TOMAS COATES ULRICHSEN

The Case for a Substantial Increase in HEIF Funding

A Technical Note for the Higher Education Funding Council for England (HEFCE)

January 2018

Contents

1 Introduction

The UK HE sector has been challenged by government in recent years to increase their knowledge exchange (KE) performance. The 2015 Productivity Plan (Fixing the Foundations, HM Treasury, 2015) set a target for UK HEIs to increase the amount of KE income to £5 billion by 2025 (p.39). Most recently the Minister of State for Universities, Science and Research, challenged the sector to deliver a 'gear change' in KE performance that would accompany increases in the levels of funding; currently standing at £200 million with the recent £40 million industrial strategy-related uplift. The Witty Review (Witty, 2013) recommended increasing HEIF funding further than this, to £250 million per annum.

This technical note presents evidence for increasing the levels of HEIF funding allocated to qualifying institutions the English higher education sector. It seeks to address the following questions:

1. What evidence is there that increasing HEIF funding would generate significant returns on investment?
2. Is there a case for increasing HEIF funding substantially to £250 million per annum?

1.1 Context

The latest HEBCI returns show that UK HEIs generated £4.21 billion in income from their engagements with external partners Table 1. There is thus a £0.8 billion gap between the current position and the target of generating £5 billion in external income set out in the 2015 Fixing the Foundations report. By nation, England generated approximately 82% of total KE income over the period 2012-16. This suggests that it could be expected to generate just over £4 billion of the target. English HEIs therefore need to generate an additional £562 million by 2025 to meet the target.

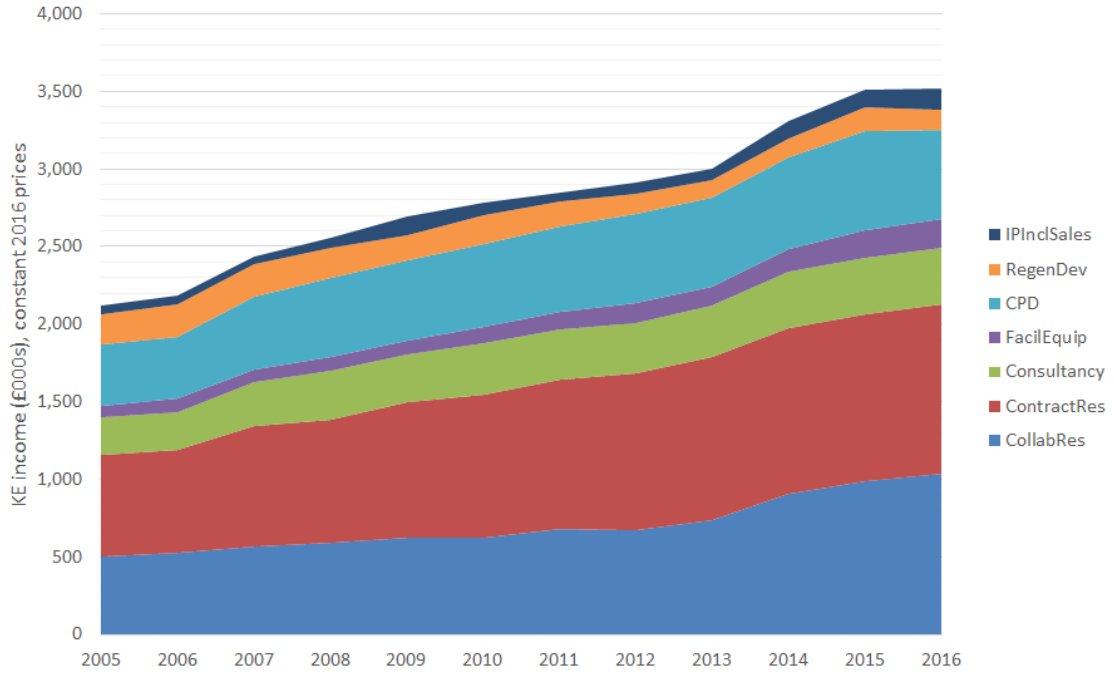
Table 1 Distance to £5 billion target in KE income for the four nations

Nation	Actual KE income, 2016 (£000s)	Average share of total KE 2012-16 (%)	Target KE income by 2025 (£000s)	Gap (£000s)
England	3,518,860	82	4,080,844	561,984
Scotland	425,694	11	550,692	124,998
Wales	171,536	5	242,318	70,782
Northern Ireland	92,374	3	126,146	33,772
Total	4,208,464	100	5,000,000	791,536

1.2 Key trends in knowledge exchange income

The following charts provide key trends in KE income for English HEIs (in constant 2016 prices; adjusted for inflation using the GDP deflator supplied by HM Treasury). While real growth in aggregate income is relatively flat, key components such as collaborative research, and income from the licensing and sale of intellectual property continue to grow strongly (4.2% and 27.6% respectively compared with 2015). Contract research exhibits some real growth at 2.2% compared with 2015.

Figure 1 Knowledge exchange income 2005 – 2016



Source: HESA HEBCI

When examining trends in real KE income per academic by research intensity cluster[1], we observe that KE income per academic correlates strongly as research intensity increases, with most HEIs observing a decrease in the past year. Interestingly, the top 6 research intensive HEIs have observed two consecutive years of decline in the value of KE income per academic. Despite this, Figure 2 suggests that KE income per academic over the longer term is still diverging between higher and lower research intensive HEIs.

Digging into these trends further by separating income generated from the private sector (Figure 3), public/third sectors (Figure 4), and through collaborative research (Figure 5), much of the decline in recent years for the top 6 research intensive HEIs comes from the loss of public/third sector income. Income from the private sector and through collaborative research has remained relatively stable since 2014. This follows a significant jump in collaborative research activity by the top 6 and high research intensive HEIs between 2013 and 2014.

[1] Based on the clusters developed by PACEC/CBR in the 2009 evaluation of HEIF

Figure 2 Knowledge exchange income per academic FTE 2005 – 2016, by HEI cluster

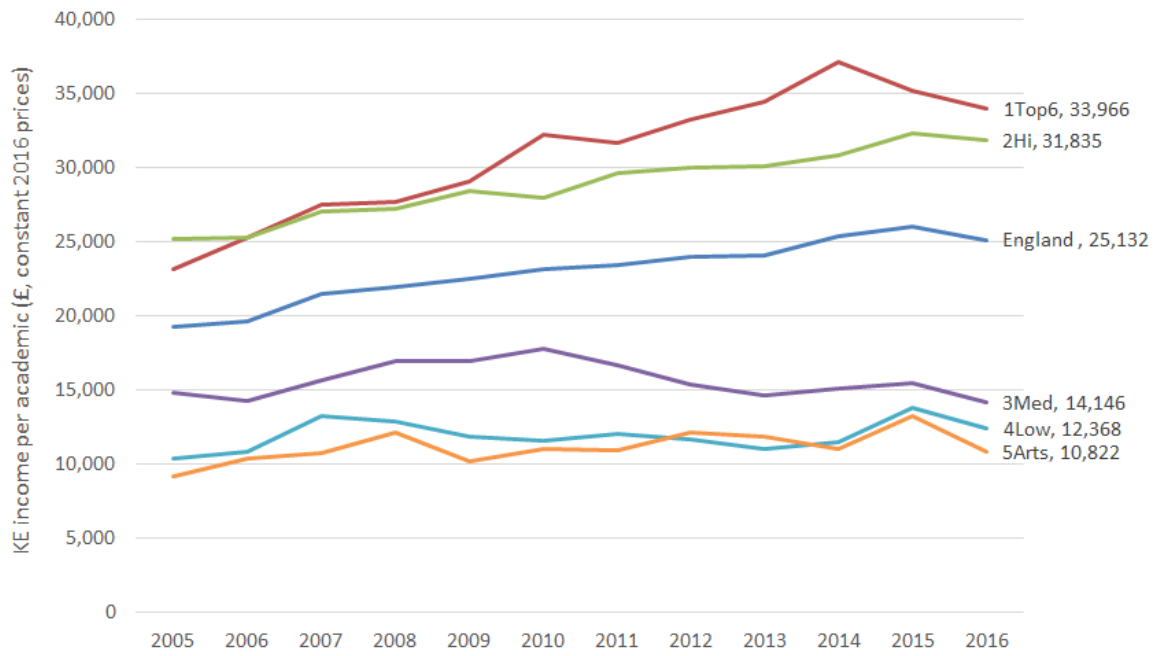


Figure 3 Knowledge exchange income per academic FTE from the private sector 2005 – 2016, by HEI cluster

