The market for Technology Licensing in the UK

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Suma Athreye
Brunel University
Suma.Athreye@brunel.ac.uk

Rhian Eveleigh
UK Intellectual Property Office
Rhian.Eveleigh@ipo.gov.uk

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ABSTRACT

The social benefit of a patent system lies in its ability to underpin the circulation of technology in the economy through technology licensing and in facilitating the growth of technology markets. This evidence brief considers the main dimensions of the technology licensing market in the UK, drawing on expenditure data from the Community Innovation Survey in order say more about the characteristics of buyers in the market. This is an area which remains relatively under explored and can provide a useful basis upon which to develop effective policy. We estimate the size of the technology licensing market, highlight the temporary nature of licensing expenditure and explore the participation of firms. We find small firms are more frequent purchasers of technology licensing but large firms account for the larger shares of spending. Similarly, R&D services firms are large buyers of technology licenses and dominate spending in the technology licensing. We also find the participation of innovative firms dominates that by non-innovative firms.

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INTRODUCTION

The social benefit of a patent system lies in its ability to underpin the circulation of technology in the economy through technology licensing and facilitating the growth of technology markets. By conferring ownership rights and promoting disclosure of a new invention, patents underpin and facilitate the trade of technology and ideas. In this evidence brief we will sketch the main dimensions of the market for technology in the UK, drawing on three waves of the Community Innovation Survey which measures technology expenditures by firms at two-year intervals from 2008-2014.[1] Since we draw on expenditure data we are also able to say more about the characteristics of the firms that are buyers in technology markets, a dimension of technology licensing which remains relatively under explored in other analyses which have focussed on the use of patents. Understanding the characteristics of the demand for technology licensing can be useful as a basis upon which develop effective policy.

Historically, the size and success of technology markets has been variable.[2] Despite initial booms in the nineteenth century this was followed by extensive decline in the twentieth century, as large corporations developed their own in-house R&D operations. Since the 1980s, enabled by developments in general purpose technologies, there has been a steady resurgence in markets for technology. Popular examples of technology markets that have given rise to whole industries include the growth of shrink-wrapped software and biotechnology. But markets for technology also include the small R&D firm that undertakes work on contract or the design house that helps firms to develop prototypes. This has made the

[1] Our approach is different from the approach in earlier empirical surveys such as the PatVal in two ways: First, our respondents are not the suppliers of technology licenses - they are the ones that demand technology licensing. Second, the focus of our analysis is technology licensing rather than patent licensing.

[2] See Khan, B. Z., & Sokoloff, K. L. (2004). Institutions and Democratic Invention in 19th-Century America: Evidence from Great Inventors, 1790-1930. The American Economic Review, 94(2), 395-401 and Winder, G. M. (1995). Before the corporation and mass production: The licensing regime in the manufacture of North American harvesting machinery, 1830–1910. Annals of the Association of American Geographers, 85(3), 521-552.

role of technology markets ever more important as the relationship between external and internal technology has become increasingly interlinked.

The remainder of this brief is organised in the following way: in Section 2 we estimate the size of the technology licensing market; in Section 3 we analyse participation by size and industry; in Section 4 we analyse participation by innovators and section 5 concludes.

MEASURING THE MARKET FOR TECHNOLOGY LICENSING IN THE UK

Measures of Technology Licensing

Before assessing the size of technology markets it is important to define how we will measure them. In their seminal work, which is still relevant for discussions about technology licensing in the UK, Taylor and Silberston (1973)[3] noted that most licensing agreements they studied also included 'know-how' components, as access to technology is not much use without the knowledge to utilise it. Arora (1995)[4] showed that licensing agreements typically bundle know-how because of this complementarity between the codified and tacit elements of knowledge, with the former finding their way into licensing contracts while the latter are the subject of additional R&D agreements. Since one is not very valuable without the other, licensing agreements typically occur with R&D agreements. Other studies find this too. Hagedoorn et al (2009)[5] analyse a large sample of US and European licensing agreements and find that when companies decide to engage in technology transfer through exclusive licensing to other firms, they are more likely to set-up partnership-embedded licensing agreements.

