

MANAGEMENT FOR SCIENTISTS

This page intentionally left blank

MANAGEMENT FOR SCIENTISTS

EDITED BY

ROBERT B. MELLOR

Kingston University, UK



United Kingdom – North America – Japan – India – Malaysia – China

Emerald Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2019

Copyright © 2019 Emerald Publishing Limited

Reprints and permissions service

Contact: permissions@emeraldinsight.com

No part of this book may be reproduced, stored in a retrieval system, transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise without either the prior written permission of the publisher or a licence permitting restricted copying issued in the UK by The Copyright Licensing Agency and in the USA by The Copyright Clearance Center. Any opinions expressed in the chapters are those of the authors. Whilst Emerald makes every effort to ensure the quality and accuracy of its content, Emerald makes no representation implied or otherwise, as to the chapters' suitability and application and disclaims any warranties, express or implied, to their use.

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

ISBN: 978-1-78769-204-6 (Print)

ISBN: 978-1-78769-203-9 (Online)

ISBN: 978-1-78769-205-3 (Epub)

AgilePM and AgileBA are registered trademarks of the Agile Business Consortium Limited in the United Kingdom and other countries.



ISOQAR certified
Management System,
awarded to Emerald
for adherence to
Environmental
standard
ISO 14001:2004.

Certificate Number 1985
ISO 14001



INVESTOR IN PEOPLE

To the lovely ladies of my life: K, A & S.

This page intentionally left blank

Contents

About the Authors	<i>ix</i>
Foreword	<i>xi</i>
Introduction	<i>xiii</i>
Chapter 1 Economics, Monetary Theory and Fiscal Policy <i>Chiragh Desai</i>	<i>1</i>
Chapter 2 Theory of the Firm and the Law <i>Ken Morrison</i>	<i>17</i>
Chapter 3 Entrepreneurship <i>Robert B. Mellor</i>	<i>33</i>
Chapter 4 Organizational Structures for Tech Firms <i>Matthias Georg Will</i>	<i>49</i>
Chapter 5 Strategy and Strategic Management <i>Chiragh Desai</i>	<i>65</i>
Chapter 6 Information and Knowledge Governance <i>Sandra Whittleston</i>	<i>85</i>
Chapter 7 Change Management: The Organization as a Micro–Macro System <i>Matthias Georg Will and Julia Mueller</i>	<i>99</i>
Chapter 8 Marketing for Scientists <i>Rahul Chawdhary</i>	<i>113</i>
Chapter 9 HR Theory and Employment Law <i>Ken Morrison</i>	<i>129</i>

Chapter 10 Intellectual Property Rights (IPRs) <i>Lee Chapman</i>	<i>147</i>
Chapter 11 Online Resources for Biologists <i>Jean-Christophe Nebel</i>	<i>161</i>
Chapter 12 Management in Life Sciences <i>Mehmet Teyfik Dorak</i>	<i>175</i>
Chapter 13 Agile Methods for Engineering <i>Islam Choudhury</i>	<i>187</i>
Index	<i>207</i>

About the Authors

Dr Lee Chapman is the Global Head of Discovery Science and Intellectual Property for Celixir, a UK Company focussed on developing cell and gene therapies to treat incurable or poorly treated diseases including cancer and heart failure. Lee previously worked for a leading UK private practice firm of Patent Attorneys for 14 years and was a Partner of the firm for five years. As part of his role, Lee was responsible for managing the intellectual property strategy of Universities and companies of all sizes, patent drafting, patent prosecution, patent opposition and appeals, due diligence and freedom to operate. Lee also developed expertise in working closely with the inventors of small to medium sized companies to identify innovative discoveries and to help design experiments for further innovation with a view to generating intellectual property. When he joined Celixir, Lee not only continued to manage the intellectual property strategy and portfolio, but also became responsible for inventing cell and gene therapies. Lee holds a MA in Physiological Sciences and a DPhil in Reproductive Endocrinology, both from the University of Oxford, and is a European Patent Attorney (EPA), a Chartered Patent Attorney (CPA) and a Higher Courts Patent Attorney Litigator.

Rahul Chawdhary, Kingston University Business School, Marketing and Strategy. Rahul is an experienced Lecturer and his research interests include the domain of Word of Mouth. Rahul's research work has been published in leading journals in the field, for example, *Journal of Marketing Management* and *International Journal of Market Research*.