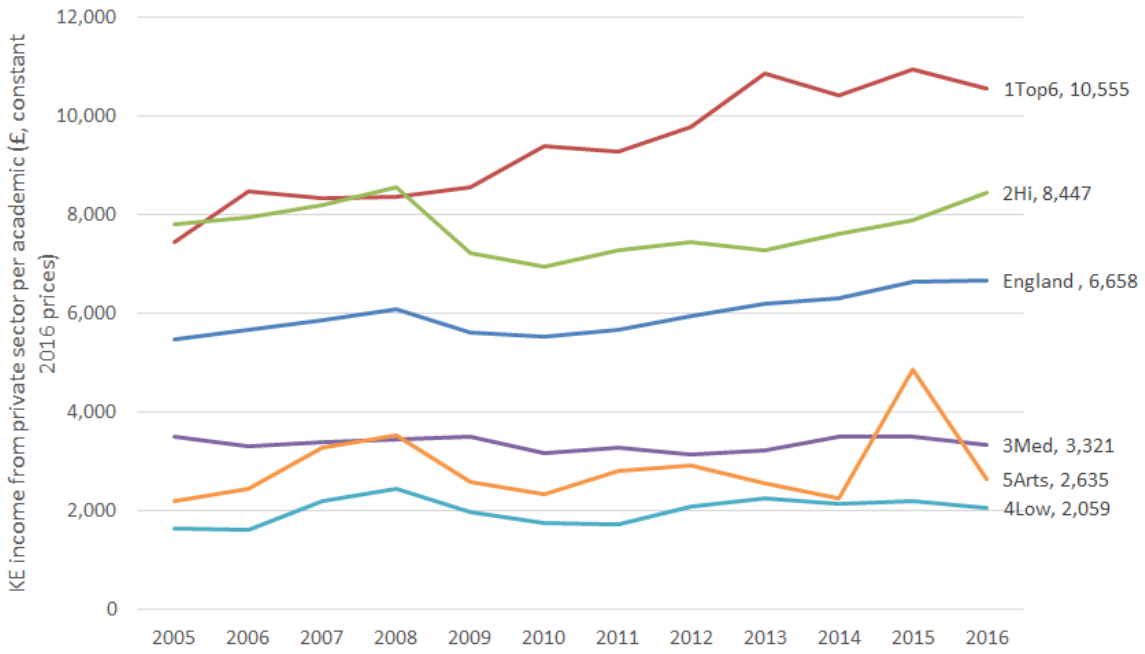


Figure 4 Knowledge exchange income per academic FTE from the public and third sectors 2005 – 2016, by HEI cluster

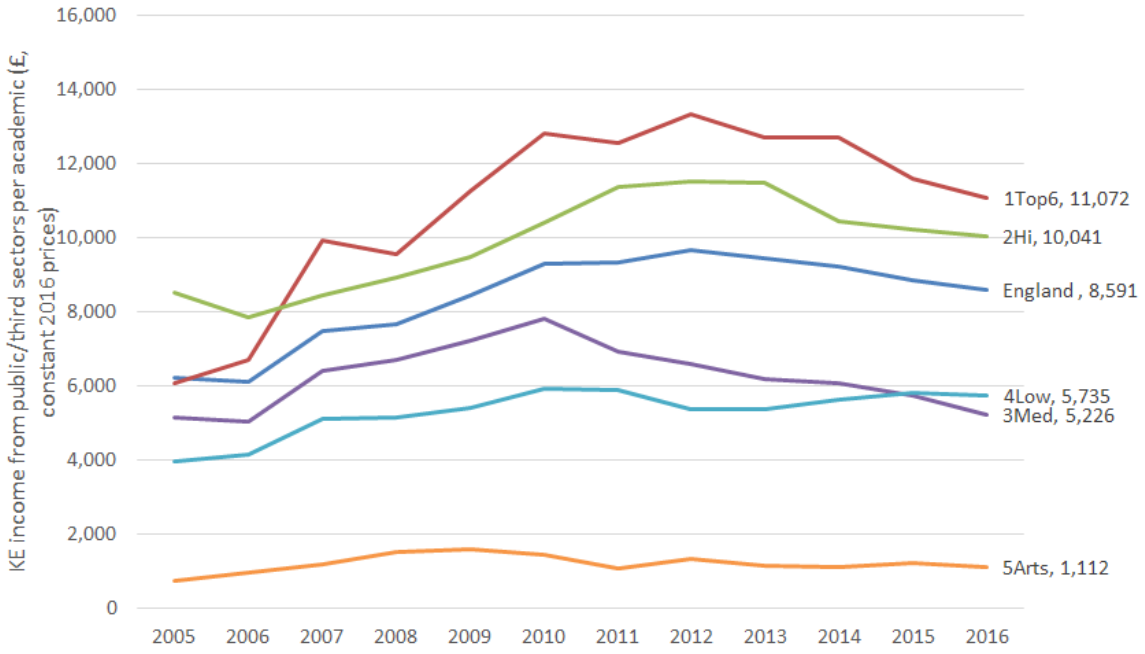
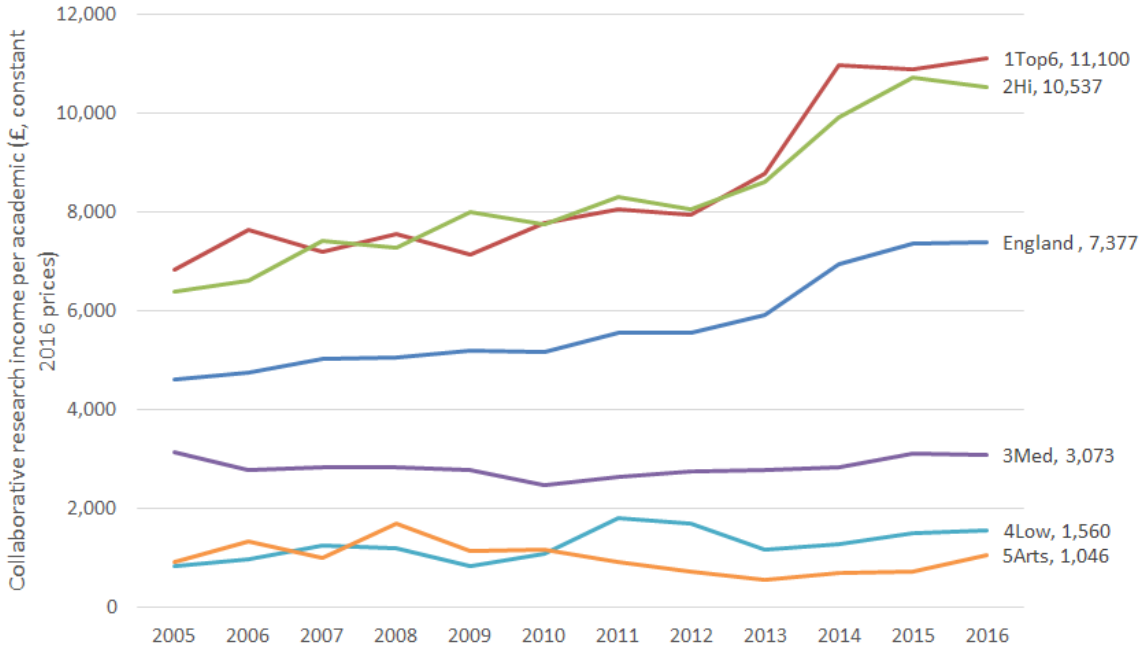


