

Definition of scientific economics and the reality of the neo-classical economics framework within production competitive markets

Robert W Vivian
Professor of Finance & Insurance
School of Economic & Business Sciences
University of the Witwatersrand

September, 04 2019¹
(Last revised 6th September)

Contents

1	Introduction	3
2	Definition: Scientific economics.....	3
3	Conceptual foundation of the definition	4
4	Neo classic economics as the product of observation, explanation when applied to production competitive markets and the generalisation thereof.....	7
5	Examining the neo-classical “assumptions”.....	8
5.1	Individuals maximise their utility and firms maximise profits	8
5.1.1	Individual’s enter into contracts because the utility of the contract exceeds the utility of retaining the price	8
5.1.2	Firms enter into contracts for the profit to be gained from the contract	10
5.1.3	Exchange in production competitive markets: Individual’s utility of very limited significance.....	11
5.2	People [consumers] have rational preferences among outcomes.....	13
5.3	People act independently on the basis of full and relevant information.	14
5.4	Examples	14
5.4.1	Purchase of insurance	14
5.4.2	Pooling high and low risks.....	16

¹ Paper presented at the Biennial Conference of the Economic Society of South Africa, Birchwood Estate, Gauteng, September 4, 2019

6	Conclusion.....	17
---	-----------------	----

Abstract

The hallmark of scientific research has always been that explanations are drawn from and explain observations. The explanations may be in some cases be stated as general principles. Scientific economics is thus economics which is based on and explains observations. In recent years the Neo-Classical Economics framework has come increasingly under attack. This paper demonstrates that if approached from the perspective of scientific economics the attack will fail. Seen as scientific economics the neo-classical framework is merely the explanation of observed reality; it represents the observable truth. The truth is what it is. Attacking the neo-classical framework is thus an act of futility. What is open to improvement is the generalized statement of the explanation of the observed reality.

1 Introduction

Economics is a very broad discipline, accordingly it is unlikely a single definition can capture the entire essence of the discipline. A distinctive characteristic of science, however, going back to the clash between Galileo and those who subscribed to the then generally accepted view, is that science explains observable phenomena. In the case of Galileo, The accepted view of the day was that the earth was at the centre of the solar system but Copernicus concluded from observation that the sun, not earth, was the centre solar system. Copernicus died before he could become engulfed in the ensuing bitter clash brought about by his conclusions drawn from observations. Galileo tried, unsuccessfully, to avoid the clash by stating, simply, he was not party to any clash but was merely conveying the conclusion which is drawn from his (and others) observations. This led to an obvious reality, persons could hold a wide variety of views but less controversial or even non-controversial would be views which were based on conclusions simply drawn from observation. From a methodological perspective drawing conclusions from observations and stating these as general rules is known as the scientific method (Principle 2011). Of course, the Scientific Method is concerned primarily with observing natural phenomena when applied to social sciences matters are recognized to be more complicated.²

2 Definition: Scientific economics

Scientific economics can be defined as the discipline which explains economic phenomena. Clearly this does not exclude other broader definitions of economics. Not all of economics concerns explaining observable phenomena. Other definitions have been suggested. Alfred Marshall opined “Political Economy or Economics is a study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of well-being (Marshall 1920, 1).” Probably more enduringly, Lionel Robbins suggested “Economics is the science which studies human behaviour as a relationship between ends

² This complication is well-known and has been debated in great detail (Von Mises 1933; Robbins 1932).

and scarce resources which have alternative uses' (Robbins 1932). Thus the idea that economics is the study of optimum resource allocation gained considerable credence.

The above definition defines the *science* of economics which leaves space for economics to have different meanings in broader contexts; so for example some may argue economics can be broader than being scientific economics and can encompass concepts such as economy policy not necessary derived from scientific principles. Economics can thus include general political economy, falling outside the narrow confines of the science of economics.