[3] Christopher Taylor and Aubrey Silberston, (1973). The Economic Impact of the Patent System. Cambridge University Press, Cambridge.
[4] Arora, Ashish, (1995). Licensing tacit knowledge: intellectual property rights and the market for know-how. Economics of Innovation and New Technology 4: 41-60.
[5] John Hagedoorn, Stefanie Lorenz-Orlean and Hans van Kranenburg (2009) Inter-firm technology transfer: partnership-embedded licensing or standard licensing agreements? Industrial and Corporate Change 18 (3): 529-550.

This previous research suggests that disentangling the expenditure on R&D services from the pure licensing may be quite difficult and also not very meaningful. Accordingly, we estimate the size of the technology market by considering expenditure on R&D services and patent licensing together. We will consider two measures. The first is a narrow measure of technology in-licensing which involves total expenditure on technology in-licensing and external R&D for the group of firms who in-license patents. In addition, we also estimate the broader measure of technology markets which includes firms who buy-contract R&D but not patent licenses. Both types of expenditure – on contract R&D and patent licensing – are routinely collected in the Community Innovation Survey.

Size of the UK Technology Market

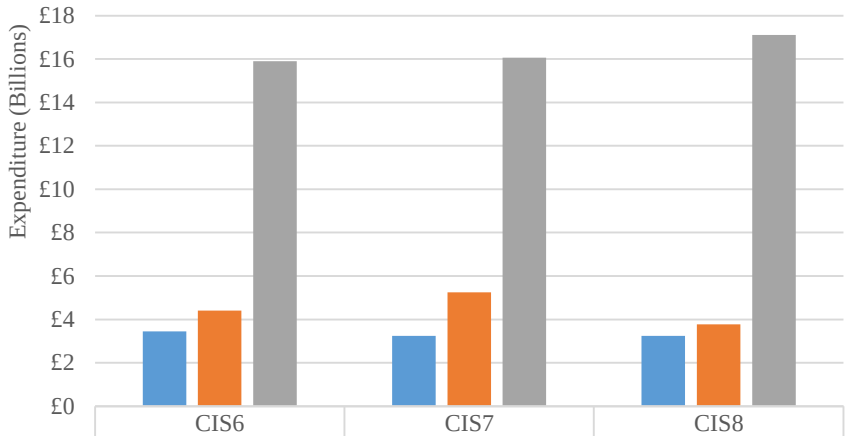
Figure 1 below reports the absolute value of technology licensing in the UK, using both the narrow and broad definitions defined above. Based on the narrow definition, the value of technology in-licensing for the UK economy as whole, was approximately £3.4 billion in CIS6 (2006-2008), £3.2 billion in CIS7 (2008-2010) and £3.2 billion in CIS8 (2010-2012).[6] It is also informative to consider this estimate in relation to overall private R&D spending (as measured by the Business expenditure on R&D reported by the ONS) to get a sense of what these magnitudes mean. The estimates for private R&D in this period are shown in grey. Thus, £3.4 billion was 22% of all private R&D expenditure in CIS6, falling to 20% in CIS7 and 19% in CIS8. This indicates that, narrowly defined, the size of the technology market has remained relatively stable over time, at a fifth of all R&D.

The broader measure involves total expenditure on technology in-licensing and external R&D and reveals a slightly different story of expenditure growth, both absolute and as a proportion of total R&D spending. In CIS6, using this measure the size of the technology in-licensing market is

[6] We use sample estimates from the CIS, and use population weights for each sample estimate. These weights are based on the ONS Inter-Departmental Business Register (IDBR). For further details see the Appendix.

approximately £4.4 billion, growing to £5.2 billion in CIS7 and falling substantially to £3.8 billion in CIS8. As a share of private R&D expenditures, technology licensing is 27% in CIS6, rising to 32% in CIS7, and dropping down to 22% in CIS8. Despite the differences between broad and narrow measures, the findings for both measures suggest the size of technology markets in the UK today is substantial.