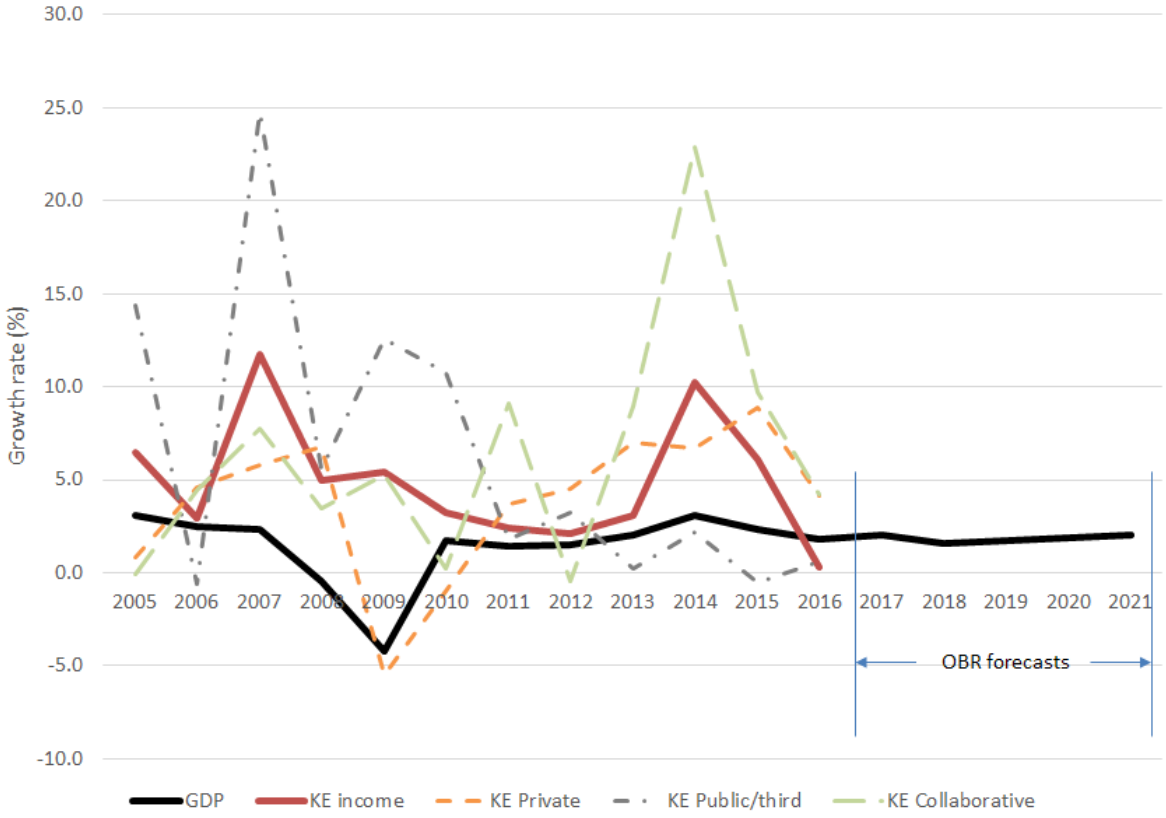
Figure 5 Knowledge exchange income per academic FTE from collaborative research 2005 – 2016, by HEI cluster



1.3 KE income growth compared with GDP growth

Figure 6 compares annual growth in real KE income with that of the overall economy (based on the growth in GDP[2]). Real GDP growth forecasts were obtained from the UK's Office for Budget Responsibility (OBR)[3]. This shows that, for much of the past decade, real KE income (from all sources) has grown faster than the overall economy. Importantly, it showed particular resilience during the early years of the economic recession, largely maintained by activity for the public/third sectors. In recent years, however, growth KE activity with these sectors has been declining, with private sector and collaborative research activity growing much faster until 2014 than the economy has a whole. The past year has seen some tapering off of this growth, potentially as demand has adjusted to the new economic and innovation landscape post-recession.

Figure 6 Annual real knowledge exchange income growth and annual GDP growth, 2005 – 2016, forecasts for GDP growth 2017-2021



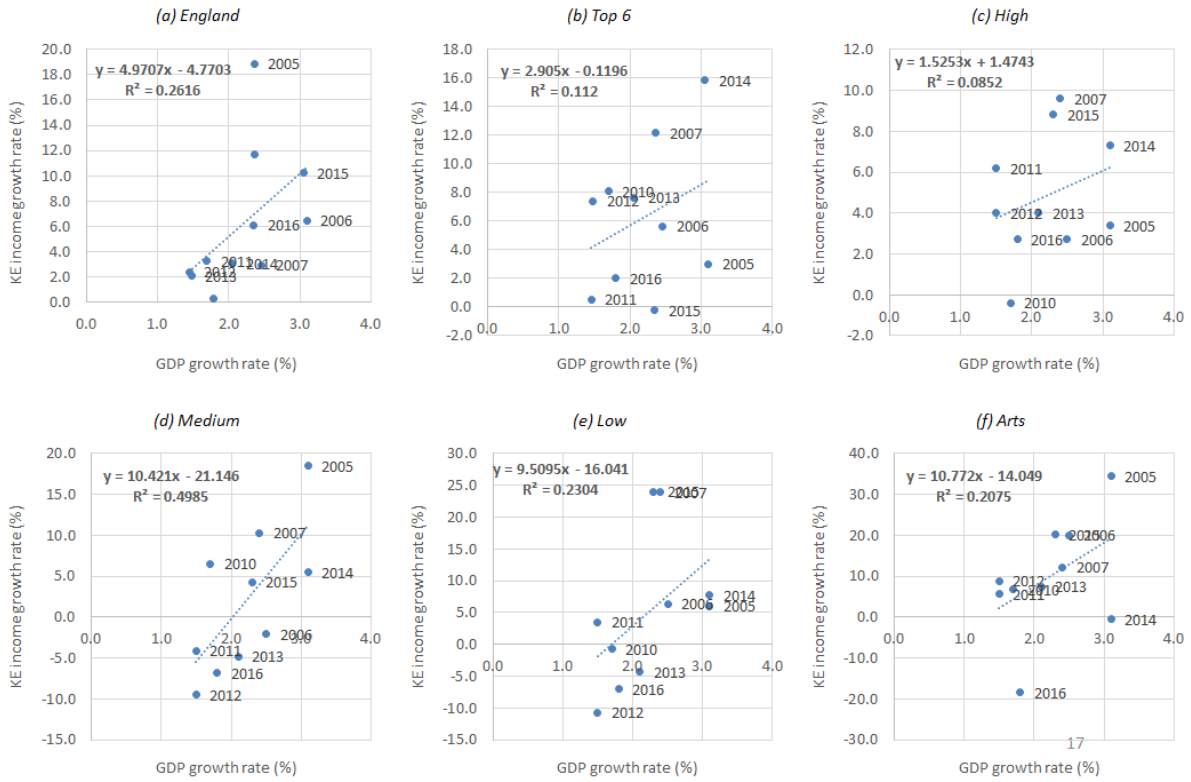
1.3.1 Estimating the change in KE income, 2017-2021

In examining the effects of a change in HEIF funding on KE income, it is necessary to attempt to forecast how KE income will change in the coming years. Figure 7 presents the relationship between real KE income growth and GDP growth in each year since 2005. Data for 2008 and 2009 were omitted due to the extreme economic circumstances in the very early years after the onset of the

[2] GDP based on chain volume measures and seasonally adjusted, source: UK Office of National Statistics https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/ybez/bb#othertimeseries, accessed in November 2017
[3] OBR: http://budgetresponsibility.org.uk/data/, accessed in November 2017

economic recession in which the UK found itself. The charts in this figure show a broadly positive relationship between KE income growth and GDP growth.

