations in differences and the lagged first difference as instrument for the level equations. We assume that the ownership variables are predetermined and therefore use their first and second lags as instruments for the equations in differences.

The results

Table 4 reports the coefficients of our baseline specification. Column 1 reports the coefficient of an augmented production function where we control for age, industry, region and time effects. The coefficient on the offshoring variable, imported services over total purchased services, is positive at 0.095 and significant at the 1%. In column 2, I control for the ownership status of the firms. In line with previous results using this data we find that US firms are the most productive followed by other foreign and domestic MNEs. The offshoring coefficient is still significant at the 1 percent level but is now 0.068. Our favourite specification is presented in column 3. This column shows that controlling for ownership status and exporting, offshoring intensity is still significantly positively correlated with productivity. The coefficient on offshoring is smaller than in the first 2 columns, having decreased to almost one half of the coefficients in column 2, and only significant at the 5% level. The coefficients of the global engagement dummies are also in line with the ranking predicted by theory and by previous empirical analysis: US MNEs being the most productive; followed by other MNEs - foreign and domestic- and exporters.

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26 See van Biesenbroeck (2005) for a similar argument on exporting. Similarly one should control for the role of offshoring when modeling the endogenous exit decisions of firms. When a profit function is increasing in capital and in the decision to import, the threshold value of productivity that induces exiting, is decreasing in capital but also in import intensity. Specifically, plants having larger capital stocks and offshoring expect larger future profits and hence stay in the market at the lower realized values of omega. Kasahara and Rodrigue (2004), suggest a modification of the Levinsohn and Petrin approach that accounts for the simultaneity of import of materials in the production function and for the role of the import decision in the exit decisions. As long as we are willing to accept the validity of their assumptions in the case of imports of services (rather than materials) a similar approach can be adopted to model the relationship between services offshoring and productivity.

Table 4: OLS Regressions Results: ABI 2000-2003. Manufacturing and services sectors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Whole sample			Manufacturing			Services		
ln(EMP)	0.005***	-0.002**	-0.003***	0.019***	0.012***	0.012***	0.001	-0.008***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Ln(K/EMP)	0.207***	0.205***	0.204***	0.134***	0.130***	0.130***	0.224***	0.222***	0.221***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)
Ln(M/EMP)	0.230***	0.229***	0.230***	0.271***	0.270***	0.270***	0.220***	0.220***	0.221***
	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.003)	(0.003)	(0.003)
Ln(S/EMP)	0.205***	0.202***	0.201***	0.263***	0.262***	0.261***	0.192***	0.188***	0.187***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)
OFFSHORING	0.095***	0.068***	0.037**	0.058***	0.045***	0.035**	0.111***	0.079***	0.036*
	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.017)	(0.022)	(0.021)	(0.022)
UK MNE		0.119***	0.118***		0.045***	0.044***		0.183***	0.181***
		(0.008)	(0.008)		(0.007)	(0.007)		(0.014)	(0.014)
Foreign non-US MNE		0.141***	0.140***		0.062***	0.062***		0.192***	0.190***
		(0.008)	(0.008)		(0.007)	(0.007)		(0.012)	(0.012)
US MNE		0.166***	0.164***		0.097***	0.097***		0.210***	0.205***
		(0.010)	(0.010)		(0.010)	(0.010)		(0.018)	(0.018)
Exporter			0.035***			0.011*			0.047***
			(0.005)			(0.006)			(0.007)
Observations	123222			29001			94221		

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. The dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and an age censoring dummy that equals one if the plant exists since 1980 in the manufacturing sector and since 1997 in the services sector; region; 4-digit industry and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

The following two panels (columns 4 to 9) present results for the manufacturing (columns 4 to 6) and services (columns 7 to 9) sectors separately. In each panel, the results are presented in the same order as columns 1 to 3: no control for global engagement in the first column, inclusion of controls for multinationality status and foreign ownership in the second column and finally in the third column our favourite specification where we control for all dimensions of global engagement: exporting status, multinationality and foreign ownership. Comparing the two panels we notice that the inclusion of the export dummy affects the coefficient on offshoring much more in the services sector than in the manufacturing sector: in the manufacturing sector, the coefficient on exporting is, as expected, [27] not significant while in the services sector the coefficient on exporting is strongly positive and significant. A possible explanation of this result is that while in the service sector the (services) export dummy