The above definition is, as one would expect, virtually self-evident in the same way one can define medical science as the discipline which explains medical phenomena; aeronautical science is the science which explains aeronautical phenomena and so forth.³

3 Conceptual foundation of the definition

As indicated in the introduction the above definition rests on a firm foundation. Man is *par excellence* a rational being, looking for and finding rational explanations over a wide spectrum. For a long time it was thought that truth can be arrived at via mere rational thought. Through this process it was *believed* the sun rotated round the earth. Through careful observation Copernicus concluded this belief was incorrect and in fact it was the earth which rotated round the sun, and its own axis (Gingerich 2016). The error that truth could be found from mere rational thought was rejected in favour of what is known as the scientific method was stated famously by Sir Francis Bacon:

“Man ... understands as much as his observations permit him and neither knows nor is capable of more.” (Bacon 1620, 11).

Bacon specifically rejected the notion that truth could be derived from mere rational thought. Mere logic by itself not validated by observation are merely phantoms of the mind (Engles 1883). These phantoms can lead to logical conclusions which are in reality practical nonsense. This can be demonstrated using Zeno's paradoxes (Salmon 1970; Fearn 2001). One such paradox would argue rationally it is impossible for anyone to leave any room. A finite distance

³ Some may argue the definition is so self-evident that it is not very meaningful. Other suggestions include, 'the era of modelling' (Colander 2000). This I suggest conveys less meaning. Scientific economics means the rules which are set out are based on observation.

must exist between the person who wishes to leave a room and the exit. This finite distance can be divided into an infinite number of halves. The person leaving the room would first have to go halfway to the exit and then to the next half and so on. Since an infinite number of halves exist the person can rationally never leave the room. Of course all persons who are in rooms are observed to leave those rooms. So whatever problems rational thought may conjure up the observed truth is that people factually leave rooms. To observe reality does not always require a formal experiment be set up and the outcomes documented, data collected, validated and analysed. It is common knowledge that persons who are in rooms are able to walk out of those rooms. From observation then the Zeno type paradox can be resolved; people do exist rooms. Assume Mr X is in a room at a distance D_0 from the exit. After the first half he will be $D_0/2^1$ from his original position, $D_0/2^2$ after the second half and $D_0/2^n$ after the n^{th} half. Thus his distance from his original position after n halves will be:

$$D_n = D_0 \sum_1^n \frac{1}{2^n}$$

After an infinite number of halves Mr X will be observed to reach the exit, a distance D_0 from his original position or:

$$D_0 \times 1 = D_0 \sum_1^\infty \frac{1}{2^n}$$

From which:

$$\sum_1^\infty \frac{1}{2^n} = 1$$

Thus simply from observation, and knowing nothing about the mathematical theory of infinite series, the above infinite series can be shown to be a converging series, converging on an outcome of 1. There are other ways to solve the same infinite series.

Truth is what is observed, reflecting common experience, and explanations of what is

observed can be set-out. These explanations may then further be stated as a generalised rules. This is the fundamental methodological process followed, known as the scientific method. The above solution to the Zeno paradox can lead to the general statement, “Mere rational thought can lead to absurd conclusions.”

The scientific method can be (and historically was) applied to economics, that is to explain economic phenomena. That economics explains the observable world has often been stated.

“The laws of economics are framed to explain facts. The conception of utility has its origin in the facts of human preference or decision as observed in producing consuming and exchanging goods and services. To fix the idea of utility the economist should go no farther than is serviceable in explaining economic fact (Fisher 1926, 11) “

Again elsewhere, “our object (as economists) is to understand and explain things as they are rather than to comprehend what ought to be” (Littlechild 1990, 161; Von Mises 1933, 212). Bacon’s view ushered in centuries of debate on this scientific method and knowledge formation and acquisition, which continues to this day.

A notion that economics explains economic phenomena, leads naturally to the question what is a phenomenon? and more specifically what is an economic phenomenon? A phenomenon is something which can be observed as such calls for an explanation. Phenomena are of interest to economists when observations are about an economic activity. A single observation may not lead to a general conclusion but through the process of induction may allow a conclusion to be stated as a general conclusion, or rule or in Fisher’s terminology “laws of economics”. The rule itself is subject to validation flowing from further observations. The general statement or conclusion can then be tested by experimentation or observation. Exchange in an economy is a phenomenon.

