Google

# Books

## Innovation in Economics: Missing Pieces

Chris Farrell

Technology Matters, 2018 - 100 pages

★★★★★

1 Review

Detailed and fully referenced Research Monograph uses otherwise unknown commercial knowledge to answer 25 leading US Department of Commerce questions needed for 'Innovation Measurement in the 21st Century Economy'. The resulting graphic - on the front cover - reveals how six variables, including innovation, work with each other to produce economic growth. Each side of the parallelogram signifies such simple algebra that its truth is beyond reasonable doubt. Neither capital nor labor predominate, nor does any combination thereof. Economics has known that for a long time. It's called its 'measure of ignorance'. But Economics still offers no alternative. That alternative is available from this book. A step-by-step guide leads the reader through a potent synthesis of data and argument. Missing pieces fall into place. The puzzle of economic growth is solved. A ring-binder web edition is available to download from www.techmatt.com

« Less

## What people are saying - Write a review

User Review - Flag as inappropriate

Chris Farrell has produced a book that uses the most original and unusual constructs. These constructs are based on data widely available in everyday life but heretofore not collected academically in a coherent way. His approach involves tools applicable to increasing levels of aggregation. Six levels are frequently used: (1) Device. (2) Establishment. (3) Firm. (4) Industry. (5) Sector. (6) National economy. Chris uses S-curves to track technological change at the device level then proceeds with aggregation through the various phases until the connections to GDP are deciphered. The text is unusual in that the author does not limit himself to traditional economic nomenclature. Consequently it provides insight where none existed before. And this goes a long way to advance our knowledge of the interplay among economics and technology.

---

Review by Prof. Rias van Wyk, Extraordinary Professor, Stellenbosch University, and Director of Technoscan Centre, Minnesota

## About the author (2018)

Chris Farrell is a seasoned Innovation Professional with 25 years experience in Corporate Technical settings. His patents have been commercialized and won awards. His fascination with how innovation actually works in commerce, which is not what can be viewed from a campus - has led to this monograph. He served on the Board of Directors for the Product Development and Management Association and the Industry Relations Advisory Board of Northwestern University. He holds a BA in Natural Sciences from Cambridge University (Christ's College) and a Ph.D. in Physics.

## Bibliographic information


| | |
|---|---|
| Title | Innovation in Economics: Missing Pieces |
| Author | Chris Farrell |
| Edition | illustrated |
| Publisher | Technology Matters, 2018 |
| ISBN | 0578453630, 9780578453637 |
| Length | 100 pages |