[27] Note that very few firms in the manufacturing are exporting services. Ideally for the industrial classification to be exact we should not see any manufacturing firm exporting services. The fact that we do have some firms in the manufacturing sector exporting services suggests that either there is a classification problem or there is an issue with multiproduct firms who do both manufacturing and services (perhaps as a secondary activity), but are classified as manufacturing firms.

captures all exporters; in the manufacturing sector we are only identifying a small portion of exporters, i.e. those that are misclassified or those firms that export services as well as goods. Thus, the coefficient estimate of offshoring in the manufacturing sector is upward bias because of the omission of an indicator of material goods export for manufacturing firms. This source of bias is likely attenuated in the fixed effects regressions presented in table 5, in that exporting status is less likely to vary over time and thus can be captured in the unobserved firm fixed effect component which is absorbed in the within group regression. This is also true for the multinational status.

Table 5: Within Group Regressions Results: ABI 2000-2003. Manufacturing and services sectors

	(1)	(2)	(3)
	Whole Sample	Manufacturing	Services
ln(EMP)	-0.080***	-0.048***	-0.086***
	(0.006)	(0.007)	(0.010)
ln(K/EMP)	0.217***	0.147***	0.260***
	(0.007)	(0.008)	(0.010)
ln(M/EMP)	0.153***	0.247***	0.127***
	(0.004)	(0.009)	(0.005)
ln(S/EMP)	0.162***	0.198***	0.143***
	(0.005)	(0.006)	(0.006)
OFFSHORING	**0.037****	**0.009**	**0.068****
	(0.016)	**(0.018)**	**(0.027)**
UK MNE	0.006	0.006	0.004
	(0.006)	(0.006)	(0.011)
Foreign non-US MNE	0.032***	0.020***	0.039***
	(0.007)	(0.007)	(0.012)
US MNE	0.009	0.007	-0.011
	(0.009)	(0.008)	(0.020)
Exporter	-0.007	0.005	-0.017**
	(0.005)	(0.005)	(0.008)
Observations	123222	29001	94221

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. The dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and an age censoring dummy that equals one if the plant exists since 1980 in the manufacturing sector and since 1997 in the services sector; region; 4-digit industry and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

Table 5 reports the results of a within-group, or fixed effect, estimation: column 1 report results for the whole sample, column 2 for manufacturing and column 3 for services. The estimates show that offshoring is positively correlated with TFP at the 5% level (column 1). However, as shown in columns 2 and 3, this effect is driven by the services sector. The positive coefficient that we had found in the manufacturing sector becomes insignificant when we control for firm fixed effects. This suggests that in the manufacturing sector the "best" firms are the ones that offshore. In the services

sector, the coefficient on offshoring is significant and larger in absolute value than the OLS coefficient (see column 9 of table 4).[28]

Robustness checks

Offshoring and other dimensions of Global Engagement

In the results presented in the previous section we estimated our preferred specification on all the firms in the sample. However, exporters and multinational firms are likely to use a different production technology than domestic non-exporters (see also Görg et al.). In previous empirical analysis of Irish data, Görg Hanley and Strobl have found that the effect of material offshoring was positively correlated with productivity only for exporting firms. As noted by the authors, firms that are part of an international production network are likely to enjoy lower search costs for international suppliers with whom they can establish an outsourcing relationship; and thus gain more from offshoring than purely domestic firms.

However in a companion paper Görg and Hanley find that in the Irish electronics industry the only firms for which they could find a positive correlation between offshoring and productivity were firms with low export intensity. Plants with low import intensities are likely to benefit more from procurement of inputs on the international market; firms that are already globally engaged enjoy already the benefits of offshoring.

In both papers, however, they find no correlation between services offshoring and productivity, possibly as they mention in their paper because of the very small number of firms that offshore services in their sample.

