Questions Behind UK Productivity

Answers & Action

Third Edition

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http://www.techmatt.com/techmatt/Commercial_Knowledge_on_Innovation_Economics.pdf

This slim volume addresses an urgent problem that holds back the UK Economy. Its productivity growth rate stalled in 2008 and hasn't recovered since.

The financial crisis caused this? But did it?

This volume says **no**.

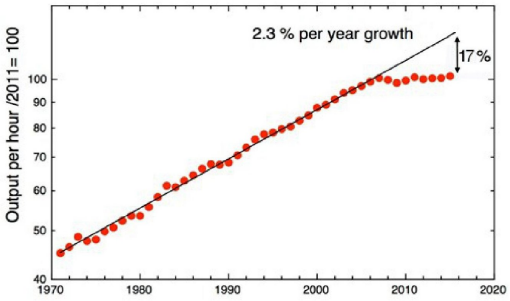
Nine exhibits answer fundamental questions that point to a cause whose origin cannot be identified without access to commercial knowledge, a chronological summary of which is available from this link,

← left

Questions abound,

Why did UK Labour Productivity (output per hour) - which had grown steadily at 2.3% per year to 2007 - suddenly stagnate? Why does the **gap** between what ought to be achieved and what has been achieved continue to rise? It was up from 17% in 2015 to 24% last year.

SPERI Paper No. 28 [1]



Why is it,

'conceivable that by 2030 economists will have devised a new means of measuring an economy's productivity directly, rather than through its proxy, output per hour'? [2]

Why wait until 2030? Isn't it obvious that what is done in those hours is more important than the hours themselves? Hours spent developing ideas that create innovations are primarily responsible for GDP (proven in[8]) and those hours are accurately accounted for as current expense.

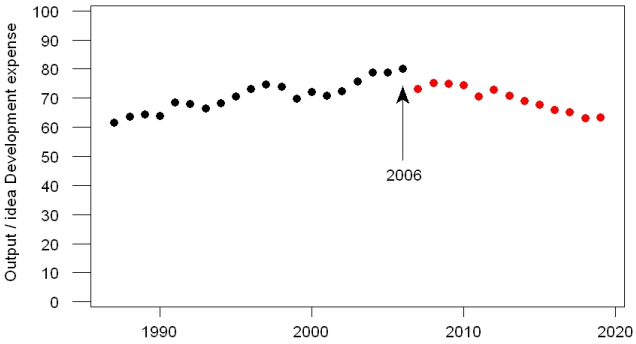
Idea development expense - iDe - is therefore substituted for hours in the following exhibits.

The results have profound consequences. The situation is more serious than hours reveal. Some UK innovation productivity has been in decline since 2000.

Further details on this shocking result are unfolded in nine Exhibits.

Exhibit 1

When the productivity input is switched from hours to innovation the economy's growth behaviour is quite different. It includes decline. Whereas the hourly productivity grows and then essentially stagnates, innovation productivity for the whole economy rises to 2006 and then falls. Now the slowdown has become a reversal that should cause alarm.



Divide the economy by sector for more insight. These divisions are Manufacturing and Non-Manufacturing where Manufacturing can be sub-divided into non-durable manufactured goods and durable manufactured goods. Non-durable goods are considered next,

Exhibit 2

Innovation productivity in non-durable goods[3] has its own unique pattern. It would be hard to discern an overall trend upward or downward. There are no red dots.

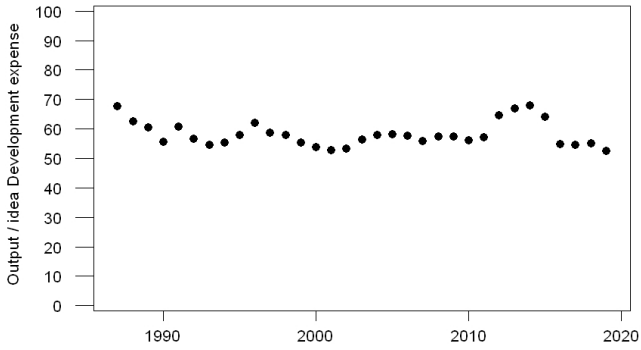


Exhibit 3

Another unique pattern for innovation productivity emerges for durable goods[4] Their decline begins after 2010 as shown by the red dots.

