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Growth, Innovation and Intangible Investment*

Jonathan Haskel
Imperial College Business School, Tuck School of Business, Dartmouth College and CEPR, UKIRC and IZA

1 Introduction

I thank the Growth Commissioners for the invitation to provide evidence on the link between growth, innovation and intangible investment. The question has achieved additional urgency with the current turmoil in the Eurozone and, more parochially, the entry of the UK into a double-dip recession.

So how can we get some growth? Economists split out the supply and demand side. In the long run, growth depends on the supply side: more investment in people, physical capital and ideas. In the short run, which in exceptional times may turn out to be rather lengthy, that steady growth can be interrupted by shortages of demand. The Commission has set itself the task of the formulation of a "long-term growth strategy in the UK"[1] so this note asks what we know on the supply side about long run growth and policy that affects it.

2 Growth

As pointed out by Nickell (2012)[2] there have been a wealth of reports and enquiries on British growth. He correctly asks the hard questions (a) what if anything has changed about the economy from previous reports and (b) why have not previous recommendations been taken up? I shall try to argue that a possible answer at least to the first part of his question is a shift in the economy to a more

*Contact: Jonathan Haskel, Imperial College Business School, Imperial College, London SW7 2AZ, j.haskel@imperial.ac.uk. This is a note to the LSE Growth Commission, intended to be accessible to non-specialists: see in particular section 2.1 in particular. Much of this work has kindly been financially supported particularly by NESTA and also the UKIRC , whom I thank, and the debt to all my co-authors will be obvious: opinions and mistakes are mine of course.

[1] http://www2.lse.ac.uk/researchAndExpertise/units/growthCommission/home.aspx.

[2] Or more accurately the summary of his remarks available at http://www2.lse.ac.uk/researchAndExpertise/units/growthCommission/evidenceSessions/evidenceSessionLaunch.aspx.

service- and intangible-intensive structure. But to see all this we need a framework, which is as follows.[3]

2.1 An non-technical example

To fix ideas, consider a specific example. Ryanair has grown from, in the 1980s, a one-propeller plane airline flying contract labourers from Dublin to Luton, to, in the 2000s, one of the largest airlines in the world (by international destinations, the largest). How has it managed to grow?

There are three ways. First, most obviously, Ryanair has expanded its fleet from one plane to almost 300. So it has grown through physical or tangible capital investment. Second, it has hired and trained more staff: growth through human capital investment. Third, it has innovated: ticketless boarding, faster turnarounds of planes, rostering of crews: growth through employing new ideas, which we shall call intangible capital investment. The separation into the different capital components helps distinguish the locus of innovation. Suppose we have an economy where airlines grow more efficient by simply buying more efficient aircraft, we should locate innovation in the aircraft industry, not the airline industry.[4]

Thus the first step in seeking to understand growth in the economy is to document investment in human, tangible and intangible capital (the second is to ask if policy can affect it). Measuring human and tangible capital via labour force and investment questionnaires has been a standard part of the National Accounts since their inception.[5] Matters are more complicated when it comes to intangible assets. Human and tangible capital leave an economic "footprint", since they are typically traded in markets and so have an observable price and quantity (a new Boeing costs $X, and Ryanair has Y of them). Intangible capital is different, for it is trade in ideas. At one extreme ideas leave no economic footprint at all, since they are free. In Ryanair's case this is ticketless boarding, observed by Michael O'Leary when flying on Southwest Airlines in the USA. At another extreme, ideas leave an observable footprint, when, for example, firms buy a licence to use patented techniques (for example, Virgin own a patent on a certain layout of cabin seating and sell the rights to use it to other airlines)[6].

[3] This framework focuses on GDP and its growth, not other measures of happiness or wider GDP. See Oulton, 2012, for an excellent defense of GDP. The following framework is that set out in Corrado, Hulten and Sichel (2009).

[4] And we similarly think of the aircraft industry as employing different types of capital, so that the design of a better plane, due to R&D in that industry locates innovation there. In turn, the \installation of a better computer locates innovation in the computer industry.