Figure 1: The Market for Technology in the UK



	CIS6	CIS7	CIS8
Narrow Technology Market	£3,447,689,020	£3,240,458,110	£3,243,200,130
Broad Technology Market	£4,401,851,000	£5,252,348,400	£3,768,426,700
BERD expenditure	£15,896,000,000	£16,067,000,000	£17,107,000,000

It is worth noting that the way firms were asked about their technology expenditures changed after CIS6. Until CIS6, firms had been asked about their average spending on external technology acquisition and external R&D in the previous three years. However, in CIS7 and CIS8 firms were asked to report their expenditures in the last year of the survey viz. 2010 for CIS7, and 2012 for CIS8. This change in questioning had a profound effect on response rates (noted in the statistical reports for CIS7 and CIS8) but here we should note that it makes estimates for the total in CIS7 and CIS8 somewhat different when compared to previous CIS rounds.

Is technology licensing expenditure persistent?

Firms that innovate often undertake R&D expenditures that are quite persistent over time. Since acquisition of external technology through

technology licensing is a complement to R&D, we may expect technology licensing expenditures also to be persistent. On the other hand, if we consider that external technology acquisition helps firms to plug crucial knowledge gaps or act as an insurance against failed R&D projects, we may expect such expenditures to take place as and when the need for them arises. Furthermore, it is likely that firms will not base their innovative strategy on externally bought inputs alone as this may expose them to other problems such as opportunistic behaviour from contractors**.** For both these reasons, we should expect spending in technology markets to be occasional rather than persistent.

To explore whether firms persist in their licensing expenditures over time we look for whether firms that bought R&D and technology licenses in one period, did so in other periods. To this end, we focus in Table 1a on the 811 firms who were sampled both in CIS6 (2006-2008) and the Survey of Innovation and Patent Use (2009-2012)[7] and asked about technology market expenditures. 56% of the firms surveyed in SIPU did not buy external technology in either survey period. Further, of the 172 firms that did report external acquisition of technology in SIPU, only 103 or about 60% also reported spending on external technology purchase in 2006-2008 (CIS6). Conversely, of the 289 firms that reported acquisition of external technology in CIS6, only 103, or about 35%, report acquisition of external technology in SIPU. Although the chi-square test allows us to conclude the firms that bought R&D services or licensed in technology in the CIS6 period are more likely to do the same in the SIPU period than the firms that did not buy R&D services or license in technology in the CIS6 period, this persistence does not appear very strong. This implies spending on in-licensing is less persistent than spending on R&D.

[7] Henceforth referred to as SIPU 2013. Details about SIPU 2013 can be found in Ashish Arora, Suma Athreye and Can Huang (2013) Innovation, Patenting and Licensing in the UK: Evidence from the SIPU survey. UK intellectual Property Office, December 2013. ISBN: 978-1-908908-91-9. Downloadable from http://www.ipo.gov.uk/ipresearch-sipu.pdf

Table 1a: Number of firms buying of R&D and/or in-licensing technology in CIS6 and SIPU

SIPU / **CIS6**	Not buying of R&D and/or in-licensing technology	Buying of R&D and/or in-licensing technology	**Total**
Not buying R&D and/or in-licensing	453 (56%)	69 (8%)	522 (64%)
Buying of R&D and/or in-licensing	186 (23%)	103 (13%)	289 (36%)
Total	639 (79%)	172 (21%)	811 (100%)

A similar picture emerges when we compare firms that are sampled in both CIS7 and CIS8. Here the sample is somewhat larger but as noted earlier, firms are asked about their estimates of spending in a particular year rather than over three years. A slightly higher 66% of firms reported not making any technology market expenditures in either period. But the proportion that bought technology in both periods remained remarkably similar and small at 11%. Almost double this proportion 22% had bought technology in CIS7 or CIS8 alone, confirming the findings on the occasional nature of spending on technology licensing.