Figure 7 Relationship between KE income growth and GDP growth over the period 2005 – 2016, by cluster



Using these relationships and the OBR forecasts for economic growth, Table 2 presents estimates for real KE income growth over the period 2017-2021. These figures are used in the subsequent modelling to estimate how KE income will change during this period.

Table 2 Estimated KE income growth rates, 2017 – 2021

	Year	GDP growth rate (%)	KE income growth rate (% p.a.)					
			England	Top 6	High	Medium	Low	Arts
Actual	2016	1.8	0.3	2.0	2.7	-6.8	-7.0	-18.5
Estimated	2017	2.0	5.2	5.7	4.6	0.0	3.2	7.8
	2018	1.6	2.9	4.4	3.9	-4.9	-1.2	2.7
	2019	1.7	3.9	4.9	4.2	-2.8	0.6	4.8
	2020	1.9	4.6	5.4	4.4	-1.3	2.1	6.5
	2021	2.0	5.2	5.7	4.6	-0.1	3.2	7.7

2 The case for increasing HEIF funding

With this context and key relationships in mind, the technical note now turns to the case for increasing HEIF funding further.

Mounting evidence over the past decade points to the success of HEIF funding in enabling Higher Education Institutions (HEIs) to engage in knowledge exchange (KE) with partners in the wider economy and society and increase the socio-economic benefits achieved from their research and teaching activities, and through their other knowledge-related services (PACEC/CBR, 2009; Ulrichsen, 2014, 2015). The success and importance of the funding programme has also been well articulated by practitioners and experts in response to recent government reviews of university-business collaborations and knowledge exchange (see e.g. Dowling, 2015; Witty, 2013) and select committee inquiries on the topic (Science and Technology Committee, 2017, 2013).

The most recent quantitative assessment of the economic impact of HEIF funding was presented in Ulrichsen (2015) who estimated the additionality of HEIF funding using both subjective methods (based on the expert views of practitioners gathered through their HEIF strategies), and objective methods (using econometric modelling techniques). These estimates are presented in Table 3. These methods focus on using income generated through different forms of knowledge exchange mechanisms as a *proxy* for the economic value generated. This assumes that the income received by the HEI reflects the user's willingness to pay for the KE 'service'; their perception of its value to their organisation.

However, we recognise that there are a range of KE services for which the income will not fully capture the value realised. Using data generated through an evaluation of the non-monetary benefits arising from HEIF funded activities, Ulrichsen (2015) also estimated an additional component for the income-based additionality estimates focusing on the non-monetary components (Table 3).

Table 3 Estimates of additionality to HEIF funding

Cluster	Attribution of KE income to HEIF (%)	Additionality of HEIF funding (2009-2014)		
		Monetary-component		Non-monetary component
		Subjective method	Objective method	
Top 6	31	17.4	21.5	n/a
High	33	6.9	11.7	n/a
Medium	39	4.2	5.7	n/a
Low	28	2.3	3.6	n/a
Arts	23	1.6	n/a	n/a
England	33	6.3	7.3	2.6

Source: Ulrichsen (2015)

2.1.1 What happened to gross additionality over time as HEIF funding was increased?

Institution-level KE funding has been through a number of phases since its inception in the early 2000s. The early period was characterised by relatively low levels of funding being distributed through a range of different programmes that were progressively consolidated into the HEIF funding stream. In the early period, they were initially distributed through competitions and subsequently through a mix of formula and collaborative projects. It received a boost in level of overall resource

allocated to the English HE sector in round 4 (2008-09 – 2010-11), with its allocation solely driven by formula. This second phase is thus characterised by higher levels of funding that have been stable (in cash terms). However, changes to the formula meant that the distribution of this funding across the English HE sector changed quite considerably.

In addition, we can exploit the fact that expert subjective estimates of attribution of KE income to HEIF funding were obtained in each of the two phases, the first through a survey undertaken for HEFCE by Quotec in 2007 of English HEIs, and the second as part of the HEIF institutional strategy process in 2011.

Accepting issues regarding different methods of data collection and nuances in the way the question on attribution was asked to the senior KE practitioners within English HEIs, *it appears that HEIF funding in the second phase (high level of funding, focused more on KE performance) is generating, on average for the English HE sector, a higher return to investment than in the first phase* (Table 4).

Table 4 Estimates of gross additionality of HEIF funding in 2001-07 and 2009-14

Cluster	2001-2007 estimates (based on Quotec 2007 survey)*			2009-2014 estimates (based on HEIF2011-15 data)†
	Lower estimate	Mid-point	Upper estimate	2009-2014
Top 6	8	11.1	14.2	17.4
High	4.7	5.7	6.7	6.9
Medium	4.7	5.4	6.1	4.2
Low	4.2	5.0	5.8	2.3
Arts				1.6
England	4.9	6.0	7.1	6.3

* Source: PACEC/CBR (2009)
† Source: Ulrichsen (2015)

The estimates of gross additionality are significantly higher in the second phase for the top 6 research intensive HEIs compared with the first, and somewhat higher for the high research intensive HEIs. By contrast, gross additionality for the lower research intensive HEIs appears to have dropped. Again, one must be cautious here due to the different modes of data collection in the different periods.

2.1.2 What happened to KE income as HEIF funding was redistributed in the past?

The systematic changes to the distribution of HEIF funding over the past 8 years also suggests interesting comparison groups: between those that have gained in HEIF funding, and those that have lost (Table 5). HEIs were grouped into one of 5 groups based on the change in the average HEIF funding received during the period 2008-11 and that received between 2012-16:

- Significant gains (greater than 50% gain)
- Some gains (between 5% and 50% gain)
- Minor changes (between 5% loss and 5% gain)
- Some losses (between 5% loss and 50% loss)
- Significant losses (greater than 50% loss)

Table 5 KE income performance of HEIs experiencing different changes in HEIF funding between 2008-11 and 2012-16

Change in HEIF in average received between 2008-11 and average received between 2012-16	KE income from all sources				KE income from private sector sources (large companies and SMEs)			
	Amount (£000s), 2011	Annualised growth rate (% p.a.) 2008-11	Amount (£000s), 2016	Annualised growth rate (% p.a.) 2012-16	Amount (£000s), 2011	Annualised growth rate (% p.a.) 2008-11	Amount (£000s), 2016	Annualised growth rate (% p.a.) 2012-16
Significant gains (≥ 50% change)	2,013,547	4.7	2,539,699	4.9	524,078	-0.5	735,157	7.5
Some gains (5% < change ≤ 50%)	345,278	5.1	408,009	4.5	89,589	-2.1	113,266	3.7
Minor changes (-5% < change ≤ 5%)	74,471	-6.8	74,703	2.7	8,094	4.0	12,052	14.0
Some losses (-50% < change ≤ -5%)	377,845	-0.9	417,882	4.9	61,321	-5.0	66,537	3.5
Significant losses (Change ≥ -50%)	38,519	12.8	50,827	-2.2	5,927	11.7	4,482	-5.8

Table 5 suggests that:

- Those HEIs that gained significantly in HEIF funding between periods maintained a strong and steady growth rate of almost 5% in the period before the change and that after it. In particular, they experienced significant growth in their income from the private sector following the increase in HEIF funding. A similar story exists for those that experienced some gain in HEIF funding (between 5% and 50%)
- HEIs that experienced only minor changes in HEIF funding managed to turn their KE income performance around between periods, from a decline of 6.8% before the changes, to 2.7% growth following the change. They exhibited particularly strong private sector growth.
- Those HEIs that lost some HEIF funding (between 5% and 50%) similarly managed to turn around their KE performance both in aggregate and with the private sector.
- HEIs that experienced significant losses in HEIF funding were those that generated relatively small amounts of KE activity. These institutions saw their KE incomes suffer declines following the changes, both in aggregate and with the private sector in particular.