[5] The more complicated part is how to weight different types e.g. cabin crew and pilots or Airbuses and Boeings. This is done by weighting by relative wages or capital rental costs, for, under competition, the relative (marginal) productivity, of a pilot and a cabin crew is given by their relative wage.

[6] http://haskelecon.blogspot.com/2011/03/science-and-innovation-in-just-one.html.

Most ideas are however somewhat in between these two extremes. Many are developed in-house e.g. by R&D scientist. Such a cost can be uncovered by asking firms for spending on their scientists, but this is complicated for firms to answer and needs to consider all product development effort that might contribute to long-term idea-building in firms including e.g. designers and market researchers. In the light of these complications, the standard method has been to treat ideas as coming for free. Thus the calculation of Ryanair's innovation is as follows: subtract from their output growth the growth in human and tangible capital (weighted by their respective cost shares which measure their relative productivity). That residual is the growth due to innovation, that is to say, the growth in output over and above that from human and tangible capital inputs.

What do we find? To give an example, a typical finding from this subtraction is that growth in some Asian tigers from the 1950s to the 2000s (e.g. Singapore) involved relatively little innovation. Put another way, there was little residual growth: almost all growth was accounted for by the accumulation of physical and human capital, whereas in European countries, around 50-70% of growth was due to the residual, i.e. growth over and above human and tangible capital accumulation.

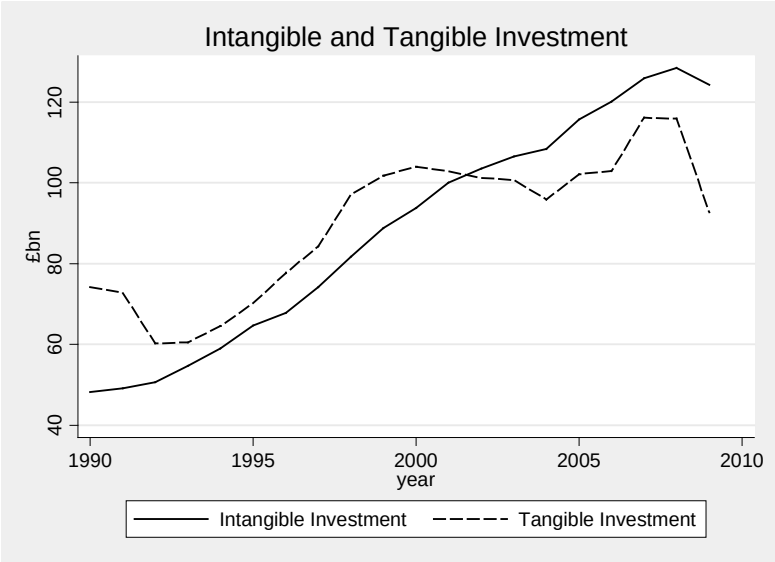
2.2 What has changed?

With this framework in mind, we may now come to Nickell's question. What if anything has changed in the UK economy that might cause us to revisit some the previously set out recommendations?

First, the economy has become more knowledge intensive. Figure 1, taken from Goodridge (2012) sets investment in tangibles versus intangibles and shows investment in intangibles to now exceed tangibles.

As an aside, note the contrasting behaviour in the most recent period, where tangible investment has fallen very strongly, but intangible less so. The data in this graph are up to 2009 in order to be consistent with the UK National Accounts and Input/Output tables, so we have no broad intangible spending data after then. We do have officially published data on R&D (up to 2010) and purchased software investment, up to 2011. R&D spend 2009 to 2010 is more or less flat in nominal terms, and purchased software has risen slightly. So our best guesstimate is that nominal tangible spend is flat. Our initial calculations however indicate that the capital services from such a pattern are similar to those from tangible investment which has fallen hugely, because intangible life lengths are so much shorter (and hence the net stock of intangibles falls sharply each period just due to depreciation, see Awano, Franklin, Haskel and Kastrinaki, 2010, for direct survey evidence on intangible life lengths).