It is also possible to note something cannot be unobserved, because it does not exist and advocate an hypothesis to explain its absence. An explanation is advance for the absence of what is expected is not observed since it is not there. In economics an example of this is the problem of incomplete markets which Arrow tried to explain (Arrow 1963). Another example is the perceived problem that prices do not incorporate all the costs which some may believe should be captured by the price. This led to the problem of social costs (Coase 1960) and the economic theory of externalities (Pigou 1932; Greenwald and Stiglitz 1986). This problem is

more problematic than explaining what can be observed.

Some have advocated explanations, hypotheses, and then set about designing empirical experiments to validate that hypothesis from observations. This is fairly common-place in science but more problematic in economics. In science this happened for example with Einstein's theory that light, travelling at the speed of light, has mass which was validated when it was shown that light, having mass, because of gravity, bends when passing planets (Bodanis 2016).

Stating a general hypothesis and attempting to validate these from observation is well-known in economics but has usually proven to be problematic. Examples include concepts such the existence of a Giffen good,⁴ or "perfect competition" which cannot be observed (Hayek 1948), or "axioms of decision making" (Von Neumann and Morgenstern 1944) and also Fama's "efficient market hypothesis" (Fama 1970; Vivian and Auret 2018).

Through the process of applying the scientific method a body of economic knowledge can be accumulated.

4 Neo classic economics as the product of observation, explanation when applied to production competitive markets and the generalisation thereof

Neo-classical economics, in recent times, has been subject to much criticism⁵ and proposals are underway to augment undergraduate teaching of economics in terms of a wider framework, the New Economics paradigm. It is usually stated that neo-classical economics is based on certain assumptions. If this is the case then of course the assumptions can be attacked, challenging the rules of Neo-Classical Economics. It is much closer to the truth to understand that the so-called neo-classical assumptions are more accurately understood to be explanations of observations. If this is

⁴ Name after the Scottish economist Sir Robert Giffen as attributed by Marshall.

⁵ The term "neo-classical economics" itself does not have a clearly defined meaning, but this is not the exception to the rule since virtually all the commonly found terms in economics lack clear meanings when examined in detail. The argument is not with the content of "neo-classical economics" but the label "neo-classical economics" (Colander 2000).

understood then there are no assumptions to attack. It is generally accepted that neo-classical economics are based on three “assumptions” (Weintraub 2002):

- 1 Individuals maximise their utility and firms maximise profits
- 2 People have rational preferences among outcomes
- 3 People act independently on the basis of full and relevant information.

These are now examined.

5 Examining the neo-classical “assumptions”

5.1 Individuals maximise their utility and firms maximise profits

Let us start with the second “assumption” first; individuals maximise their utility and then that firms maximise profits. This involves two observations, individuals maximise their utility and then firms maximise profits.

5.1.1 Individual’s enter into contracts because the utility of the contract exceeds the utility of retaining the price

The vast bulk of economic activity takes place via the process of exchange and the most common basis of exchange is a contract. Consumers can be observed entering into exchange contracts. They exchange money for goods and services. This is a common-economic phenomenon as common an experience in as walking out of a room. That is the observation.

What then is the economic explanation for entering into contract of exchange? When an individual enters into a contract, it is to derive some benefit. The only rational explanation for entering into the contract is that the utility of acquiring the contract benefit exceeds the utility of retaining the price. The utility of acquiring the contract benefit to the purchaser exceeds the utility of retaining the price. Or as Fisher stated in his analysis of utility; “Each individual acts as he desires” (Fisher 1926,

11);⁶ It is the utility the individual derives which causes him to exchange money to acquire the contract benefit. In this case the price is the individual would be willing to pay.

$$U(\text{Acquisition of the contract benefit}) > U(P_{WtP})$$

The utility the individual enjoys from the acquisition of the contract benefit is Adam Smith's Value in Use and the monetary of Value in Use is the P_{WtP} .