Islam Choudhury, Kingston University, Computing and Mathematics. Islam has worked in the university sector for 25 years and has main research interest in the agile business, business analysis and modelling area, including developing an agile framework for building a Generic Reusable Business Object Model. Islam is one of the Directors of the Agile Business Consortium and involved in the very successful International Ambassadors scheme. As an APMG-certified Agile Project Management trainer and Agile Business Analysis trainer, Islam regularly introduces Agile concepts into teaching, including running Agile certification courses for students.

Chiragh Desai, Canon Europe. Originally a Chemical Engineer, Chiragh worked in Africa and South East Asia before doing his MBA at Illinois Institute of Technology in Chicago. Since then he has worked as a Strategy Consultant to various private and public organisations in the USA and Europe, and, after another short stint in the Middle East, currently works in the Emerging Markets Business Unit for Canon Europe.

Mehmet Tevfik Dorak, Kingston University, Head of the School of Life Sciences, Pharmacy and Chemistry. Originally trained as a Medical Doctor, Mehmet completed a PhD in Genetics and his research area is genetic epidemiology and genome biology. Following a series of research-oriented academic and industry positions in the United Kingdom and the United States, he settled into academic management in 2014. His current research involves bioinformatics approaches to analysing the results of genome-wide association studies.

Robert B. Mellor, Kingston University, Computing and Mathematics. Originally a Molecular Biologist and Author of around 100 scientific publications, his citation index makes him a 'top 10%' researcher. He also has over a decade industrial experience and is a serial entrepreneur. After gaining another doctorate in Computer Science he became active in 'Big Data', and his present research involves large-scale mathematical modelling and analysis of business environments to predict fruitful directions for organisations to follow.

Ken Morrison, St George's, University of London. Ken is a Solicitor and has practiced law in South Africa, Ireland, Singapore and England and Wales over his career spanning nearly 20 years. Ken is the Director of Legal Services for his institution and also serves as a Mediator in employment disputes for organisations.

Julia Mueller is a Professor at the Department of Strategic Management at the University of Halle-Wittenberg and external Lecturer at the Hochschule Anhalt. Prior to that, she was at the Department of Strategic Management, Marketing and Tourism at the University of Innsbruck. Her research focuses on strategic management, especially on microfoundations of management processes. She has studied knowledge and innovation processes in the online and offline setting, has published several articles, and presented her work at international conferences. She has won several best paper awards for her publications.

Jean-Christophe Nebel, Kingston University, Computing and Mathematics. Author of over 100 peer-reviewed publications. He is an interdisciplinary academic whose research includes the development of novel pattern recognition approaches applied to both computer vision and bioinformatics. In particular, he has designed a framework allowing usage of stochastic context free grammar for protein sequence analysis and proposed a genomics-inspired paradigm for video analysis (vide-omics).

Sandra Whittleston, University of Northampton Business School. After many years in management roles, Sandra became a Lecturer in IT Service Management (ITSM) and is Programme Leader in ITSM in two UK universities as well as playing a major role in supporting the UK CIO network and UK Government's Digital Skills Agenda. She is an acknowledged expert ITSM including the role education has to play, presenting her research regularly at conferences.

Matthias Georg Will is a Consultant for Horn & Company. Matthias was an Academic at Martin-Luther-University Halle-Wittenberg and is Visiting Professor for GISMA Business School, Porto Business School and Grenoble École de Management. His fields are digital strategies, big data applications and change management, as well as organisational economics. As an acknowledged expert, he has been organising several tracks for the annual conference of the European Academy of Management has been Guest Editor for several special issues in academic journals.

Foreword

Normally when asked to write the foreword to a book one is flattered, agrees but then sometimes thinks, OK now what shall I say? It then becomes in danger of being a chore. When I was approached I confess to the first part but in this case the rest was easy and a pleasure, because the strength of this book and the need it fills, are so self-evident.

We live in a world where science and technology increasingly drive success in the corporate world either as the core business and/or a key enabler of it. This means professionals and academics from the Science, Technology, Engineering and Mathematics (STEM) disciplines learning how the commercial world works. Contributing to an endeavour and forming partnerships requires working as a team and to do this you need to understand the context, drivers and needs of those you work with.

Many academics attempt to understand this world by taking a postgraduate course, sometimes an MBA. Others, and I confess to being in this category, learn through experience; this of course takes sometime and you make mistakes along the way; you of course learn from these but they often represent lost opportunities.

This book bridges the gap, it is a bite-sized (but no less rigorous for that) introduction to business for those in the STEM disciplines. It doesn't require the expense and intense application of an MBA or learning the hard way over a good chunk of a career.