Overall, the evidence suggests that the changes that were meant to reward KE performance appears to have done so. It also tentatively suggests that those that lost some of their HEIF funding (but not all of it) have adapted to the new landscape and have managed to turn their KE income performance around.

2.1.3 What would happen to additionality if HEIF was increased to £250 million and redistributed?

The Witty Review (Witty, 2013) recognise the importance of HEIF funding in enabling knowledge and technologies to be exchanged, diffused and deployed in support of British innovation. He called for HEIF funding to be increased to £250 million per annum, and ensure that no opportunity for effective KE engagement be missed due to lack of resources. Given the evidence on KE income trends, attribution to HEIF funding, and gross additionality presented above, a question arises: how would KE income generated by the HE sector change as a result of such an increase?

This section considers the effects on aggregate KE income and gross additionality arising from an increase in HEIF to £250 million. For the purpose of modelling the changes in KE income up until 2021, I assume that the increase in funding occurs in 2019 and is maintained in flat cash until 2021.

I then model a number of different scenarios looking at distributing the funding in different ways across the sector by modifying key parameters of the *existing* formula, including: the maximum cap, and the maximum percentage increase allowed for any given HEI. I explore the following scenarios:

1. Status Quo: maintain the same distribution of funding as for the core formula-based component of HEIF in 2018
2. 8M_500: Raise the cap to £8 million from its current level of £3.35 million, and increase the maximum increase to 500%. This has the effect of significantly reducing the disparity in the amount of HEIF received per academic in the large, global elite research HEIs (top 6 cluster).
3. 5M_200: Raise the cap to £5 million from its current level of £3.35 million, and increase the maximum increase to 200%.
4. 4.5M_70: Raise the cap to £4.5 million from its current level of £3.35 million, and increase the maximum increase to 70%. This represents a more equitable distribution of HEIF funding across the research intensity clusters than is currently the case.

Table 6 presents the results of the modelling for the different scenarios. The table shows, for each of the scenarios, the HEIF allocations across clusters, along with estimates of the amount of KE income generated in 2021 that is attributable to HEIF, the amount of KE income generated in 2021 that is not attributable to HEIF, the total KE income expected in 2021, and an estimate of the gross additionality.

The model suggests that increasing HEIF funding to £250 million would increase KE income generated by English HEIs in 2021 to between £4.3 billion (scenario 4.5M_70) and £4.7 billion (scenario 8M_500). The English HE sector would greatly exceed their target of generating approximately £4 billion in KE income by 2025.

The changing distribution of HEIF funding would also affect the estimates of gross additionality (using KE income as the *proxy* for economic impact). The modelling suggests the highest gross additionality is realised for scenario 8M_500 (which acts to increase the proportion of HEIF going to research intensive HEIs, and acts to alleviate the disparities in HEIF per academic for the top research intensive HEIs), and , and lowest for 4.5M_70 (which represents a somewhat more equitable allocation across clusters). This is not surprising given that gross additionality increases with research intensity, and is much higher for the large research intensive HEIs.

Table 6 Distribution of HEIF funding and KE income attributable to HEIF by cluster, estimates of gross additionality and total KE income generated in 2021 for each scenario

	Cluster	Additionality	Status Quo		8M_500		5M_200		4.5M_70	
			HEIF allocation, 2021	KE income attributable to HEIF, 2021	HEIF allocation, 2021	KE income attributable to HEIF, 2021	HEIF allocation, 2021	KE income attributable to HEIF, 2021	HEIF allocation, 2021	KE income attributable to HEIF, 2021
Distribution of value across clusters (%)	Top 6	17.4	12.4	31.4	19.2	42.0	12.0	30.5	10.8	28.8
	High	6.9	49.7	50.2	53.3	46.5	50.9	51.5	46.7	49.7
	Medium	4.2	21.9	13.3	16.2	8.5	21.5	13.1	24.0	15.4
	Low	2.3	11.2	3.8	7.9	2.3	11.0	3.7	12.8	4.5
	Arts	1.6	3.2	0.7	2.3	0.4	3.1	0.7	3.6	0.9
	Null	2.3	1.6	0.5	1.0	0.3	1.5	0.5	2.0	0.7
	England (%)		100	100	100	100	100	100	100	100
Value (£millions)			229	1,570	229	1,821	229	1,567	229	1,492
KE income not attributable to HEIF				2,858		2,858		2,858		2,858
Total KE income, 2021 (£millions)				4,428		4,679		4,426		4,350
Monetised additionality (England)		6.3		6.8		7.9		6.8		6.5
*Non-monetised additionality (England)**		*2.6*		*2.6*		*2.6*		*2.6*		*2.6*

* Note: changes to the estimate of non-monetised gross additionality have not been modelled.

As with all estimates of gross additionality using methods that exploit KE as a *proxy* for KE impacts, there are a number of important caveats. The discussion below is reproduced from Ulrichsen (2015).

> "…the best alternative proxy indicator currently available [for KE impact] is the amount of income received by HEIs through their KE activities. The primary assumption made here is that reasonably well governed and accountable organisations in the private, public and third sectors willing to pay for a service (here KE-related) must believe that they are deriving value from it in some way. At minimum, KE income represents implied demand for the capabilities and expertise available within universities. Standard economic theories of the firm would go further and suggest that the price paid for the service reflects the marginal contribution of that service to their organisation. Alternative theories of the firm reveal other pricing approaches which weaken this assumption somewhat. Given the complexities of spillovers, multiplier effects, supply chain effects, unexpected benefits being realised and other reasons, it is likely that KE income represents a *minimum bound* on the monetary value of the KE activity on the organisation. Importantly, assuming that the extent to which the price paid for different types of KE is at least proportional to its economic value (if not reflective of it), KE income can be aggregated across different mechanisms and, importantly, compared across institutions."

2.1.4 Modelling the effects of a HEIF uplift using regression estimates

The effects of an uplift in HEIF can also be explored using the regression models developed in Ulrichsen (2015). The 2015 econometric model found that a 1% uplift in HEIF per academic FTE over the period 2009-14 resulted in a 0.4% uplift in KE income per academic over that period. The model explored the effects over a six year period in order to internalise the well-known time lags between investing in KE and realising economic benefits.