Table 1b: Number of firms buying of R&D and/or in-licensing technology in CIS7 and CIS8

CIS8 / **CIS7**	Not buying of R&D and/or in-licensing technology	Buying of R&D and/or in-licensing technology	**Total**
Not buying R&D and/or in-licensing	943 (66%)	151 (11%)	1094 (77%)
Buying of R&D and/or in-licensing	170 (12%)	161(11%)	331(23%)
Total	1113 (78%)	312 (22%)	1425

Participation in the Technology Licensing Market

The use of technology expenditure data enables us to shed light on which

groups buy technology in smaller or larger amounts, i.e. participation in the technology licensing market. The temporary nature of spending in the technology market makes the assessment of participation in this market harder to pin down but we do our best based on the data we have. To assess participation, we consider the expenditure breakdown by firm size and then also by industrial sector and report the composition using the narrow rather than the broader definition of technology markets. Our definition of firm size is based upon estimates of the number of employees in an organisation with small firms being 0-49 employees, medium firms being firms which employed 50-250 employees and large firms being firms that employed over 250 persons.[8] We use the SIC2007 definitions for industrial classification.[9]

FIRM SIZE

The composition of the Technology Licensing Market by Firm Size for each CIS wave is presented in Table 2 below. As for Figure 1, all data presented are weighted to project a national average. We see that by far the biggest spenders on technology in-licensing in all CIS waves are large firms. This is the case whether we look at the value of expenditure in absolute terms or we consider the average spend of the firm. As larger firms have much greater purchasing power than smaller firms this is not a surprising result. Despite the fact that large firms are the biggest spenders, participation is much lower for these firms than for small and medium sized enterprises. This implies that a small number of large firms are making significant investments in the technology market. At the same time, a lot of small firms are making many small investments.

[8] CIS6 used SIC2003 while CIS7 and 8 used SIC2007. We used the correlation table between SIC 2003 and SIC2007 to report CIS6 numbers.
[9] Employment figures are reported for all firms in the Inter Departmental Business Register (IDBR) used to sample population for surveys by the Office of National Statistics.

Table 2: The Technology Market in the UK by Firm Size

	Participation	Value (£millions)	Average Value (£)	Value (% of Turnover)
CIS6				
Small	11258	330.6	29	1.0%
Medium	2500	588.1	235	1.6%
Large	408	2,529.1	6,199	2.8%
CIS7				
Small	5139	352.8	69	2.8%
Medium	1166	346.9	297	1.6%
Large	366	2,540.8	6,944	5.1%
CIS8				
Small	2984	412.9	138	4.7%
Medium	669	580.3	867	0.9%
Large	188	2,250.0	11,946	5.9%

Finding a difference in the behaviour of firms of different size as above may be expected given existing literature. Qualitative evidence gathered by Arora, Athreye and Huang (2013) suggests that there are different motives between small and large firms, where small firms tend to license to improve the quality of their product offering while large firms appear to license for reasons linked to industry sector. In pharmaceuticals for instance, the authors find large firms tend to license transiently to make up for failed internal efforts. By contrast, in telecommunications, cross-licensing is the norm suggesting strategic motivations for licensing.

It is also interesting to consider the value that firms of different sizes spend on the technology market in relation to their total turnover.[10] This metric suggests that although again, large firms spend the biggest proportion of their turnover, small firms are spending an increasing proportion of turnover in successive waves. This trend is also reflected in the range of average values between large and small firms: in CIS6 the average large firm was

[10] Turnover is taken from IDBR estimates.

spending over 214 times more of their turnover than the average small firm, but this reduces to less than 87 times more in CIS8.

A final observation to make from this table is that in general, the participation estimates appears to be decreasing over time, despite total expenditure remaining relatively constant. This could suggest an increasing concentration of licensing expenditures, with fewer firms spending more, but is also likely to reflect the change in response rates due to a different wording of the question in CIS7 and CIS8.