In table 6 and 7 we distinguish among different dimension of global engagement: domestic vs foreign-owned establishments; multinational vs non-multinational establishments; exporters vs non-exporters. The offshoring coefficient is larger for domestic, for non-multinationals and for non-exporters. If we then isolate the group of domestic non-multinationals non-exporting plants, i.e. of establishments which are not globally engaged, we find that the offshoring coefficient is positive and significant with the coefficient decreasing from 0.52 in OLS to 0.048 in the fixed effect regression. The coefficient for domestic exporters is only significant in the fixed effects regression and is higher in absolute value than the value estimated in the OLS regression, as we had found in the services

[28] How can we interpret these result? A possible explanation is that the export dummy coefficient in the fixed effects model is identified through firms that switch exporting status during the three year period analysed (2000-2003). If, as it is likely, firms that start exporting incur in high fixed costs, these firms will experience a short-term drop in their TFP. An alternative explanation is that the negative coefficient reflects misspecification of the production function.

sector. The coefficient estimates for multinationals – independently from whether they are exporting - are not robust.

How can we interpret these results? We can provide two possible explanations. Firstly, suppose that, as suggested by trade models, there is a selection of best firms into becoming globally engaged; then in the group of "best firms" offshorers are not necessarily better than exporters and multinationals; but in the group of non-globally engaged firms "offshorers" are better than firms that do not trade internationally at all.

Second if we believe that the positive coefficient indicates a positive effect of offshoring to productivity then we can read the result as suggesting that for firms which are already globally engaged the extra kick coming from offshoring has less of an impact than if it was your only international activity.

Table 6: Domestic vs Foreign; nonMNEs vs MNEs; exporters vs Non-exporters OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Domestic	Foreign	non MNE	MNEs	Non Exporter	Exporter	Domestic non MNE non exporter	Domestic non-MNE exporter
ln(EMP)	-0.002	-0.005	-0.002	-0.003	-0.004***	0.004	-0.003**	0.006
	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.004)
ln(K/EMP)	0.201***	0.249***	0.198***	0.241***	0.198***	0.218***	0.193***	0.205***
	(0.003)	(0.011)	(0.003)	(0.009)	(0.003)	(0.010)	(0.003)	(0.011)
ln(M/EMP)	0.229***	0.237***	0.234***	0.219***	0.245***	0.150***	0.247***	0.136***
	(0.003)	(0.008)	(0.003)	(0.007)	(0.003)	(0.006)	(0.003)	(0.007)
ln(S/EMP)	0.197***	0.272***	0.192***	0.279***	0.191***	0.289***	0.184***	0.288***
	(0.003)	(0.010)	(0.003)	(0.008)	(0.003)	(0.010)	(0.003)	(0.011)
OFFSHORING	**0.039****	**0.024**	**0.035***	**0.027**	**0.050****	**0.009**	**0.052****	**0.021**
	(0.017)	**(0.031)**	**(0.018)**	**(0.026)**	**(0.020)**	**(0.021)**	**(0.026)**	**(0.025)**
EXPORTER	0.041***	-0.020*	0.044***	-0.014				
	(0.006)	(0.012)	(0.006)	(0.010)				
UK MNE	0.115***				0.121***	0.086***		
	(0.008)				(0.008)	(0.016)		
Foreign non-US MNE				-0.008	0.146***	0.103***		
				(0.009)	(0.008)	(0.015)		
US MNE		0.035***		0.022*	0.172***	0.125***		
		(0.011)			(0.011)	(0.018)		
Observations	112742	10480	106401	16821	110903	12319	97828	8573

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. The dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and an age censoring dummy that equals one if the plant exists since 1980 in the manufacturing sector and since 1997 in the services sector; region; 4-digit industry and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