Figure 1: **Market sector tangible and intangible investment, £bn, 1990-2009**



Source: Goodridge, Haskel, Wallis, 2012. Investment in intangibles is investment in software, R&D, design, creation of artistic originals, product development in financial services, branding, firm-provided training and business processes. See paper for methods of calculation. Tangible investment are plant, machinery, buildings, vehicles (domestic dwellings are excluded).

Second, as Nickell points out the economy has become more service-sector intensive. One feature of service sectors is that they do not invest much in R&D. R&D has long been used as a summary measure of knowledge investment and much invaluable work has been done in the area to better understand such investment and how it might spill over into other areas. However, some of the newly dominant areas of the UK economy do almost no measured R&D investment: retailing, banking, (non R&D industry) business services for example (in 2010, 73% of R&D was performed in manufacturing[7] and 400 firms accounted for 80% of total 2010 R&D spend[8]). To better measure innovative investment in these areas we need to move beyond R&D.[9]

Table 2 sets this out in more detail. Table 2 shows investment by intangible asset for 1990, 1995, 2000 2005, 2008 and 2009 with tangible investment for comparison. There are a number of points. First, R&D at 14bn, is only about 11% of the total. Second, the largest other categories are software, training and what we call "organisational capital". In passing it must be said that the last is the least well-measured area of the work. This category attempts to measure investment in organisational capital that makes Wal Mart so different from Kmart. Ultimately, then this must have something to do

[7] http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-237838, http://www.ons.gov.uk/ons/rel/rdit1/bus-ent-res-and-dev/2010/research-and-development-in-uk-businesses-2010---datasets.xls, Table SB2.

[8] http://www.ons.gov.uk/ons/dcp171778_238137.pdf, Background note 1, page 5.

[9] This may have no consequences for policy if the only spillovers from knowledge creation are from R&D. See below.

with management. But what units is this to be measured in? The highly innovative Bloom/van Reenen (2010) approach is to unearth management practices using a tested survey instrument. The approach here is bound up in the logic of GDP and growth accounting and so tries to confine itself to the units of money. That means trying to measure how much management is investing in a knowledge capital stock at the firm. Survey instruments are not tested in this domain, a major problem relative to the Bloom/van Reenen approach. So we have used purchased management consultancy (excluding IT related consulting which might overlap with software) and 20% of the (non-bonus) value of managerial time, the latter being an arbitrary number that future work hopes to explore.[10]

Nonetheless, even if one were to discount *all* organisational spend, we still end up with the picture that intangible investment is very considerable. Software, R&D and artistic originals are all from official ONS data. Training is from an official BIS survey. Design uses the method ONS use for software and it based on the input/output tables. So it is not the case, we believe, that the measurement problems are so horrendous none of this spending can be considered.

Table 1: Tangible and Intangible Investment, £bns

[10] Awano, Franklin, Haskel and Kastrinaki, 2010, is an attempt to measure company spending on business process re-engineering and other forms of organisational capital.