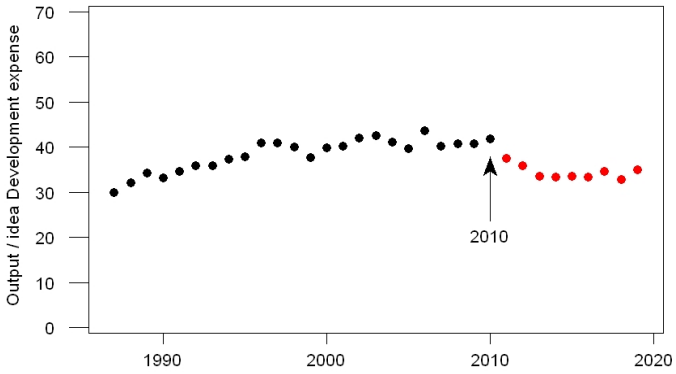
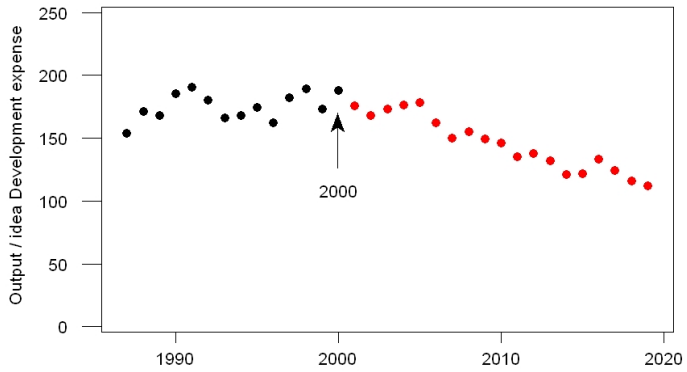


Exhibit 4

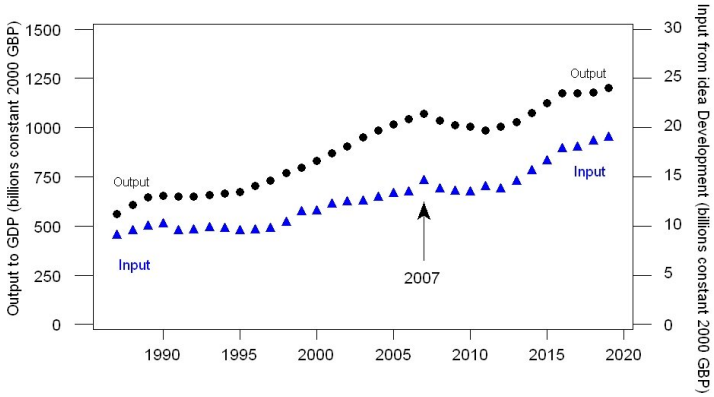
For non-manufacturing[5] a decline begins even earlier. The red dots start in 2001.



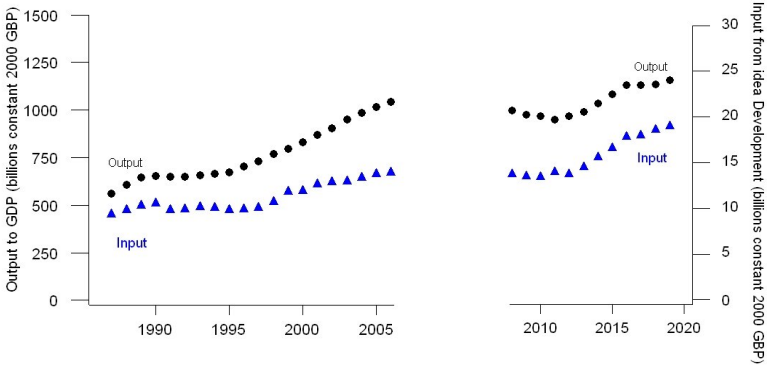
These exhibits show that trends in innovation productivity are sector dependent[6]. Their effect on the economy as a whole is an accretion of these trends. For this reason no specific importance should be attached to an event in a particular year. This unique insight derives directly from redefining productivity. As a consequence of missing pieces[8] too much current economic attention has been drawn to the financial crisis.