Using this result (and assuming that the other factors in the model stay the same), I explore the effects of increasing HEIF to £250 million per annum (in cash terms) over a six year period 2019-2024 (*uplift* scenario). I then compare this to a scenario where KE funding is maintained at £160 million per annum in cash terms over the same period (*status quo* scenario). Both scenarios are estimated with reference to the 2009-14 results (the *baseline*). In both the *uplift* and *status quo* scenarios I assume that the number of full time equivalent academic staff in the HE sector grows at same average rate for the period 2007-16

Table 7 presents the results (and calculations). It suggests that a £490 million uplift in HEIF (in real terms) over the six year period (difference in HEIF between the uplift and status quo scenarios) will generate an additional £3.75 billion in KE income (i.e. a ratio of 7.65). In the uplift scenario, English HEIs would generate £24.4 billion over the 2019-24 period (an average of £4.06 billion per annum).

Table 7 Effect on KE income resulting from an uplift in HEIF to £250 million over the period 2019-2024

	2009-14 baseline	Values		Absolute change		% change	
		Status Quo	Uplift	Status Quo	Uplift	Status Quo	Uplift
HEFCE KE funding (£000s) †	924,456	871,723	1,362,067	-52,732	437,612	-5.7	47.3
Academic staff FTE (000s) *	122,897	163,589	163,589	40,692	40,692	33.1	33.1
HEIF per academic (£000s) †	7.52	5.33	8.33	-2.19	0.80	-29.2	10.7
% change in KE income expected from funding change**		-11.75	4.31				
KE income per academic (£000s) †	142.7	126.0	148.9	-16.8	6.1	-11.8	4.3
KE income (£000s) †	17,543,360	20,607,873	24,357,886	3,064,513	6,814,527	17.5	38.8

† Monetary values are in real terms in 2016 prices

* Number of academics estimated to grow at same rate as average annual growth rate during period 2012-2016

** Based on a 1% uplift in HEIF per academic generating a 0.4% uplift in KE income per academic

Table 8 Effect on KE income resulting from different levels of HEIF compared to the status quo, over the period 2019-2024

	2009-14 baseline	Value				Absolute change				% change			
		Status Quo	Uplift £200M	Uplift £250M	Uplift £400M	Status Quo	Uplift £200M	Uplift £250M	Uplift £400M	Status Quo	Uplift £200M	Uplift £250M	Uplift £400M
HEFCE KE funding (£000s)	924,456	871,723	1,089,654	1,362,067	2,179,308	-52,732	165,198	437,612	1,254,852	-5.7	17.9	47.3	135.7
Academic staff FTE (000s)	122,897	163,589	163,589	163,589	163,589	40,692	40,692	40,692	40,692	33.1	33.1	33.1	33.1
HEIF per academic (£000s)	7.52	5.33	7	8	13	-2	-1	1	6	-29.2	-11.4	10.7	77.1
% change in KE income expected from KE funding change		-11.75	-5	4	31								
KE income per academic (£000s)	142.7	126.0	136	149	187	-17	-7	6	44	-11.8	-4.6	4.3	31.1
KE income (£000s)	17,543,360	20,607,873	22,274,545	24,357,886	30,607,909	3,064,513	4,731,186	6,814,527	13,064,549	17.5	27.0	38.8	74.5

Table 8 provides an analysis of the effects of an uplift (in cash terms) HEIF on KE income using the regression results under different scenarios: (i) HEIF increases to £200 million; £250 million; and £400 million. Note that the ratio of uplift KE income (scenario – baseline) resulting from the uplift in HEIF (scenario – baseline) remains constant. This is due to the way in which the model is constructed based.

3 The case for increasing HEIF funding to £250 million

The evidence thus far points to higher returns to investment from increasing HEIF funding to £250 million, coupled with addressing some of the disparities in funding per academic in the sector. This increase would have the effect of bringing forward the date at which the English HE sector meets it target of generating £4 billion in KE income.

However, the Witty Review, nor others who suggest the level of funding to be £250 million have provided a rationale for this figure. This section explores such a rationale.

At its core, knowledge exchange is about strengthening the more direct pathways through which the knowledge generated and accumulated within HEIs can be more effectively exchanged, diffused and deployed into the wider socio-economic system to contribute to processes of innovation and wider socio-economic development. The effectiveness of KE is thus driven by the scale and nature of the accumulated knowledge base within the HEI, and the types of engagement opportunities in the innovation and wider socio-economic systems available to the given HEI.

While there is some evidence to suggests economies of scale exist in supporting KE between academics and external organisations, particularly in medical and STEM disciplines (Ulrichsen, 2015), in general, as the scale of the accumulated knowledge base increases, so do the need for resources to support KE engagements from this base.

Table 9 Research funding distributed by UK Research Councils and HEFCE, and proportion of core formula driven HEIF grant in this research funding, 2005 – 16

Year	Research grants and contracts from Research Councils	Recurrent Research	Research grants (HEFCE/RCs)	Core HEIF grants	% core HEIF grant in HEFCE/RC research grants
2005	948,014	1,322,092	2,873,982	131,167	5.8
2006	1,063,207	1,487,405	3,019,151	104,157	4.1
2007	1,115,267	1,558,196	3,182,771	125,966	4.7
2008	1,262,613	1,590,239	3,395,322	122,488	4.3
2009	1,377,167	1,622,235	3,701,088	124,912	4.2
2010	1,395,424	1,739,185	3,829,933	147,201	4.7
2011	1,340,767	1,691,311	3,830,473	161,564	5.3
2012	1,273,617	1,644,793	3,860,515	159,682	5.5
2013	1,276,410	1,615,146	4,022,599	162,950	5.6
2014	1,362,166	1,581,839	4,172,614	164,329	5.6
2015	1,477,616	1,580,284	4,878,753	163,580	5.3
2016	1,586,377	1,557,267	4,800,758	160,233	5.1
2017	1,558,396*	1,550,167	4,716,081	157,178	5.1
2018	1,534,332*	1,553,531	4,643,259	178,931	5.8
Average (2012-16)					5.4

Sources: Research council grants and HEFCE recurrent research data from 2005-2016: HESA; Core HEIF funding 2005-2018: HEFCE; Recurrent research 2017 and 2018 from HEFCE circulars

*Note: Research Council research grants for 2017 and 2018 assumed to be the same as in 2016 in cash terms.

One way of exploring the appropriate level of HEIF funding is thus to explore the amount of institution-level KE resources required to service KE opportunities from a given scale of knowledge base. If we proxy the scale of the research base with the amount of research funding awarded to

English HEIs by HEFCE and the UK Research Councils (Table 9), HEIF funding represents just 5.8% of this funding in 2018 (5.4% when taking an average proportion over the period 2012-18).

3.1 Increasing the scale of the research base

The UK government has announced plans to substantially increase the scale of the research base with the establishment of the National Productivity Investment Fund (NPIF). This seeks to allocate an additional £4.7 billion to fund research across the four UK nations over the period 2018-2021 (in current prices) (an additional £2 billion in 2021). This will be allocated in part through the UK Research Councils and in part through the new organisation, Research England based on the balanced funding principle. The latter will be subject to the Barnett formula which seeks to apportion funding across the four UK nations.

Table 10 presents a forecast estimate of how the scale of the research base will evolve over the period 2017 – 2021.