Table 7: Domestic vs Foreign; nonMNEs vs MNEs; exporters vs Non-exporters Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Domestic	Foreign	non MNE	MNEs	Non Exporter	Exporter	Domestic non MNE non exporter	Domestic non-MNE exporter
ln(EMP)	-0.092***	-0.032**	-0.094***	-0.044***	-0.090***	-0.026	-0.102***	-0.041
	(0.007)	(0.013)	(0.008)	(0.010)	(0.007)	(0.017)	(0.008)	(0.026)
ln(K/EMP)	0.225***	0.169***	0.230***	0.170***	0.223***	0.171***	0.235***	0.175***
	(0.008)	(0.013)	(0.008)	(0.011)	(0.007)	(0.020)	(0.008)	(0.027)
ln(M/EMP)	0.144***	0.197***	0.147***	0.169***	0.157***	0.136***	0.153***	0.111***
	(0.004)	(0.014)	(0.004)	(0.011)	(0.004)	(0.012)	(0.005)	(0.009)
ln(S/EMP)	0.153***	0.229***	0.147***	0.227***	0.152***	0.228***	0.139***	0.216***
	(0.005)	(0.011)	(0.005)	(0.009)	(0.005)	(0.013)	(0.005)	(0.017)
OFFSHORING	**0.041****	**0.026**	**0.055*****	**0.016**	**0.037****	**0.041***	**0.048****	**0.070****
	(0.018)	**(0.035)**	**(0.019)**	**(0.028)**	**(0.018)**	**(0.023)**	**(0.021)**	**(0.028)**
EXPORTER	0.000	-0.030***	-0.002	-0.019**				
	(0.005)	(0.011)	(0.006)	(0.009)				
UK MNE	0.001				0.006	0.002		
	(0.006)				(0.006)	(0.014)		
Foreign non-US MNE				0.022***	0.037***	0.013		
				(0.008)	(0.007)	(0.014)		
US MNE		-0.009		-0.000	0.014	-0.003		
		(0.011)		(0.011)	(0.010)	(0.019)		
Observations	112742	10480	106401	16821	110903	12319	97828	8573

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. The dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and an age censoring dummy that equals one if the plant exists since 1980 in the manufacturing sector and since 1997 in the services sector; region; 4-digit industry and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

Additional Robustness Checks

Table 8 reports additional robustness checks.

Our preferred specification is static. This is due to data limitation: in the ARD only larger firms are selected in all years; small firms have each year at most a 50% probability of being sent the ABI survey. This implies that when we limit ourselves to firms for which we have at least two consecutive years –as we do when we estimate a dynamic model - we lose all small firms. This issue becomes even more relevant when we try to estimate a system GMM model: for estimating such a model we need to have at least 4 consecutive observations for the firms included in the sample: this means that for our 2000-2003 sample we can only keep firms that are in the ARD in each and every year. This corresponds to only xx% of the original sample.

Table 8:Additional robustness checks

	(1)	(2)	(3)	(4)
	Dynamic 1	Dynamic 2	IMPORT/WAGES	VALUE ADDED
ln(EMP)	-0.009***		-0.010***	0.011***
	(0.001)		(0.001)	(0.002)
ln(K/EMP)	0.084***		0.204***	0.261***
	(0.004)		(0.003)	(0.003)
ln(M/EMP)	0.109***		0.225***	
	(0.004)		(0.003)	
ln(S/EMP)	0.120***		0.194***	
	(0.004)		(0.003)	
OFFSHORING	0.006	0.029*	0.022***	0.090***
	(0.016)	(0.017)	(0.005)	(0.026)
EXPORT	0.001		0.125***	0.150***
	(0.005)		(0.008)	(0.012)
UK MNE	0.034***		0.147***	0.103***
	(0.005)		(0.008)	(0.011)
Foreign non US MNE	0.026***		0.171***	0.193***
	(0.006)		(0.010)	(0.016)
US MNE	0.043***		0.031***	0.099***
	(0.007)		(0.005)	(0.008)
ln(GO/EMP) *t-1*	0.576***			
	(0.008)			
OFFSHORING*t-1*		-0.021		
		(0.015)		
Observations	30504	30311	114441	124902