Asset	1990	1995	2000	2005	2008	2009
Purchased Software	2.7	5.7	9.2	8.5	10.6	9.1
Own-Account Software	3.5	4.2	7.4	10.2	12.2	13.5
Total Software	***6.2***	***9.9***	***16.5***	***18.7***	***22.8***	***22.6***
R&D	7.3	8.0	10.5	12.2	14.4	14.0
Design	7.1	7.3	10.3	13.5	15.5	15.5
Non-scientific R&D	0.2	0.3	0.4	0.3	0.7	0.8
Mineral Exploration	1.6	1.1	0.3	0.4	0.6	0.6
Financial Innovation	0.3	0.4	0.7	0.9	1.2	1.5
Film Originals	0.0	0.1	0.2	0.2	0.2	0.3
TV (fiction) Originals	0.5	0.9	1.2	1.5	1.6	1.4
TV (non-fiction) Originals	0.2	0.5	0.6	0.7	0.7	0.7
Total TV Originals	0.7	1.4	1.7	2.2	2.2	2.1
Literary Originals	0.8	1.0	1.1	0.8	0.9	1.0
Music Originals	0.9	1.4	1.7	1.7	1.3	1.3
Miscellaneous Art	0.1	0.2	0.4	0.3	0.4	0.4
Total Artistic Originals	*2.6*	*4.1*	*5.0*	*5.2*	*5.0*	*5.1*
Total Innovative Property	***19.1***	***21.2***	***27.2***	***32.5***	***37.4***	***37.3***
Advertising	4.2	6.0	9.4	10.0	10.8	10.8
Market Research	0.9	1.2	1.5	2.4	2.1	2.0
Total Branding	*5.2*	*7.2*	*10.8*	*12.4*	*12.9*	*12.8*
Own-Account Organisational Capital	4.6	9.8	14.5	19.5	23.5	21.8
Purchased Organisational Capital	0.8	1.7	3.3	6.0	4.4	3.9
Total Organisational Capital	*5.4*	*11.4*	*17.8*	*25.5*	*27.9*	*25.7*
Training	12.3	14.9	21.4	26.6	27.4	25.8
Total Economic Competencies	***22.9***	***33.5***	***50.0***	***64.6***	***68.2***	***64.3***
TOTAL INTANGIBLES	**48.2**	**64.7**	**93.7**	**115.7**	**128.4**	**124.2**
Buildings	30.1	21.8	34.5	35.9	50.1	40.7
Plant & Machinery (excl ICT)	25.5	25.8	33.9	34.5	35.6	27.8
Vehicles	9.4	9.8	12.3	14.3	14.5	11.9
IT Hardware	6.2	9.0	15.9	12.4	11.1	8.6
CT	2.9	3.6	7.4	5.1	4.5	3.7
ICT (excluding software)	*9.1*	*12.7*	*23.3*	*17.5*	*15.7*	*12.3*
TOTAL TANGIBLES	**74.1**	**70.1**	**104.0**	**102.1**	**115.9**	**92.7**
MSGVA						
without intangibles	393.8	485.1	642.0	812.4	946.2	900.0
with NA intangibles	404.3	500.2	663.9	836.7	974.7	928.2
with all CHS intangibles	442.0	549.8	735.7	928.1	1074.7	1024.2

Source: Goodridge, Haskel, Wallis, 2012

Note to table. Data are investment figures, in £bns, current prices: italicized data are sub-totals for broader asset definitions. 'Design' refers to architectural & engineering design. MSGVA is presented with no intangibles capitalized; with only NA intangibles capitalized (software, mineral exploration and artistic originals); and with all CHS intangibles capitalized. Market Sector refers to sectors A to K plus OP, excluding residential real estate. Source: ONS data for tangibles, this paper for intangibles.

2.3 Implications for growth

The implications for growth are set out great detail in Goodridge, Haskel and Wallis (2012) so here we concentrate on new evidence across countries set out in Corrado, Haskel, Jona-Lasinio and Iommi,

(2012). The results here use a newly-constructed harmonized cross country data set (that differs slightly from the data shown above due to the need to harmonize results, the growth accounting results are however similar).

Table 2: Contribution to the growth of output per hour. 1995-2007

	Labor productivity growth	*Contribution of components:*				
		Total Capital Deepening	Tangibles	Intangibles	Labor Composition	Multifactor productivity
	(1)	(2)	(3)	(4)	(5)	(6)
Austria	2.4	0.8	.3	.5	.2	1.4
Belgium	1.8	0.7	.2	.5	.1	.9
Czech Republic	4.2	2.4	1.9	.5	.3	1.5
Denmark	1.4	1.2	.7	.5	.2	-.1
Finland	3.8	.9	.2	.7	.2	2.6
France	1.9	1.0	.4	.6	.4	.4
Germany	1.7	1.0	.7	.3	.0	.7
Ireland	3.8	1.4	.8	.6	.1	2.2
Italy	.6	.7	.5	.2	.2	-.4
Netherlands	2.3	.9	.4	.5	.4	1.0
Slovenia	5.3	1.7	1.2	.5	.7	2.8
Spain	.8	1.0	.7	.3	.5	-.6
Sweden	3.7	1.9	1.1	.8	.3	1.4
United Kingdom	2.9	1.5	.8	.7	.4	1.1
United States	2.7	1.7	.8	.9	.2	.8
Memos		*Average percent contribution of component:*				
EU countries		47.0	27.1	19.9	11.0	42.0
US		64.5	30.8	33.7	6.0	29.5

Source: Corrado, Haskel, Jona-Lasinio and Iommi, (2012)

Note: For individual countries, figures in column (1) are annual percent changes, and figures in columns (2) through (6) are percentage points.