, almost always the price of the contract will exceed the direct cost of producing that the desired benefit. This must be so because there are considerable indirect costs such as administrative costs, including profits. Based on a cost to benefit analysis most contracts would not exist; but contracts do factually exist; they can be observed. This price is determined by the consumer's and not cost to benefit considerations.

A generalised statement can thus be made that individuals enter into contracts it is because the utility of acquiring the contract benefit. The individual will do so when this utility exceeds the utility of retaining the price.

Two comments can be made about this generalised statement. Firstly once it is accepted, it opens the door to complex and convoluted arguments as to the meaning of utility; which raged before Fisher and continued ever since to this day. Fisher correctly disposed with these concerns with, "To fix the idea of utility the economist should go no farther than is serviceable in explaining *economic* [observable] facts. It is not his [ie the economist] province to build a theory of psychology." In the above context utility explains why individuals enter into contracts of exchange. It is not needed for any other purpose. The second is consumers enter into more than one contract of the period of time which brings a time period into consideration. The consumer can choose several contracts out of a

⁶ Cited by (Rothbard 1956; Cook 2016)

very wide range of options. From each contract the consumer will derive utility. The ability to enter into these exchange contracts is driven in each instance by the consumer's utility. It is rational therefore to believe the consumer in entering into the bundle of contracts is driven to maximise the satisfaction he or she can get from the limited budget from all of these contracts.

Thus it is rational to believe consumer's enter into contract of exchange to maximise their utility. The "assumption" of neo-classical economists is thus merely a statement of reality. It should be noted to avoid confusion, it is not the utility of the single contract which consumers attempt to maximise but the utility from the bundle of contracts.

5.1.2 Firms enter into contracts for the profit to be gained from the contract

Firms, as suppliers, enter into contracts for a reason different to that of the consumer. Whereas individuals enter into contracts to obtain the utility derived from the benefit of the contract, the firm disposes of the very benefit the individual wishes to obtain. The same utility thus does not explain why suppliers enter into contracts. For example a car manufacturer does not manufacture cars because the firm wants cars but exactly the opposite, manufacturers want to dispose of cars to those who are prepared to pay for those cars. Firms want money not cars. So the firm cannot enter into the contract for the same reason the individual enters into the contract. The firm enters into the contract to earn the profit from the contract. If it costs E to produce the good or service being sold then:

Profit per unit sold = Price of the Unit – E the attributable cost to produce the unit.

Profit = Price – E

The firm can set P and control E to the best of its ability

Price = E + Profit

A generalised statement can thus be made that Firms enter into contracts because they can profit from the contract.

Thus the “assumption” of neo-classical economics that individuals enter into exchanges because of their utility and firms do so to maximise profits is not a mere assumption but a conclusion drawn from observable facts. The above analysis may lead to the conclusion that individual utility is of considerable importance but in a competitive market this turns out not to be the case.

5.1.3 Exchange in production competitive markets: Individual’s utility of very limited significance

The vast bulk of exchange transactions take place in competitive markets. In competitive markets prices are observable and to attract consumers individual suppliers continually adjust their prices with a view to attracting these consumers and thereby making a profit, as indicated above. There are more than one type of market; two can be noted, production markets and investment markets. In the production market:

Profit = Income – Expenditure or

Profit per unit sold = Price per unit – Attributable Expense or

Price = Expenses + Profit

In an investment market:

Profit = $P_{t1} - P_{t2}$ - Expenses

This article concerns production markets.

To obtain the maximum unit profit the supplier and do two things. Firstly they tightly manage the expenses E and secondly set the price. Competition influences both. In competitive markets costs are restrained and the price is set bearing the prices of other suppliers in mind. The net effect is prices reduce to what can be called the market price, the value in exchange, and the profits will not permit monopoly profits, only economic profits, to exist. It can be noted that zero economic profit does not mean zero profit to shareholder since the cost of capital would in any event be an expense. Like all expenses, the cost of capital, would be lowered as a consequence of competition. As pointed out by Adam Smith the value in use would be greater than the Value in Exchange (Stigler 1950b, 1950a). Marshall in the first instance and then Knight in slightly different context on the other side of the Atlantic market prices will decline below the price set by the consumer's utility (Marshall 1920; Knight 1921):

$$P_{WtP} > P_M$$

Value in Use > Value in Exchange

Or

$$P_M < P_{WtP}$$

In a competitive market the price is the market price which is and thus consumer pays an amount less than the amount the consumer would be willing to pay. The difference is Alfred Marshall's consumer's surplus, developed in more detail by others (Hicks 1943).