Exhibit 5

Exhibit 5 separates the output and input values that are divided to find innovation productivity for the whole economy in Exhibit 1. Output to GDP (black solid circles) is enumerated from the left axis. Corresponding input from iDe (blue solid triangles) is enumerated from the right axis.



Portion this plot to discover that

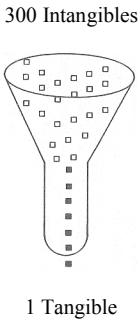


in the left portion the output is growing **faster** than the input while in the right portion the output is growing **slower** than input. This dichotomy leads to a diagnosis. The cause of the UK's Productivity Crisis lies in the process that connects the blue solid triangles to the black solid circles. That process is the Innovation Funnel's process.

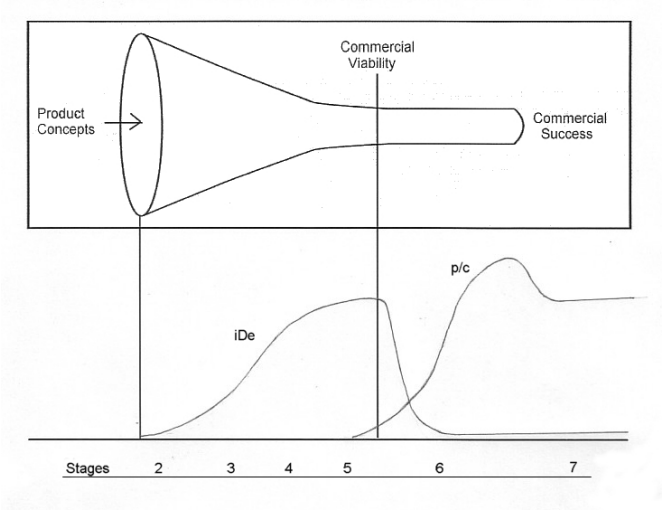
And is the province of the Innovation Profession - Exhibit 6.

Exhibit 6

The original Innovation Funnel from the 1980s pictures many ideas (open squares, right) that are somehow sorted out into a single successful one (black square, right). This version is too simple for the current purpose.



In the economic version iDe has stages that produce a product or service with innovation metric (p/c) whose numerator drives GDP[7]. Its successful execution from concepts (very cheap) to commercial success (extremely expensive) requires dedicated teams with very special professional skills. Exhibits 7 and 8 indicate that the UK is not at the leading edge of honing these special skills.



Action Requires a Stronger Innovation Profession

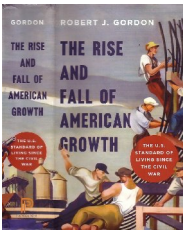
The UK is rightly proud of its Science. It also realizes that the advantages its scientific advances offer has too often been exploited elsewhere. This tension is only resolved when there is a strong innovation profession at work. Otherwise the only impact of the science sector on UK GDP will be publication and education.

The foregoing demonstrates that the UK Productivity crisis arises from **within innovation itself**. It could be getting harder to execute or have a lowered success rate or the UK innovation profession is internationally weaker than is realized (compare Exhibit 8 to Exhibit 7). These possibilities merit immediate urgent investigation and assistive action.

Exhibit 7 - Innovation Professional Support in the USA

Exhibit 8 – Innovation Professional Support in the UK

Exhibit 9 – The Rise and Fall of Economic Growth (two views)



The Rise and Fall of American Growth (Gordon 2016) can also be explained from 1951 to 2001 by the innovation metric (p/c) driven by iDe (Farrell 2018) (Endnotes[8], figure 43) where a transit gap separates basic research, R, from iDe. Crossing this R-iDe gap is an historical ? for the UK since Harold Wilson's 'White Heat' of the 1960s. There is also a current ? on the other side of the gap over UK execution of its innovation funnels. Funnel success requires the prospect of a superior p in conjunction with the lowest eventual c in markets. Output from funnels to GDP requires R-iDe followed by iDe→ p/c (not just R&D).