INDUSTRIAL MAKE-UP

Table 3 details participation by industry, focusing on the most important industries by value of spending. The main finding, observable in all survey waves, is that by far the largest spender has been firms who engage in scientific research.[11] It might be expected that the largest spenders are firms who are dedicated to R&D, although the fact that they make up more than two thirds of total demand for UK technology in-licensing remains surprising. Further exploration suggests that this expenditure is driven by a small number of firms who engage in scientific research in engineering and natural sciences, rather than in social sciences and humanities. These are likely to include a number of pharmaceutical and chemical firms, aligning with recent literature that suggests these industries, along with ICT, are most likely to license.[12]

[11] This includes research in the areas of social sciences, humanities, natural sciences and engineering.

[12] See Sheehan, J., Martinez, C., & Guellec, D. (2004, October). Understanding Business Patenting and Licensing: Results of a Survey. In Patents, Innovation and Economic Performance OECD Conference Proceedings: OECD Conference Proceedings (p. 89). OECD Publishing., Cesaroni, F. (2003). Technology strategies in the knowledge economy: the licensing activity of Himont. International Journal of Innovation Management, 7(02), 223-245., Arora, A., Fosfuri, A., & Gambardella, A. (1998). Licensing in the chemical industry. In Conference paper, Intellectual Property and Industry Competitive Standards, Stanford University.) and Anand, B. N., & Khanna, T. (2000). The structure of licensing contracts. The Journal of Industrial Economics, 48(1), 103-135.

Table 3: The Market for Technology in the UK by Industry

	CIS6		CIS7		CIS8	
	Value (£millions)	% of market	Value (£millions)	% of market	Value (£millions)	% of market
Architecture & engineering	32.1	0.9%	186.2	5.8%	72.4	2.2%
construction	87.2	2.5%	19.3	0.6%	7.1	0.2%
Electrical & optical equipment manufacture	92.7	2.7%	33.8	1.0%	38.4	1.2%
Financial intermediation	65.7	1.9%	49.3	1.5%	145.7	4.5%
Food, clothing, wood, paper, publish & print manufacture	138.0	4.0%	14.8	0.5%	5,684	0.2%
Fuel, chemical, plastic, metal & mineral manufacture	108.2	3.1%	76.8	2.4%	116.0	3.6%
ICT	26.7	0.8%	40.4	1.3%	50.6	1.6%
Scientific research	2,201.4	63.9%	2,384.8	73.6%	2,022.6	62.4%
Transport equipment manufacture	203.7	5.9%	54.0	1.7%	64.3	2.0%
Wholesale trade	86.0	2.5%	179.0	5.5%	681.8	21.0%
All other industries	405.9	11.8%	202.4	6.3%	38.7	1.2%

Across all waves, firms in wholesale trade are also significant spenders in the market. As an industry sector this division is relatively broad, incorporating goods or services from any specific sector where there is trade without transformation and include a large number of system integrator firms. Other industry sectors dominate spending in particular waves suggesting that technology market expenditures are short-term expenditures for such firms and not persistent - quite consistent with our own analysis in Tables 1a & b. In CIS6, transport equipment manufacturing firms made up almost 6% of the market value, but in the next two periods made 2% or less of the total value spent by buyers.

In view of the dominance of scientific research firms in the market, we present more detail on technology market spending by this sector

especially when compared to all other industries in Table 4 below. Scientific research firms[13], despite making up only a small number of total buyers, contribute the biggest share of market value. Across all firm sizes, the average value spent of technology market expenditures by scientific research firms is much higher and their expenditure as a proportion of turnover is much greater than all other similar firms. In other industrial sectors, large firms actually spend a very small amount of their turnover on technology licensing, less than small and medium sized firms. Similarly, their total expenditure is much lower overall and not significantly different to the expenditures by small and medium firms. This suggests a small number of large, scientific research firms are driving technology market expenditures.