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. In columns 1 to 4 the dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. In column 5 the dependent variable is the deviation of log value added at factor costs per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and an age censoring dummy that equals one if the plant exists since 1980 in the manufacturing sector and since 1997 in the services sector; region; 4-digit industry and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

However, in this section we want to check the robustness of our result when we adopt a dynamic specification. Thus, column 2 of table 8 reports the estimates of a dynamic model where the error term is allowed to be (first order) serially correlated. As shown by Blundell and Bond (1998), this specification accounts for lags in adjustments of the production process and for unobserved characteristics that are persistent over time but are not fixed.[29] Secondly, our preferred offshoring variable is the proportion of imported services over the total services purchased. Pervious empirical work (Görg et al.) normalise imported services over wages. Thus, we check the robustness of our results to using this alternative measure and we find that offshoring is still positively correlated with productivity. Finally, we test the robustness of our results to using a value added specification rather than the gross output one used in the preferred specification. The empirical benefit of using the value-

[29] This specification has an additional implication that it is important in justifying the GMM estimation method. The presence of lags of adjustments to shocks is a behavioural theory that justifies the use of lagged levels of inputs as instruments for their growth rates.

added specification is that it avoids the endogeneity problem in estimating the coefficient on materials (see Griliches and Ringstad (1971) for more details). However, estimating a value added specification imposes a separability assumption in the production function, which makes it more restrictive than the gross output specification. The table shows that the positive coefficient on offshoring to using value added as output measure.

Distinguish between type of service and partner country

Table 9: Type of services and partner countries. OLS

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. The dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and an age censoring dummy that equals one if the plant exists since 1980 in the manufacturing sector and since 1997 in the services sector; region; 4-digit industry and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

Table 10: Type of services and partner countries. Fixed Effect estimation

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. In columns 1 to 4 the dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. In column 5 the dependent variable is the deviation of log value added at factor costs per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

In this section we exploit detailed information from the ITIS to investigate whether the positive services offshoring coefficient is driven by the import of particular services and/or from a specific partner country. The rational behind this hypothesis is that services imported differ in the amount of knowledge they incorporate; thus if the productivity effect of offshoring derives mainly from knowledge spillovers, these should be strongly correlated with the amount of R&D services imported. Similarly, learning can spillover from ICT services. If we distinguish among partner country, the UK is more likely to learn from services coming from countries that are closer to the frontier such as the United States. If the source of the productivity advantage is mainly cost savings, then we would not observe any significantly different effect coming from R&D or computer services relative to other business services and we would be more likely to find that imports from low wage countries, such as India and China, have a stronger effect.

Tables 9 and 10 present the results of this exercise. We include besides the offshoring measure, variables that capture the composition of offshoring. In column 1 we include as additional variable the proportion of R&D imported over total imported services. In column 2 we include a similar measure but for ICT: the ratio of imported ICT services over total imported services. Columns 3 and 4 investigate the geographical origin of imports. In Column 3 the variable “US offshoring” is the share of the total services offshored that is imported from the United States. Similarly “China offshoring”;

"EU offshoring"; "India offshoring" and "Japan offshoring" are the share of total services imported from each country.

The results show that there is no robust additional effect coming form any of the type of services and partner country considered.

Conclusions

The increase in services offshoring to low wage countries has sparked debate on the effect of this new phenomenon on OECD economies. This paper contributes to this debate presenting new plant level evidence on the UK. This is the first UK study that looks at the effect of services offshoring and the first plant level paper that studies this relationship for both the manufacturing and service sector. We estimate extended production function for the period 2000-2003. We find that there is a positive correlation between services offshoring and productivity in our sample. When we control for unobserved firm heterogeneity we find that this effect is not significant among manufacturing firms but that it is strongly significant for services sector firms. Secondly, when we investigate differences in the effect of offshoring among internationally engaged firms, we find that the correlation is significant and robust to controlling for unobserved firms fixed effects only for domestic non exporters.

Finally, we exploit detailed information on the type of services traded and the partner countries firms trade with. We do not find any robust evidence of the offshoring-productivity association being driven by a particular type of service or partner country. This might be due to the small number of firms that offshore and to the small time series considered.