Table 10 Estimated scale of HEIF funding based on scale of HEFCE/Research Councils research funding, 2017-2021

Variable	Nation	2,017	2018	2019	2020	2021
Research grants and contracts from Research Councils [a]	England	1,558,396	1,534,332	1,510,098	1,482,648	1,454,797
Recurrent Research [b]	England	1,550,167	1,553,531	1,528,994	1,501,201	1,473,001
Research grants (HEFCE/RCs)	England	4,716,081	4,643,259	4,569,921	4,486,851	4,402,566
NPIF Investments [c]	UK	0	411,057	780,572	1,401,919	1,834,113
NPIF Investments [d]	England	0	338,886	643,524	1,155,779	1,512,091
Total Research Funding (HEFCE/RCs)	England	3,108,563	3,426,750	3,682,616	4,139,628	4,439,889
Amount core (recurrent) HEIF required to maintain share in research funding	England	157,178	198,568	199,389	224,133	240,390
Amount core (recurrent) HEIF required (cash terms)	***England***	***160,000***	***205,303***	***209,460***	***239,814***	***262,132***

[a]: 2017-2021 assumed to be flat cash based on 2016 value. Assume any increase to recurrent research grant comes through NPIF

[b]: 2017 and 2018 are actual research funding allocations to universities (source: HEFCE circulars). 2019-2021 assumed to be flat cash based on 2018 value. Assume any increase to recurrent research grant comes through NPIF

[c]: NPIF allocations to research base obtained from Table 3.1 of UK HM Treasury's Autumn Statement 2016. This was then allocated between the Research Councils and the national funding bodies based on the 2016 balance between research grants and contracts distributed by the former and recurrent research funding distributed by the latter. The amount allocated to national funding bodies was then distributed to the nations based on their populations. For NPIF being distributed through the UK Research Councils, I have assumed that English HEIs receive a similar proportion of the total compared with the 2016 distribution.

Given the growth in the scale of research activity expected to take place in English HEIs, and using the proportion of HEIF in research funding, Table 10 suggests that by 2021, HEIF will need to be approximately £240 million in real terms (£262 million) in current prices.

This, of course, assumes that the existing ratio of HEIF resources to research funding provided by HEFCE and the Research Councils has been approximately correct and the nature of research (in terms of the near-to-medium term KE opportunities it creates) does not change. However, given that government reviews have previously called for increases to such funding for prior to the announcement of substantial increases to research funding through NPIF; given that pressure is

growing on universities to become more engaged with users in developing and performing their research; and given that pressure is growing on them to undertake increasingly industrially-relevant and challenge-led research requiring more systematic and institution-wide responses to industrial innovation needs, it is possible that the estimate above is a lower bound.

3.2 Increasing the scale of the research base – alternative (preferred) method

The UK government has announced plans to substantially increase the scale of publicly funded research in the UK with the establishment of the National Productivity Investment Fund (NPIF). This seeks to allocate an additional £4.7 billion to fund research across the four UK nations over the period 2018-2021 (in current prices) (an additional £2 billion in 2021). This will be allocated in part through UK HEIs, and in part investing alongside the private sector. This section explores the effect of this increased amount of R&D being undertaken on the requirement for HEIF funding in English HEIs. It does so by exploring the relationship between the amount of R&D undertaken in the economy and the amount of KE engagement with HEIs. From this I derive the requirements on HEIF. Table 11 presents the key calculations.

Table 11 Estimated scale of HEIF funding based on the relationship between increased R&D in the economy and increased demand for KE with HEIs

Variable	Nation	2,017	2018	2019	2020	2021
UK GDP growth forecasts*	UK	2.0	1.6	1.7	1.9	2.0
Total R&D in economy (status quo)	UK	33,706	33,918	34,360	34,991	35,769
Additional NPIF investments into R&D (into business)	UK	0	411	781	1,402	1,834
Crowding in effects on private sector R&D	UK		559	1,062	1,907	2,494
Total R&D in economy (new)	UK	33,706	34,888	36,202	38,299	40,097
R&D growth (new)	UK	2.2	3.5	3.8	5.8	4.7
KE growth based on R&D growth	UK	5.4	6.4	6.7	8.4	7.4
Estimated KE income in UK economy (RD-KE growth method)	UK	4,434	4,719	5,033	5,454	5,859
Share of KE in English economy	England	84	84	84	84	84
Estimated KE in English economy (RD-KE growth method)	England	3,707	3,946	4,208	4,560	4,899
KE attributable to HEIF (32.8%)	England	1,216	1,294	1,380	1,496	1,607
HEIF required (deflated) estimated based on additionality (6.3)	England	193	205	219	237	255
HEIF required (undeflated)	***England***	***160***	***185***	***230***	***254***	***278***

Notes:
* GDP forecasts obtained from the UK Office for Budget Responsibility

The projected total R&D in the UK economy without the additional NPIF investments is estimated based on the relationship between R&D expenditure and GDP growth (Figure 8, panel (a)). I have excluded the years 2008 and 2009 due to the extreme economic conditions in which the UK (and many of its key collaborative partners) found itself in due to the global economic recession. This provides estimates of how total R&D spending might change based on the expected changes in GDP.

To this I then add then the planned increase in NPIF investments. These act to increase the overall amount of R&D being undertaken in the UK economy undertaken by either public sector or private sector actors.

There is also evidence that public sector R&D spending *crowds-in* rather than *crowds-out* private sector spending on R&D – i.e. rather than leading to substitution of private sector R&D, it acts as leverage enabling private sector actors to increase their own R&D spending. I use the estimates of crowding-in that were used by Jo Johnson in his speech XXX (for every £1 increase of public R&D spending, we would expect £1.13 - £1.59 of private sector spending increase). I have taken the mid-point of this range (£1: £1.36).

Using these estimates results in a new projection for the amount of R&D being undertaken in the UK economy over the period 2017 – 2021 which includes the NPIF investments and crowding-in effects.

Figure 8 Key relationships used in the modelling: (a) between GDP growth and R&D expenditure growth; and (b) between R&D expenditure growth and KE income growth

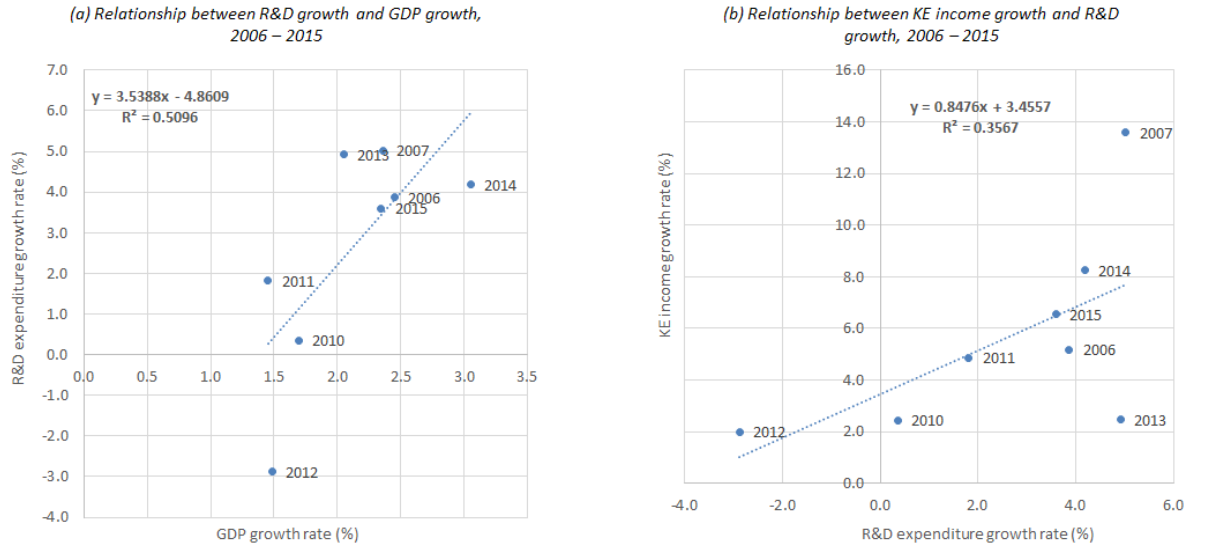


Figure 8, panel (b) presents the relationship between R&D spending in the UK economy and KE income generated by UK HEIs. This relationship is used to estimate the projected KE income that could result from the uplift in R&D spending suggested above. I assume that English HEIs will generate the same proportion of this KE income as in 2016 (approximately 84%), which gives us an estimated KE income for English HEIs over the period 2017 – 2021.