Table 4: Technology market expenditure by Scientific Research firms and all other firms

	CIS6		**CIS7**		**CIS8**	
	SR Firms	All Other Firms	SR Firms	All Other Firms	SR Firms	All Other Firms
Small						
Participation	66	11192	50	5,090	17	2968
Value (£millions)	17.0	313.5	22.5	330.3	3.0	409.9
Average Value (£)	258	28	455	65	182	138
% of Turnover	18.4%	1.0%	28.6%	2.6%	9.0%	4.6%
Medium						
Participation	23	2477	10	1,156	6	663
Value (£millions)	219.7	368.4	13.9	333.0	22.7	557.5
Average Value (£)	9,551	149	1,428	288	3,668	841
% of Turnover	137.0%	1.0%	7.7%	1.6%	15.6%	0.8%
Large						
Participation	6	402	12	354	2	186
Value (£millions)	1,958.1	571.0	2,348.3	192.5	1,996.8	253.2
Average Value (£)	326,344	1,420	190,404	544	921,606	1,360
% of Turnover	34.1%	0.7%	59.2%	0.4%	85.7%	0.7%

[13] SIC72 in 2003 classification and SIC 73 in 2007 classification

These findings on the role of scientific research firms are consistent with evidence from data on recorded licensing agreements. Gambardella and Torrisi (2010) use firm-level licensing agreements data to shed light on the technology flows between sectors by tabulating the industrial sector of the licensor and the licensee. They found the largest flows of technology through licensing are in fact within the same technological sectors although related sectors (such as Chemicals and Drugs and computers and electronic equipment sectors) benefit from licensing arrangements. In addition, sectors like instrumentation and the knowledge intensive business services (KIBS) buy and sell licenses to a range of other sectors.[14]

TECHNOLOGY LICENSING AND INNOVATION

Another dimension of participation we consider is the participation by innovators and non-innovators. The technology in-licensing market circulates technological knowledge in the economy and both those firms engaging in technological activities and those not engaging in technological activities can gain from such circulation. This is something that has been subject to much debate in the literature. The "make-buy perspective"[15] suggests firms in-license technology when their own research efforts fail or are absent. A firm's technology in-licensing substitutes for successful internal R&D efforts. In this view, we therefore might expect to find buyers in the technology licensing market are predominantly non-innovators. Historical observations of the technology market initially found this to be the case.[16]

[14] Gambardella, A and Torrisi, S (2010), Heterogeneity of technology licensing patterns across Europe, Working paper, Globinn project EC FP7 Cooperation work programme.
[15] Ashish Arora, Alfonso Gambardella, (2010). The Market for Technology, In: Bronwyn H. Hall and Nathan Rosenberg, Editor(s), Handbook of the Economics of Innovation, North-Holland, 2010, Volume 1: 641-678.
[16] See Khan, B. Z., & Sokoloff, K. L. (2004). Institutions and Democratic Invention in 19th-Century America: Evidence from" Great Inventors," 1790-1930. The American Economic Review, 94(2), 395-401 and Winder, G. M. (1995). Before the corporation and mass production: The licensing regime in the manufacture of North American harvesting machinery, 1830–1910. Annals of the Association of American Geographers, 85(3), 521-552.

However, many recent studies have in fact found the opposite to be true.[17] Rather than acting as a substitute for internal efforts, many firms licence technology to complement internal R&D. This is because "buyers have to be technically sophisticated themselves" in order to understand what they are buying and therefore it may not be surprising that firms who engage in some level of internal innovation may be better equipped to participate in the technology market. In addition to this, as markets become increasingly complex, for instance, where a combination of innovations is required, or as licenses are used for strategic reasons, then firms who innovate will increasingly draw on licensing as a complement to their own innovations.