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Chris Farrell Ph.D. is a practitioner and innovation professional with twenty-five years private sector experience developing and managing the creation of new products and their manufacturing technologies.

Products from his many patents have been commercialized and won awards. His contribution to polymer chain dynamics had earlier vitalized an important stream of academic research.

A technology forecast he made for American Can's corporate technology strategy ignited his interest in the economics of innovation. It was spurred by the discovery of a mutual interest with Robert J. Gordon at Northwestern University in using Sears Catalog data

In 2007 the US Department of Commerce launched their effort to 'Track the State of Innovation in the American Economy' but were foiled by not identifying the missing pieces required to do so.

These were in gestation at the time and were not ready until 2014 for the volume 'Innovation in Economics: Missing Pieces'. This is an instruction manual on how to think about Economics if you do not have access to innovation professional experience. It rests on a five-decade foundation in commercial data interpreted through those experiences. Its applied physics has unearthed four previously unknown laws of economic growth.

Chris Farrell received his B.A. in Natural Sciences from Cambridge University (Christ's College) and his Ph.D. in Physics under Professor Andrew Keller FRS. He served on the Board of Directors of the Product Development and Management Association and on the Industry Relations Advisory Board of Northwestern University.

March 2024

Endnotes

[1.] This paper by Richard A.L. Jones from the Sheffield Political Economy Research Institute is an excellent exposition on the topic from 2016.

[2.] This penetrating and Delphic comment from the Federal Reserve Board's former Chairman Alan Greenspan comes from his 2007 book 'The Age of Turbulence', page 473.

[3.] iDe data for non-durable goods comes from the Office for National Statistics. Its nearest equivalent is BERD (Business Enterprise Research and Development). The non-durable sector's BERD was summed from nine series DLBY, DLCT, DLCR, DLCQ, DLCP, DLCE, DLCD, DLCC and E4BM. Its output to GDP uses the Second Element methodology from Appendix A of 'Innovation in Economics Missing Pieces' page 72 and is a sum of UTII and LLJL. Necessary intermediates are estimated by applying ratios from the 'Combined Use Matrix' for 'Intermediate Demand' in 1997.

[4.] The BERD for Durable Goods is summed from fifteen series DLCS, DLCO, DLCN, DLCM, DLCL, DLCK, DLCJ, DLCI, DLCH, DLCG, DLCF, DLCB, DLCA, LADM and DLCU. Its output to GDP is a sum of UTIA, LLJM, LLJN, LLJO, DLWZ, DLXI plus necessary intermediates.

[5.] The BERD for Non-manufacturing (services and construction) is summed from nine series DLCY, LAEB, DLCZ, DLDE, DLDD, DLDC, DLDB, DLDA and DLCX. Its output to GDP is the value added within a sum of UTIM, NQEP, ABNV, NNAQ, DFDK and DLWS.

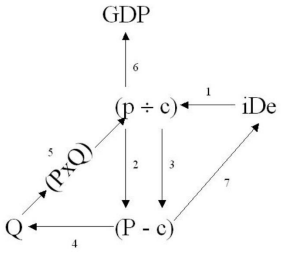
[3, 4, 5.] From comparison with HMRC tax credit statistics the Office for National Statistics has discovered an under-reporting in their BERD data; 3, 4 and 5 have inherited that limitation.

[6.] Non-manufacturing has the largest productivity and Durable Goods has the smallest. This reflects their relative ease of development.

[7.] The full economic analysis of the Innovation Funnel (absent from Economics) occupies pages 41 to 44 of 'Innovation in Economics Missing Pieces'. It also constitutes link 1 of the 'Innovation Parallelogram' reproduced from page 66 opposite[8.] Because data on c (the unit cost of delivery to a market) is not collected in the UK it is challenging to measure UK innovation performance rigorously. What is presented in this booklet is the best that can be done with available data.

8. Innovation in Economics

Missing Pieces



The Algebraic Mechanism of Economic Growth

Chris Farrell Ph.D.