From this, I use the estimated attribution to HEIF (Table 3) to calculate the amount of this income that would be attributable to HEIF – i.e. would not have been generated without HEIF being present. I then use the estimated additionality from Table 3 to calculate the amount of HEIF required to generate this attributed KE income. This suggests HEIF rising to £230 million in 2019, £254 million in 2020 and £278 million in 2021.

Of course there are important caveats to this modelling. In this, I say nothing about time lags between increased R&D spending in the economy as a whole and how this might translate into demands for KE. There may well be important lags where research has to be carried out before more translational and knowledge diffusion activities that may involve KE activity are necessary. That said, it is possible that part of the increase R&D spending by firms is undertaken in partnership,

or outsourced as contract research, to UK universities. Another key caveat is that the modelling is all based off of forecasts for GDP which can change. I am also making an assumption of a linear relationship between the key variables which may be more complex than this. Lastly, the modelling is based on an assumption that the near future will experience a similar relationship between the key variables as the past decade (excluding the few years around the onset of the economic recession). It is, of course, as yet not possible to understand the effect of Brexit on these relationships and the demand for KE from our universities.

3.3 Increasing the scale of the research base: alternative method

An alternative way of examining the level of HEIF required to underpin KE in the HE sector is to explore the likely growth of academics in the HE sector. The ambition of HEIF is to enable HEIs to support KE that emerges from any discipline, research intensive or not. The government has ambitions for the public research base to expand not least through its investments through NPIF. The expanding university research base will likely require additional academics to undertake this research.

Figure 9 Key relationships used in the modelling: (a) R&D spending in the UK economy and research grants income to UK HEIs; and (b) research grants income in English HEIs and number of academic FTEs in English HEIs

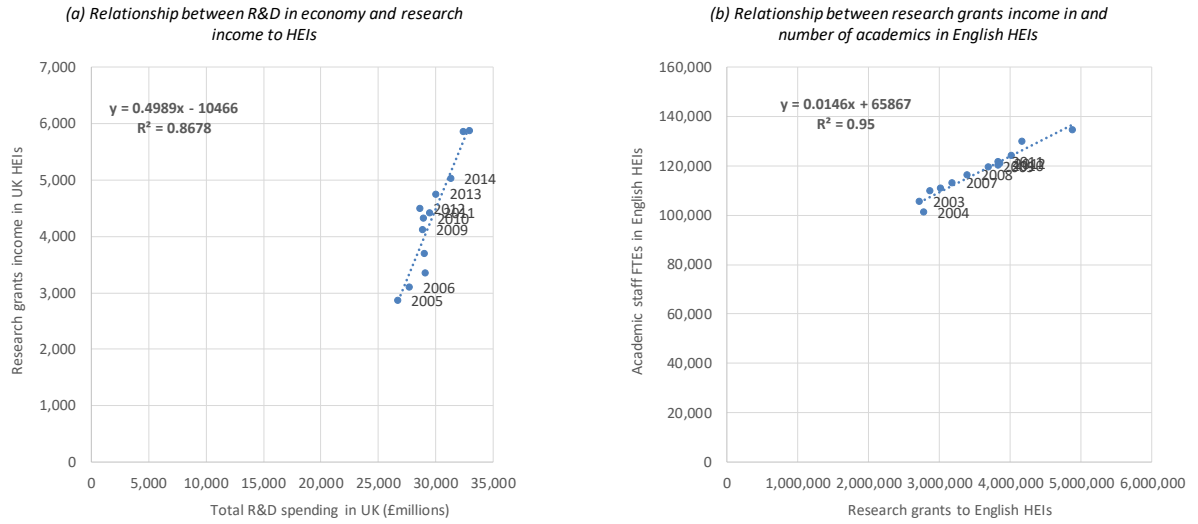


Figure 9 provides the relationship between the level of R&D undertake in the UK economy (by any type of organisation), and the level of research grants received by UK universities. This allows us to estimate the likely growth in research grants expected by UK universities. I then assume that English universities will receive a similar proportion of the UK total as in 2016 (82%). Figure 9 also provides the relationship between the scale of research grants received by English HEIs and the number of academic FTEs they employ. This allows us to estimate the number of academic FTEs they likely require to meet the needs of a growth in research funding.

Table 12 Scale of HEIF funding required based on estimated growth of number of academics in HE sector

Variable		Nation	2016	2,017	2018	2019	2020	2021
Growth in R&D in the economy	Total R&D in economy (status quo)	UK	32,967	33,706	33,918	34,360	34,991	35,769
	Additional NPIF investments into R&D (into business)	UK	0	0	411	781	1,402	1,834
	Crowding in effects on private sector R&D	UK	0	0	559	1,062	1,907	2,494
	Total R&D in economy (new)	UK	32,967	33,706	34,888	36,202	38,299	40,097
Growth in research activity in HEIs	Research grants and contracts	UK	5,886	6,350	6,940	7,595	8,642	9,538
	Research grants and contracts	England	4,801	5,179	5,660	6,195	7,048	7,780
Growth in academic staff FTEs	Academic staff FTEs	England	135,958	141,484	148,503	156,312	168,771	179,451
KE funding	KE funding per academic FTE	England	1,179	1,111	1,400	1,400	1,400	1,400
	KE funding (real terms)	England	160	157	208	219	236	251
	KE funding (cash terms)	England	160	160	215	230	253	274

Notes: the expected growth in R&D in the economy is based on the same estimation method as in section 3.2.

In then I assume that, in order to maintain the status quo in knowledge exchange activity from the research base, the amount of HEIF received per academic remains constant as the scale of research activity increases. This is estimated to be approximately £1,400 per academic in 2018. This suggests that HEIF would need to grow (in cash terms) to £230 million in 2019, £253 million in 2020 and £274 million in 2021 to maintain the status quo of support per academic.

An important caveat to this method is that I assume that the KE demands placed on academics remain broadly similar – i.e. require a similar amount of support and thus KE funding. Given the apparent direction of Government towards much greater emphasis on universities playing a greater and more strategic role in addressing industrial and economic challenges facing the UK, on research impact, on funding more challenge-informed or challenge-led research, etc. it is likely that the KE demands on academics, and likely the support they require to underpin their engagement will increase.

References

Dowling, A., 2015. The Dowling Review of Business-University Research Collaborations.

HM Treasury, 2015. Fixing the Foundations: Creating a More Prosperous Nation (No. Cm 9098). HM Treasury, London, UK.

PACEC/CBR, 2009. Evaluation of the effectiveness and role of HEFCE/OSI third stream funding (Issues paper No. 2009/15). HEFCE, Bristol, UK.

Science and Technology Committee, 2017. Managing intellectual property and technology transfer: tenth report of session 2016-17 (No. HC 755). UK House of Commons Science and Technology Select Committee.

Science and Technology Committee, 2013. Bridging the valley of death: improving the commercialisation of research: Eighth Report of Session 2012–13 (No. HC 348). UK House of Commons, London, UK.

Ulrichsen, T.C., 2015. Assessing the Economic Impacts of the Higher Education Innovation Fund: a Mixed-Method Quantitative Assessment. HEFCE, Bristol, UK.

Ulrichsen, T.C., 2014. Knowledge Exchange Performance and the Impact of HEIF in the English Higher Education Sector. HEFCE, Bristol, UK.

Witty, A., 2013. Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth: Final Report and Recommendations. UK Department of Business, Innovation and Skills, London, UK.