It has two other clear virtues, firstly it is not a popular and rather general guide written by a management guru such as you may find in a high street bookshop (though the best of these can be good), but it is specific and tried and tested. It has been delivered in various forms, both stand alone and as a part of other courses, many times to a large number of participants from a range of STEM disciplines and from across the globe.

Secondly, and in my view, its most important feature is that it is delivered by scientists for scientists; this is not some precious territoriality but rather is the key to its success. You are being guided and taught by those who have in the past entertained exactly your misconceptions; they speak the language of science and have also experienced your struggles to understand how a necessarily different world works, and probably were seeking the same things from it.

So read the book, maybe also take the course; your interactions with the commercial world will be much more fruitful. Who knows, it may even be the first step in helping your ideas to change the world for the better.

David Mackintosh

Dean of the Faculty of Science, Engineering and Computing
and Deputy Vice-Chancellor, Kingston University, UK

This page intentionally left blank

Introduction

Sometime after graduation you may enter a stage of life when you wish to become a manager in some type of company or area to do with Science, Technology, Engineering and Mathematics (STEM). This often throws up two problems; firstly, the management of scientists is quite different from the management of, for example, a factory or production line. Secondly, you are probably not trained in management economics or business concepts. You are probably more at home with micropipettes, netbeans, Vernier callipers and Markov chains, some of the more usual concepts in STEM areas. Nonetheless you are gradually becoming aware that you must understand how commercial life is, and how the world around you actually works. This may be complicated by any (or many) misconceptions you have around management and entrepreneurship, possibly gained from watching popular TV series that have not much to do with reality. You may think 'I have to find out about this'.

That was what happened to me: I left the University of Basel to become Director of R&D at a German chemical company; my approach was: why not swap my antibody for your DNA probe and together we can get a really good paper out, adding to the sum of human knowledge around 'organism X'. Needless to say this attitude had to change and I found myself doing a business qualification at the local university (Göttingen); it wasn't exactly an MBA but it had a very long name in German.

This was similar to the mindset of the first intake on the MSc minor field 'with Management Studies' around 2010 and led to my creating a bespoke module because, generally speaking, scientists wish to 'do good' and 'create progress' in a way that Business Schools often don't properly understand. Biomed people want to make better medicines, engineers want to build better bridges and computer scientists want better websites. Generally speaking, scientists don't know much about business and we care much more about improving the lot of fellow humans (and publishing a great article in a good journal along the way) than being rich. Therefore, I created a '10-day MBA' for all scientists at Kingston University, taught by an international team of experienced scientists with huge business experience that was specifically suited for relatively advanced science participants, normally at postgraduate level. The 'team' consists of experts from various disciplines from agronomy to zoology; there is a chemical engineer, a medical solicitor, econometrician, consultant, IT manager, patent lawyer, marketer, molecular biologist, an electrical engineer, etc. They have authored these chapters.

As I write there have been approaching 1,000 participants graduated on this minor field, majoring in all kinds of fields like aero-engineering, biomed,

pharmacy, construction, sport, geology and geography, computer science and information systems. Every year I am amazed by the vigour of the class, normally over 100 participants drawn from all corners of the world and participants regularly evaluate this as one of the top 10 courses. In class, we often discuss the drive towards ‘progress’; for example, the late Nobel laureate Stephen Hawking often suggested that humans needed to get off planet Earth within 100 years, and find another planet to call home if our species is going to survive. Yet it is still quite beyond our engineering capacity to get even a small crew to the inhabitable moons of Jupiter or Saturn, and the biologists tell me there are even large uncertainties about how many green plants are needed to sustain each traveller. On the way there will constantly be problems, and all the subjects (project management, leadership, etc.) will be needed constantly during and after the journey. Sound, multidiscipline evidence-based management is need to achieve progress like this.

In this course (or book or module or whatever you want to call it) we start at the very beginning: What is money? We then progress through the theory of the firm, economics, strategy, governance, marketing, HR to patenting, etc. After that there are more specialisms and the engineers can look at some aspects, while, for example, the biologists may prefer other aspects. The management of knowledge workers – scientists – is a particular issue; as scientists we automatically think we belong to the new ‘sunrise industries’ and over-performing giants like Apple and Google spring to mind. Our research has shown that to achieve that you need to have employees at least as smart as the managers and that the managers have to trust their employees and merge with them. That is a tall order; but if that is not the case then a multilevel hierarchy will inevitably spring up, which may perform well in the short-term, but will not reach the superlative peaks of performance that others can achieve. This means that in building our organizations, just as much as in our science, we must always respect others and strive for excellence.