Exhibit 10 'Innovation in Economics Missing Pieces' brings Applied Physics and Economics together,

Academic Economics is still exploring, Charlie Bean, LSE	Applied Physics is already there, Chris Farrell, Techmatt
You derive your basic equation, which the remainder of the book then builds on, by first assuming that (real or relative) price is proportional to 'performance'. You never really define precisely what you mean by performance, though the preceding examples suggest that you have in mind some appropriate physical attributes of the product and not anything that is related to the utility that buyers derive from it. I can certainly agree that you would expect a better-performing product to be able to be sold for a higher price, but I can see no reason to assume that it takes such a simple linear form.	'Performance' is perceived in the psyche of its purchaser. It sits closer to 'quality' in economic parlance than it does to 'utility'. Neither fits innovation.
By the same token there is no convincing reason to assume that, for given product characteristics, price is proportional to the reciprocal of the quantity sold, which is your second building block. (On terminology, you call ΣQ 'competitive pressure', though to me it's just quantity sold or market size.) Economists normally assume that demand is a decreasing function of price, but certainly not that the price elasticity of demand is (minus) unity as you do. The shape of the demand curve, and the sensitivity of demand to price, will vary across products according to tastes, whether or not there are good substitutes, etc. And there are plenty of empirical studies of the demand for different products throwing up an array of price elasticities.	Perceived performance of a product or service captures **attitude** to their attributes. This is uniquely enumerated from fundamental insights that are **missing** from Economics. There is a long practitioner history starting from G.F.Gause's experiments on microorganisms competing in test tubes, page 10, interpreted in economic terms by analogy with the Lotka-Volterra treatment, including the Gas Laws. Since there is rightly no firm equivalent in test tubes, output pressure correctly roles the firm effect. The equation p=P.ΣQ, where P is real price and ΣQ is indeed the 'quantity sold', controls this. Its simplicity is supported by a philosophical rule used by physicists to get to the core variables. Occam's Razor cuts away all peripherals to leave p=P.ΣQ, an equation then verified beyond reasonable doubt from unique situations. These are where p, P and ΣQ are independently known, for tire-cords, cement and nails.
Finally, your key equation, p=P.ΣQ, fails to recognise that there are a host of factors other than the characteristics of the product and its price that affect the quantity demanded – in particular, the general level of aggregate demand in the economy. This is affected by technological developments in other industries but also by factors such as the size of the labour force, the willingness of households and businesses to spend and invest, fiscal and monetary policies, etc, etc. If you want to interpret p as capturing just product innovation (and ignoring my criticisms in the preceding two paragraphs), it means that the parameter A that you introduce in the middle of p12 is not constant but rather embodies all these other influences on the quantity produced and sold and will therefore vary over time.	I do **not** assume the price elasticity is minus one; it turns out to be minus one when performance is fixed. The 'shapes' within the 'array' you are talking about will be determined by unique passages through a nest of such fundamental curves each of which represents a fixed, but different, p, page 13.
Consequently, I do not find the idea that the quantity PΣQ is a suitable measure of performance (at least as you appear to want to use the term) at all persuasive. PΣQ is just a measure of real revenues, so reflects innovation but lots of other things too. You can see that from many of your plots of various performance measures over time – most have dips when there are cyclical downturns (e.g. around 1975 following the first oil price shock, around 1980 following the second oil price shock and the Volker disinflation, and after 1990 following the oil price shock associated with the Gulf War).	The beauty of the p=P.ΣQ treatment is that the extra factors that affect aggregate demand 'other industry technology, labour force size, willingness to spend and invest, fiscal and monetary policies etc. etc.' will clearly cause the ps or the Ps or the ΣQs to vary singly or in combination, while A remains constant. By this Occam simplification the p=P.ΣQ law becomes the crucial foundation from which to build the economy from innovation to GDP.