As a benchmark, consider first the US, where capital deepening is the major source of growth, accounting for 64.5% (= 1.7/2.7) of total LPG 1995-07, see the lowest memo row. As the lowest row in the body of the table shows, half of this is tangible and half intangible. In the EU as a whole, top memo row, the picture is different : EU capital deepening is 47% of overall LPG with about 60% tangible and 40% intangible. Turning to the UK, about 50% of LPG is due to capital deepening with about a 50:50 split between tangible and intangible. Countries like Spain are notable for their small intangible contribution.

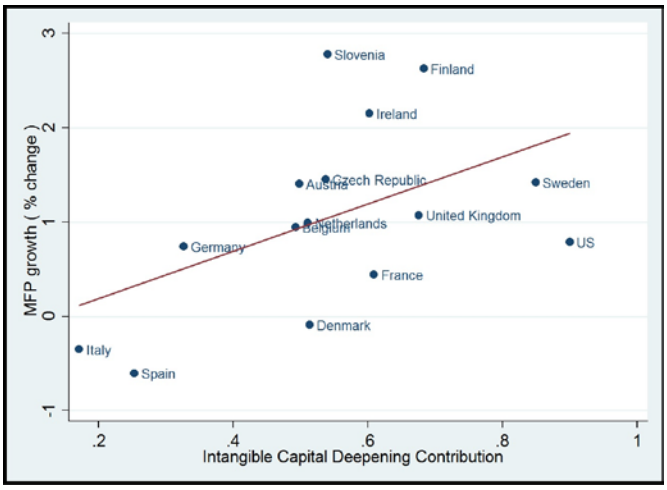
As a slight aside, how does all this vary by industry? We have no cross-country data, but for the UK, see Goodridge et al (2012, table 14). The main point is the contribution of manufacturing. Although manufacturing is only 20% of market sector value added, manufactured goods are inputs into the rest

of the economy. So productivity growth in manufacturing has a direct effect on manufacturing but also an indirect effect via its use elsewhere. It turns out then that manufacturing accounts for 44% of TFP growth in the economy and 47% of TFP plus intangible growth. Finance accounts for 18%, at 9% of value added.

2.4 Spillovers and policy

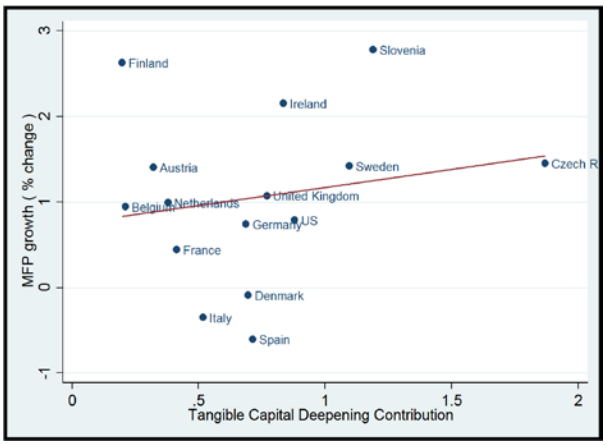
What about policy? On-going work is looking at the possible spillover effects of intangibles. We have, of course, a huge literature on spillovers of R&D, but one category of intangibles. And it is perfectly possible that only R&D is the sources of knowledge spillovers, but this is something for future research. Figure 2 and 3 graphs country MFP growth against their intangible and tangible contributions and suggests some relation for intangibles, consistent with possible spillover effects.