Table 5 below shows the participation of innovators and non-innovators in the market for technology in-licensing. It suggests that the majority of total expenditure on technology in-licensing comes from innovating firms. These are also the majority participants in the market. Thus, in CIS6 innovators spent almost £2.9 billion on technology in-licensing which was 84% of the total technology in-licensing expenditure by the narrow definition. This figure remained fairly stable at almost £3 billion in CIS7, increasing slightly to £3.2 billion in CIS8. In contrast, only £567 million was spent by non-innovators in CIS6 and this fell dramatically in CIS7 to £245 million, tumbling even further to £51 million in CIS8. In CIS6, this was only 17% of total expenditures, falling dramatically to 8% in CIS7 and dropping to less than 2% in CIS8.

[17] Cassiman, B., & Veugelers, R. (2002). R&D cooperation and spillovers: some empirical evidence from Belgium. The American Economic Review, 92(4), 1169-1184.

Table 5: Buyers in the UK Technology In-Licensing Market: Innovators & Non-Innovators

	Participation	Value (£1000s)	Average Value (£)	Value (% of Turnover)
CIS6				
Innovator	9144	2,878,728	315	2.41%
Non-Innovator	5022	568,961	113	1.40%
CIS7				
Innovator	5066	2,995,145	591	4.51%
Non-Innovator	1605	245,313	153	1.42%
CIS8				
Innovator	2762	3,192,036	1,156	2.99%
Non-Innovator	1080	51,164	47	0.73%

The average value of spending by firms reporting innovations is similarly much higher than that for firms that do not report an innovation, with the range in these values increasing significantly from CIS6 to CIS8. A similar trend can also be observed when we look at technology market expenditures as a proportion of turnover. Non-innovating firms spent a significantly lower proportion of their turnover as compared with innovating firms, with this difference increasing over time. Such findings indicate that in modern technology markets, the majority of participants both in terms of quantity and value are firms who themselves also engage in internal innovation.

Given that majority participation in the market is by innovators, it is also interesting to consider whether these innovating firms report new to the market or new to the firm innovations to look at which of these is more likely to participate in the technology market. In any period both types of firms will be buyers in the technology market but if the technology market has predominantly diffusive role then we would expect to see firms that report new to the firm innovation being dominant as participants. If however, the technology market acts as a source of novel ideas that are crucial to more complex and radical technologies we should expect to see greater participation by firms reporting new to the market innovation.

Table 6: Innovative firms in the Technology Market: New to market Innovator vs. New to firm Innovators

	CIS6		CIS7		CIS8	
	New to market	Only new to firm	New to market	Only new to firm	New to market	Only new to firm
Participation	4973	4171	3031	2035	2222	539
Value (£millions)	556.4	2,322.3	233.9	2,761.3	2,854.3	337.7
Average Value (£)	112	557	77	1,357	1,284	626
% of Turnover	2.1%	8.2%	0.5%	11.1%	6.3%	0.6%

Table 6 above looks at participation in the technology market by firms reporting at least one new to market innovation or only new to firm innovation.[18] Despite the majority of participants being firms that report new to market innovations (across all CIS waves), in value terms firms with new to firm innovations dominate the market for CIS6 and CIS7. In CIS8, however, new to market firms dominate the technology market in terms of value. Closer examination of the data shows 37 firms which were big spenders on technology licensing and had reported new to firm innovations in CIS7, reported new to market innovations in CIS8. Such an argument is consistent with the role that technology licensing can play in the catching up of firms and enhancing their technological capability.

Lastly, we consider if firms may be reluctant to use technology licensing in their most valuable innovations because dependence of technology licensing exposes them to competition or opportunism by the licensor. SIPU 2013 data allows us to look at the use of technology licensing in innovation versus the use of technology licensing in generating the most valuable innovation of the firm (viz. the innovation that made most money for the firm). In Table 7 below, we find that 59 of 327 innovators (18%) reported using technology licensing to develop their most valuable innovation while 93 of the 327 (over 28%) reported any spending on technology licensing. 34 of the 59 firms who spent money on technology

[18] In the CIS s a firm may report both types of innovation simultaneously.

licensing (73%) did not do so for their most valuable innovation. Consistent with our understanding, firms are more reluctant to allow their more valuable innovations to depend upon externally sourced technology.