Since p is just real revenues, it is hardly surprising, therefore, that you come up with the equation at the bottom of p39 that makes GDP = $\Sigma_i p_{(i)}$. This is just the standard GDP(I) accounting identity. [GDP can be measured in three ways: by summing output (value added) across industries; by summing expenditure across expenditure categories; and by summing incomes across income categories (profits and wages). All three approaches in theory give the same answer, though in practice they usually don't coincide because of measurement errors. As revenues go to either the workers in wages or the shareholders as profits, your equation corresponds to the income approach.] But this has *nothing whatsoever* to do with the role of innovation as a causal factor driving GDP. It is simply accounting.	When p is enumerated using p=P.ΣQ many markets experience dips and rises in p. Fortunately one of those markets is for televisions. In that market there appear two massive historical peaks that are impossible to explain without performance being what it is perceived to be in the psyche of the purchaser. At the introduction of B&W televisions a 'wow' factor suddenly raised p. This peak was repeated when color television was introduced. Such fluctuations in p are easily interpreted. What is more important is the **trend** in p. Matching congruent but time-shifted trends is how innovation is identified as causal.
	No it is not at all surprising that GDP = $\Sigma_i p$. Although the strict algebra is more complicated it reduces to that in the absence of foreign trade, page 39.
	[Only one of the three sides of GDP is helpful when determining GDP causality from innovation. And it is **NOT** the income approach. It is the 'summing (of) expenditure across expenditure categories'. But to properly determine innovation even this 'summing (of) expenditure across expenditure categories' needs to be consolidated into markets from its commodity categorization. That's because competition occurs between many commodities serving just one market. An overlay on this side of National Accounting is therefore required with further division into durable, non-durable and service sector markets.]
The discussion in Step 7 is more germane as you try to link data on R&D to your Σ(p/c) series. As you note on p58, the dips in the p/c series coincide with recessions. It is perfectly reasonable to look at the timing relative to the dips in the R&D series (this is a standard technique known as 'Granger-causality', though you can apply it more rigorously using statistical methods). And there is a branch of the macroeconomics literature (known as 'real business cycle theory') that locates the driver of business fluctuations in shifts in technology. However, while such technology shocks do occur, do you *really* believe that the US recessions in the mid-70s, early 80s and early 90s were the result of slowdowns in R&D expenditure a year or two earlier, as opposed to the impact of the oil price shocks? If so, I think few readers would agree with you.	In Step 7 and on page 58 the US recessions in the mid-70s, early 80s and early 90s are definitely **not** the result of slowdowns in R&D expenditure. R&D is a future-directed activity that glides through recessions and its series shows no resulting fluctuations. Large variances in Σ(p/c) are a different matter. Downturns will negatively influence purchaser decision to buy and p will be suppressed by this perception, an impact that is seen even for pens, pages 25-26, let alone for oil-shocks. When such short-term consumer anxiety is ironed out the relative stability seen in iDe (which is business funded R&D with basic research R taken out) clearly precedes the stabilized innovation magnitude Σ(p/c). No special methodology is needed to discover this. Even the latency period δ is obvious to the naked eye.
Finally, you should be aware that there has been a lot of theoretical and empirical work produced during the past 25 years that {explores} the role of innovation and of creative destruction in the growth process. In particular, there are numerous studies that {explore} the role of R&D as well as human and other intangible capital in driving the unexplained total (or multi-) factor productivity residual that comes from basic growth-accounting exercises. The recent book by Phillippe Aghion, Celine Antonin and Simon Bunel entitled *The Power of Creative Destruction - Economic Upheaval and the Wealth of Nations* is quite a good place to start.	That latency is several years for durable goods but just about one for non-durables. It is convincing that details differ by sector, including the rising shapes they display. The result is a consistent story over decades of data in Figures 43 and 47. This is not just 'germane' but the absolute crux of the matter. GDP ascends numerically from the innovation metric's numerator, p.
brackets around {explores & explore} establish its 'still exploring' status	I prefer '*The Rise and Fall of the American Economy*' by Robert J. Gordon, not just because he introduced me personally to price economics, but also because he is realistic that total factor productivity *'is the best proxy available for the underlying effect of technology and innovation on economic growth*'. But as this column asserts, and my whole volume affirms, proxies are now eclipsed by proof from the direct and rigorous economic measurement of innovation. Now the underlying effect is, what gets measured gets done, when innovation gets measured innovation gets done and GDP rises. Grasp that and solutions unfold.

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