The "price" the consumer is willing to pay, determined by the consumer's utility is thus largely irrelevant. What is relevant is the price set by the supplier's desire for profit and competition and that is not determined by utility but by the supplier's ability to manage expenses and profits. Since the price actually paid is the price set by suppliers not consumers, consumer actual utility function plays a very minor role in setting prices. This is shown in Figure 1:

Value in use v Value in exchange: competitive market



From Figure 1 it will be seen the market price, the value in exchange is less than the “price” the consumer would be willing to pay. This “price” cannot be observed in a competitive market. What can be observed is the market price, the value in exchange. Since in competitive markets prices are set at their lowest practical level. Competition lowers both the expenses and profits. Consumers can acquire the optimum bundle of goods and services within their budget constraint. Competition allows consumers to maximise their utility. And the aggregate or total utility is maximised with competitive markets. Competitive markets provide consumers with the Pigou’s optimum economic welfare (Pigou 1932).

5.2 People [consumers] have rational preferences among outcomes

The section “assumption” of neo-classical economics can now be discussed.

The observed driving force behind exchanges is in the words of Irving, the desire, or utility, of each individual to acquire the object of the contract. The individual thus over a period of time, subject to his or her budget constraint, will select a bundle of goods and services from the market. Again relying on Irving “[t]he conception of utility has its origin in the facts of human preference or decision as observed in producing, consuming and exchanging goods”. When one observes consumers selecting goods or services it is rational to believe these choices are driven by consumer’s utility and in making these selections the consumer does to maximise the consumer’s utility with these transactions. Consumers will select those transactions which satisfies the consumer’s utility to

the greatest extent. Or as already indicated to give that consumer Pigou's optimum economic welfare.

Thus the second "assumption" is an explanation of consumer's choices, driven by the consumer's preference.

5.3 People act independently on the basis of full and relevant information.

This assumption taken out of context can and does produce confusion. As already seen, it is the desire (utility) which cause individuals to act and in the case under consideration to enter exchange transactions in competitive markets. It would thus be confusing and contradictory to think of consumers acting because of information, especially information on factors which influence prices. As indicated the price is set by the firm, suppliers, the market price. It is also noted that because of competitive markets consumer's actual utility function is of limited importance since utility produces a Willingness to Pay "price" but the actual lower price is the market price. This price is set by suppliers not consumers competing with each other for consumers. A problem of the above neo-Classical economics statement taken out of contexts is that it creates the impression that it is the consumer who collects information and using this information makes the decision the enter into the exchange at a price determined by this information. The truth is the information is almost always collected by suppliers who set the price in competition with other suppliers. It is not the consumer who collects informatin. The market provides the range of goods and services at a price determined by suppliers in a competitive market. The consumer selects the desired good or service from the market at the market the price. The consumer can shop around to get the best price, which ensures the market price is lowered. This can be illustrated from a number of examples.

5.4 Examples

5.4.1 Purchase of insurance

Consumers purchase insurance in order to be indemnified in the case of a loss. Say a person owns a motor vehicle valued at R500 000. The consumer faces the risk that during the period of insurance the motor vehicle could be lost, damaged stolen and so on. The consumer can acquire the benefit of an insurance policy in exchange for the price of the premium.

The market price can be expressed as follows:

$$P_M = \text{Average cost of claims} + (\text{Expenses} + \text{Profit})$$

If expressed as ratios, taking actual market ratios into consideration, it becomes:

$$100\% = 60\% + 40\%$$

For every R100 paid for insurance, R60 is the average cost of claims paid by the insurer and the remainder is expended on expenses and profits. Looking at these ratios many have asked why does the public pay R100 to receive when the average cost of claims is on R60?