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APPENDIX

Summary statistics ARD-ITIS matched sample

Table 11: Presence of Offshorers in the ARD-ITIS sample

year	Non Offshores	Offshorers	Proportion of offshorers (%)	Total
2000	30,846	1,260	4.08	32,106
2001	33,725	1,722	5.11	35,447
2002	32,897	1,985	6.03	34,882
2003	31,945	1,882	5.89	33,827

Notes: Figures reported are annual averages. The sample includes businesses in the ARD-ITIS which reply to the offshoring questions.
Source: Authors' calculations using ARD data for 2000-2003.

Table 12: Summary Statistics in the 2000-2003 ARD-ITIS sample

		All Firms	Non-Offshores	Offshorers
1	Real Value Added per employee	27.71 *(26.00)*	26.70 *(25.12)*	46.37 *(32.40)*
2	Real Gross Output per employee	113.78 *(1301.71)*	109.12 *(1321.15)*	200.02 *(862.21)*
3	Employment	200.36 *(2173.73)*	163.94 *(1896.24)*	888.37 *(5056.65)*
4	Intermediates per employee	84.96 *(1281.00)*	81.39 *(1299.59)*	151.02 *(858.93)*
5	Purchased materials per employee	65.56 *(1264.00)*	63.33 *(1283.13)*	106.88 *(839.56)*
6	Purchased services per employee	19.40 *(182.68)*	18.06 *(184.68)*	44.14 *(138.38)*
7	Capital per employee	76.73 *(2607.00)*	71.85 *(2678.75)*	161.40 *(443.95)*
8	Hardware capital per employee	0.92 *(1.74)*	0.78 *(1.53)*	1.50 *(2.34)*
9	Software capital per employee	0.49 *(0.90)*	0.46 *(0.85)*	0.78 *(1.26)*
10	average wage	15.72 *(14.41)*	14.88 *(13.79)*	31.17 *(16.75)*
11	Import Intensity (services imported/ services purchased)	0.01 *(0.06)*		0.17 *(0.21)*
12	Export Intensity (services exported / total sales)	0.01 *(0.05)*	0.00 *(0.03)*	0.07 *(0.17)*
13	Proportion of firms that export services (%)	4.33	1.69	54.05
14	Proportion of MNEs (%)	11.49	9.14	55.95
15	Proportion UK MNEs (%)	4.43	3.85	15.46
16	Proportion Foreign MNEs (%)	7.06	5.29	40.49

Notes: Figures are unweighted averages over the sample period. Standard deviations in parentheses and italics. Figures for value added, intermediates, material inputs, services capital, Hardware, Software and wages are in thousands of pounds. Figures for employment are head counts. Finally the figures reported in the last four rows are percentages. The total number of observations is 123,222.
Source: Authors' calculations using the matched ITIS-ARD data over the 2000-2003 period.

Regression results using ARD-ITIS sample

Table 13: Regressions using the 2000-2003 ARD-ITIS sample but using the ARD offshoring measure

Table 14: Regressions using the 2000-2003 ARD-ITIS sample but using the ITIS offshoring measure

Notes: Robust standard errors in parentheses, estimated allowing correlation between unobservables for plants in the same firm. In columns 1 to 4 the dependent variable is the deviation of log gross output per employee relative to the mean firm in the 4-digit industry. In column 5 the dependent variable is the deviation of log value added at factor costs per employee relative to the mean firm in the 4-digit industry. All regressions include a quadratic polynomial in age and year dummies. * significantly different from zero at the 10 percent level. ** significantly different from zero at the 5 percent level. *** significantly different from zero at the 1 percent level.

Cleaning Procedures

A brief summary of the cleaning procedure used to clean the sample are reported below.

All implausible responses are dropped. This includes observations with negative gross output, negative intermediate purchases (including imports and exports) and observations with value added total intermediates; exports; total labour costs and/or greater than gross output.

We keep manufacturing (SIC 15 to 37) and services sectors (SIC 45 to 74). We drop tobacco and petroleum industries for confidentiality reasons.