Figure 2: MFP and intangible capital deepening



Source: Corrado, Haskel, Jona-Lasinio and Iommi, (2012)

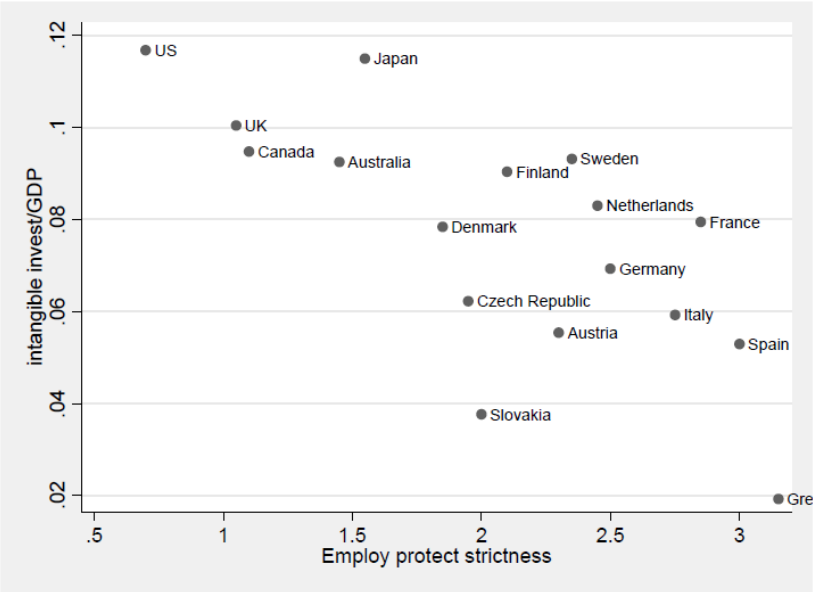
Figure 3: MFP and tangible capital deepening



Source: Corrado, Haskel, Jona-Lasinio and Iommi, (2012)

Finally Figure 4 plots intangible investment across countries against the OECD index of employment protection strictness. It shows a downward relation (interestingly, the relation is positive for tangible investment). What is driving this correlation? One interpretation is that intangible investment is highly risky and so likely to require future employment adjustment, which firms might be unwilling to take if it is costly and such costs cannot be bourne by workers.

Figure 4: Intangible Investment and OECD employment protection strictness index



Source: Haskel and Hao (2011). Note that data here cover more countries than the data above. For the same countries, the data above are an update of the data shown here, but a graph using the new data looks almost identical.

3 Conclusion

Drawing this together we have the following. First, the UK, like the US now has more intangible investment than tangible investment, and other EU countries are following. That is to say, future investment will look much more intangible than tangible. Second, this investment is important for growth. In the US, capital deepening is 65% of growth and intangible investment is now 50% of capital deepening. EU countries will be catching up to this level.

Third, is there any role for policy to affect such intangible spending? The arguments over private R&D spillovers are well-known and support for spillovers from public R&D projects is to be found in Haskel and Wallis (2010) and Guellec, D. and Van Pottelsberghe (2008). This paper suggests two

new insights. First, there are possible spillover indications that are wider than just R&D. Second, various product and labour market restrictions might be retarding intangible investment which is particularly uncertain/risky and so held up by the anticipation of such inflexibilities.[11] All this suggests that in the future, IP policy is likely to be of increasing importance along with broadband/communications equipment. Hargreaves (2011) contains a set of regulatory proposals for IP policy and Corrado (2011) shows the importance of the communications infrastructure.

[11] In passing, we may add some other policy factors that might have held back UK TFP growth, since it is generally observed that the UK is quite flexible etc. on these OECD indicators. First, Haskel and Sadun (2012) document that planning seems to have inhibited TFPG in supermarkets, a particularly strong contributor to the acceleration in US TFPG. Second, Haskel and Wallis(2011) show strong spillovers from the publically funded science budget, which was historically very low. Third, Harris and Robinson (2004) and Criscuolo et al (2011) some large industrial policies were TFP retarding. Fourth, detailed studies of the public sector show falling TFP in almost all subsectors regardless of the measurement method used.

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