Firstly can be observed that consumers do indeed purchase insurance. In South Africa consumers pay in the order of R120 bn/a for insurance. Second consumers do not purchase insurance because of the average cost of claims but for the utility gained from contractual benefit of insurance. In the example to receive R500 000 if their motor vehicle is lost or damaged. The amount consumers would be willing to pay is in excess of the market price. This may be more easily understood by analogy. Assume a person is very thirsty and decides to purchase a cold drink. Assume the price of the cold-drink is R5, the market price. The consumer may seek more information such as the cost of the ingredient, which is mainly water, say R 0.05, the additive say R 0.01, the can say R0.05. The total cost of the cold drink is thus R0.11. To this can be added in direct costs such as the manufacturing, marketing and distribution but in reality the consumer is paying R5 for a good which costs R0.11. That is the market price. If the consumer is very thirsty he or she may well be willing to pay R10.

Kahneman and Tversky conclude the probable reason why consumers pay the market price which is about the average cost of claims is because they incorrectly assess the probability of loss. They overweight the probability of the loss (Kahneman and Tversky 1979, Abstract). If this were correct if consumers and if they were properly informed, they would not purchase insurance. The truth of the matter is that as an observed fact consumers do purchase insurance and will continue to do so even if accurate probabilities are published and become widely available. Consumers purchase insurance

to be indemnified against the loss, Insurance and removes the risk of the loss. By analogy consumers would not purchase cold drinks if they knew the low costs involved in producing the cold drink. In reality they purchase cold drinks because of the satisfaction they get from the drink, the utility obtained from the drink. It is not the information which explains why they purchase the cold drink, it is utility; satisfaction.

Utility (Being indemnified against the loss) > Utility (Retaining the premium)

It is insurers which look for costlessly observable information, risk factors, and use this to offer policies at the lower cost reflected by this information; type of car, location, gender, age of owner-driver, marital status. Each of these risk factors influence the probable cost of losses (Dahlby 1983). The factual risk characteristic of the consumer allows the consumer to select the policy at the lowest possible price. The market is thus Pareto Optimal. The point is it is the suppliers who seek out information, not the consumers, and use this information to ensure the market is

An example is motor insurance purchased by women. Statistically the cost of claims by women are significantly lower than that of men. Gender is a costlessly observed risk factor. So an insurance company First for Women was launched offering insurance to women.

5.4.2 Pooling high and low risks

A question which has attracted considerable attention is what happens if in a competitive market high and low risk are pooled. More specifically the question involves situations where the distinguishing risk characteristic cannot be observed. It is commonly believed the issue was to provide an explanation for the failure of medical insurance markets to form, in the USA, for over 60s. The issue was examined by Rothschild and Stiglitz in their seminal paper (Rothschild and Stiglitz 1976). In the case of over 60's age is observable (information easy to obtain). It is very difficult to imagine unobservable risk factors which the insured knows about and the insurer cannot access. Being HIV positive was an example. Usually this would be discoverable simply by asking for the information on a proposal form. Consumers could lie but the truth will come out at the claims stage and the insurer would repudiate the claim. Social pressure was brought to bear on insurers not to

ask about the applicants HIV status. Insurers offered a discount to those who underwent tests to demonstrate they were not HIV positive. Again this was information suppliers wanted to correctly rate policies.

In other cases where insurance could be correctly rated high and low risks could be in the same pool resulting in the premium being the weighted average of the two risks. But in this case specialist insurers will be established as happened with First for Women and lower risks would migrate to the correctly rated insurers.

6 Conclusion

If neo classical economics is seen correctly as the explanation of common observations, neo-classical economics is real world economics and is not open to attack or criticism.