Table 7: The use of technology licensing and in the generation of the most valuable innovation

Technology licensing for most valuable innovation / **Technology licensing**	Yes	No	**Total**
Yes	25	68	93
No	34	200	234
Total	59	268	327

CONCLUSION

Technology licensing is becoming increasingly important as more firms turn to open innovation and as technology circulation becomes an important objective of public policy. In this evidence brief we use a demand side approach, based on analysis of expenditure information contained in the Community Innovation Surveys to understand the size and characteristics of the technology licensing market. Although the data could be improved we find there is much information that could be exploited to shed light on the characteristics of the market for technology licensing.

We find that the technology licensing market is sizeable in the UK - firms spend a pound on technology licensing for every five pounds spent on R&D (if we used a narrow definition of licensing) and for every four pounds of R&D (if we used a broader measure). Unlike R&D, expenditures on technology licensing are occasional rather than persistent. This could be because technology licensing offers a solution when resource constraints are encountered in R&D or when R&D projects do not go according to plan.

Analysis on firm size and industrial sector imply that the substantial value that is spent in the technology market is driven by a small number of large firms who engage in scientific research. However, this does not mean that

the market is used exclusively by such firms – we also find that small firms make small but frequent expenditures while firms in other industrial sectors vary spending levels over time, often making sizeable short-term investments in technology licensing.

We also find that innovating firms dominate the market at an increasing rate over time, both in terms of their participation and total spend. This suggests that increasingly the technology market is used to complement internal R&D efforts and that technology licensing supports the creation of both new to market and new to firm innovations. Nevertheless we also present evidence which indicates that firms are reluctant to use technology licensing in their most valuable innovations, reinforcing the view that firms don't like to rely on technology licensing even though technology licensing provides a useful resource to complement own R&D efforts.

Appendix 1

Data sources for tables

Figure 1 and Tables 2-6 are based on the analysis of the Community Innovation Survey (CIS) 6, 7 and 8. The CIS is the main source of information on business innovation in the UK, sampling over 28,000 firms with 10 or more employees. Since 2005 it has been conducted every 2 years. CIS6, the sixth iteration of the survey, covers the period January 1st 2006 to December 31st 2008. CIS7, the seventh iteration, covers the period January 1st 2008 to December 31st 2010. CIS8, the eighth iteration, covers the period January 1st 2010 to December 31st 2012. All three waves have received approximate response rates of between 49 and 51% giving rise to sample of over 14,000 firms in each survey.

All estimates given in Figure 1 and Tables 2-6 are weighted to represent population estimates. An individual weighting is given to each survey respondent based on a number distribution factors including region, firm size and industry in order to present estimates that are representative of the total business population in the ONS Inter-Departmental Business Register (IDBR). On average, in CIS6 each respondent represents 13 firms in the population. The figures for CIS7 and CIS8 are 12 and 13 firms respectively. We use more firm specific weights provided in the CIS itself and further information on the CIS and how these firm-specific weights are calculated are contained in the Statistical Annexes for CIS6, CIS7 and CIS8 published by the Department of Business, Innovation and Skills.

Table 1 uses two short panels based on the CIS. Table 1a uses data collected through the Survey of Innovation and Patent Use in 2013 (SIPU 2013) which was sent to 811 participants that had consented to be contacted again in CIS6. Further details of the survey may be found in Arora, Athreye and Huang (2013). Since CIS7, BIS have included a short

panel in each successive survey. Table 1b uses information from the panel for CIS 7 and Cis8 a description of which can be found in BIS (2014).[19]

Table 7 uses data from the SIPU, 2013.

[19] BIS (2014): First findings from the UK Innovation Survey 2013. See page 21.

ERC
Enterprise Research Centre

Centre Manager
Enterprise Research Centre
Warwick Business School
Coventry, CV4 7AL
Enquiries@enterpriseresearch.ac.uk

Centre Manager
Enterprise Research Centre
Aston Business School
Birmingham, B1 7ET
Enquiries@enterpriseresearch.ac.uk