Export Citation BiBTeX EndNote RefMan

**Q&A** generated during a consideration of 'Innovation in Economics Missing Pieces', by

| **Q**. Academician, Jonathan Haskel of Imperial College, London | **A**. Innovation Professional, Chris Farrell of Technology Matters, Chicago |
|---|---|
| I just want to be clear, as an economist, on your approach. Some comments and questions, if I may? | The approach I'm advocating is one that applies physics to the longstanding task of discovering exactly how innovation governs economic growth. This essentially numeric journey turns out to have surprising consequences for economists. Thinking about price as an equilibrium balance between supply and demand is one of them. It isn't useful to think this way when 'quality' is rapidly and continuously being changed by technology advancements (page 13 and 98). Because pPQ actually contains 'quality' it is uniquely useful for achieving what has previously been impossible. |
| Your performance measure can be read off from prices and the sum of quantities. According to this definition the performance of every economy, as long as it is growing, must be rising because it is simply getting bigger at given prices. | The pPQ equation $p=P.\Sigma Q$, where $\Sigma Q$ is a sum of quantities (the competitive pressure in a single market) provides the following answer when all markets are summed. As a population increases, or gets more acquisitive, $\Sigma\Sigma Q$ will naturally increase. But the market prices P are real prices that will be decreased due to inflation since an earlier base year. The balance between these two factors – one up one down - will determine whether or not the performance of the economy, as a whole, is presently rising. |
| Competitive Pressure is clearly a difficult issue for economists. China produces a vast amount of steel and Brazil relatively very little. Can I call upon a difference in competitive pressure between these countries? And how does competitive pressure work when a monopolist is operating? | Competitive Pressure is a new concept that comes from interpreting G.F.Gause's experiments on microorganisms competing in test tubes (page 10). Their behavior constitutes an economic analogy. Since there is no 'firm' equivalent in test tubes, and because the Gas Laws are deemed to apply there, 'pressure' becomes the 'firms' effect (page 11[11,12]).<br><br>Such analysis is particularly interesting in the case of a monopoly. In Economics a single firm implies no competition. In reality, and from test tubes, there is still a competitive pressure, which the single firm controls. For example, when a monopolist faces a threat it can flood the market. This increases $\Sigma Q$. If the performance of the incumbent monopolist product is well established the pPQ equation shows the price will fall. If that price goes below the unit cost of the threat, the threat will go out of business. It is important to recognize that in this case, and in **no** case, is price simply cost plus a margin. If it were then no firm would go out of business, and creative destruction would not occur. Price is determined by pPQ while unit cost is independently determined, by each firm, from its COS per unit of quantity produced. That includes materials, energy and wages, but excludes depreciation where that is allowed.<br><br>On the international front, Competitive Pressure excludes exports and includes imports. That nuances a comparison between China and Brazil, as does the currency driving the production. Exchange rates affect the viability of international trade in steel; the pPQ equation adjusts to this for a particular country's situation. |
| Why is water so cheap while diamonds are so expensive?<br>(1st challenge) | Diamond is a 'precious' stone. The word 'precious' is important because it indicates a valuation beyond attributes. The pPQ equation expresses in p whatever a purchaser hopes for in a product at the moment of purchase. In other words it captures **attitudes** to attributes. There is ample evidence for this from televisions (page 23 item 7.) and from pens (page 25 item 9.). You can see the elevated hopes of the purchasers of diamonds in diamond advertising. That is why they are so expensive.<br><br>Drinking water is cheap because the purchaser takes its availability for granted. Competitive Pressure is the total drinking water consumed. Among that total may be purer water that some consumers prefer, bottled water to drink while away from tap sources and water out of the tap. Each has a performance determined by applying the pPQ equation. Inventory from reservoirs or warehouses will keep the supply going in a drought. In severe weather the immediate inventory of bottled water may be exhausted and that opens the possibility of bottled water price increase. Whether the perceived performance of water is affected can be discovered by applying $p=P.\Sigma Q$, where P and $\Sigma Q$ are opposed in trend but operate in tandem.<br><br>Each of a diamond or a glass of water has its own performance determined in its own market. Industrial diamond has its own market too. |
| Red umbrellas versus green umbrellas?<br>(2nd challenge) | Umbrellas shield a person from rain and have certain attributes that achieve this. Purchaser attitude to these attributes is a different matter. It is very likely that colour will affect the perceived performance of an umbrella and its price will follow according to $p=P.\Sigma Q$. If it stimulates the need for multiple umbrellas that will indicate that p has risen again, through increasing $\Sigma Q$. |
| Can a faster computer command a higher price?<br>(3rd challenge) | Let's just say that when Robert Solow stated '*You can see the computer age everywhere but in the productivity statistics*' he was looking in the wrong place for it (page 79). |
| What makes products more innovative?<br>(final clarification) | Innovation is measured by (p/c), which is the output from the innovation funnel from iDe as its input (page 41). Innovative products leave the funnel and diffuse through the economy raising GDP. The depth of that diffusion and its adoption at depth determines the true innovativeness of the product. Measuring innovation with $\Sigma(p/c)$ using $p=P.\Sigma Q$ provides the key to economic success. |

For academic knowledge Peer Review decides. For Commercial Knowledge the market decides. The market here is for economic advancement from innovation.

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

## Academic Economics is still exploring, Charlie Bean, LSE

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.

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.

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.

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).

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 $GDP = \Sigma_i p_U^i$ . 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.

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.

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.

| brackets around {explores & explore} establish its 'still exploring' status |

## Applied Physics is already there, Chris Farrell, Techmatt

'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.

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.

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.

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.

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.]

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.

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.

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.