Reference list

- Arrow, Kenneth J. 1963. "Uncertainty and the Welfare Economics of Medical Care." *American Economic Review* 53 (5): 941–73.
- Bacon, Francis (Sir). 1620. *Novum Organum*. 1902nd ed. New York, United States of America: PF Collier & Son.
- Bodanis, David. 2016. *Einstein's Greatest Mistake - the Life a Flawed Genius*. London, England: Little, Brown. 9781408708101.
- Coase, Ronald. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3: 1–44.
- Colander. 2000. "The Death of Neo-Classical Economic." *Journal of the History of Economic Thought* 22 (2): 127–43.
- Cook, Eli. 2016. "The Neoclassical Club: Irving Fisher and the Progressive Origins of Neoliberalism." *Journal of the Gilded Age and Progressive Era* 15: 246–62.
- Dahlby, BG. 1983. "Adverse Selection and Statistical Discrimination." *Journal of Public Economics* 20 (1): 131–37. [https://doi.org/10.1016/0047-2727\(83\)90026-9](https://doi.org/10.1016/0047-2727(83)90026-9).
- Engles, Friedrich. 1883. *Socialism: Utopian and Scientific*.
- Fama, Eugene F. 1970. "Efficient Capital Markets: A Review of Theory and Emperical Work." *Journal*

of Finance 25 (2): 383–417. <https://doi.org/10.1017/CBO9781107415324.004>.

Fearn, Nicholas. 2001. *Zeno and the Tortoise - How to Think like a Philosopher*. New York: Grove Press.

Fisher, Irving. 1926. *Mathematical Investigations in the Theory of Value and Prices*. Yale University Press.

Gingerich, Owen. 2016. *Copernicus - A Very Short Introduction*. Very Short Introduction. Oxford, England: Oxford University Press.

Greenwald, Bruce C, and Joseph E Stiglitz. 1986. "Externalities in Economies with Imperfect Information and Incomplete Markets." *Quarterly Journal of Economics* 101 (2): 229–64.

Hayek, FA. 1948. "The Meaning of Competition." In *Individualism and Economic Order*, 92–106. London, England: Routledge & Kegan Paul.

Hicks, JR. 1943. "The Four Consumer's Surpluses." *The Review of Economic Studies* 11 (1).

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica* 47 (2): 263–91. <https://doi.org/10.2307/1914185>.

Knight, Frank H. 1921. *Risk, Uncertainty and Profit*. Houghton Mifflin Company, Boston and New York.

Littlechild, Stephen. 1990. "Commentary." In *Champions of Freedom - Austrian Economics: A Reader*, 161–66.

Marshall, Alfred. 1920. *Principles of Economics*. 8th ed. London, England: Macmillan and Co, Limited.

Mises, Ludwig Von. 1933. *Epistemological Problems of Economics*. New York, United States of America: New York University Press.

Neumann, John Von, and Oskar Morgenstern. 1944. *Theory of Games and Economic Behaviour*. Princeton University Press.

Pigou, AC. 1932. *The Economics of Welfare*. 4th ed.

Principle, Lawrence M. 2011. *The Scientific Revolution - A Very Short Introduction*. Very Short Introduction. Oxford, England: Oxford University Press.

Robbins, Lionel. 1932. *An Essay on the Nature and Significance of Economic Science*. London, England: Macmillan & Co, Limited.

- Rothbard, Murray N. 1956. "Toward a Reconstruction of Utility and Welfare Economics." In *On Freedom and Free Enterprise: The Economics of Free Enterprise*, edited by May Sennhotz. NJD Van Nostrand.
- Rothschild, Michael, and Joseph Stiglitz. 1976. "Equilibrium in Competitive Insurance Markets : An Essay on the Economics of Imperfect Markets." *Quarterly Journal of Economics* 90 (4): 629–49.
- Salmon, Wesley C, ed. 1970. *Zeno's Paradoxes*. Indianapolis: Hackett Publishers.
- Stigler, George J. 1950a. "The Development of Utility Theory I." *Journal of Political Economy* 58 (4): 306–27.
- . 1950b. "The Development of Utility Theory. II." *Journal of Political Economy* 58 (5): 373–96. <https://doi.org/10.1086/256980>.
- Vivian, Robert William, and CJ Auret. 2018. "Methodological Problems with Fama's Formulation of the Research Hypothesis Underpinning the Efficient Market Hypothesis." In *EBES*. Prague.
- Weintraub, Roy. 2002. "Neoclassical Economics." *The Concise Encyclopedia of Economics*.