So finally, wherever you are coming from and wherever you are going, I wish you all the best and perhaps this volume can help you on your journey to success. Welcome to your world and good luck.

Dr Robert B. Mellor
Kingston University, UK

Chapter 1

Economics, Monetary Theory and Fiscal Policy

Chiragh Desai

What We Will Learn

This chapter introduces the importance of economics, how the role and relevance of economics has changed and examines the role of money in this transition.

It will examine the types and validity of economic theory, command and market economies, the way in which markets work, examine the concepts of resources, opportunity and competitive advantage and look at how these factor in to International Trade Theory. The chapter will also examine the choices that consumers face, supply and demand, equilibrium, price elasticity, utility and scarcity.

The chapter concludes by discussing monetary theory and fiscal policy, examining trends, looking at the approaches of Keynes and Friedman, and the function of money and inflation and the role of government, banking and other financial institutions.

What is an Economy?

At a fundamental level, an economy is a system comprised of individuals and organisations that either consciously or unconsciously contribute to the production of goods and services. By this understanding we can see that the primary concerns of an economy are efficiencies in production of said goods and services and an effective use of resources enabling individuals or organisations to maximise output while reducing costs.

A Brief Historical Introduction

Ever since human beings discovered that they had different aptitudes from those around them, there became the obvious need for an exchange of goods and services. The farmer produced crops for the consumption of the shepherd who in

exchange provided meat. As time went on, the structures and mechanisms for this have become increasingly complex, and over time, when new cultures, languages, religions and political ideologies were introduced we have seen what started as a simple human need mushroom into something far more intricate.

In 1815 when Adam Smith wrote his modern-day economic epic *The Wealth of Nations*, the newly born British Empire (with its eyes on other resources) used some of the ideas expounded by Smith as a prism through which they saw the world in front of them. Smith's ideas were used to utilise the resources Britain gained in its newly acquired colonies to further its goal of further colonial expansion. Smith was a philosopher and expounded a philosophy of modern economics that, at heart, is not mere science but borders on a variety of other academic disciplines, from philosophy to geopolitical theory to religion.

The study of economics is, therefore, the study of the very basic values that underpin much of modern thinking; influencing much of life as we know it today. One needs only to examine the ingredients of a soft drink and then look into from where those ingredients were sourced, how they were manufactured, produced, shipped and delivered to get a small insight into this. Each of these components has an economic weight not only in the countries in which the activity takes place but on a global scale as well. Globalisation, with its complex view of markets and legislation, has had a profound effect on the science of economics.

The academic study of economics has been developed to allow us to frame our understanding of the rate of development of any economy, creating metrics for growth, and even determining which country or indeed which region in a country is desirable to live and work in. These metrics have been used to justify war, peace and everything in between, and understanding them is crucial in our quest to understand business and answer pressing questions such as 'Why did the financial crash happen and what does it mean to me?' and 'What will Brexit bring to my standard of living?'

As with all matters of academia, it is important to understand the importance of terms, and economics is no exception; in that understanding the language used by economists is the first step to delving into some of the deeper concepts at play.

Thinkbox 1: What are Microeconomics and Macroeconomics?

Microeconomics examines the effect of primarily individual choices such as the determination of price in a market, the effect on an economy of the behaviours of individuals and firms, how these are coordinated by markets, production cost efficiencies, supply and demand and uncertainty.

Macroeconomics examines the effect of the aggregate of all micro-economic factors, contributing to an understanding of growth, business cycle, employment, inflation, monetary policy, public sector considerations, interest rates and banks.

A fundamental starting point is to discuss what some of the terms mean. What is a Resource? In economic terms resources can be classified as human and nonhuman.

- Human (e.g. labour, management)
- Nonhuman (e.g. land, capital)

What is an Opportunity?

- Opportunity cost: The cost of doing something when you could be doing something else.
- Transaction cost: The cost of whatever it is you are doing.

Command Economies versus Control Economies

Fundamentals

At its essence, Economic Theory speaks of control and where this should lie. When examining economic theory, this should never be far from the reader's mind. While analysing any economic system, one must consider the following:

- What is control?
- Where does the control lie?

As an economy is made up of individuals, firms and governments, the issue of control surrounds who has the power to dictate price and production of goods and services.

In a command economy, control is exercised from the centre, be that through government or central institutions and these will have the largest control over all matters of production, pricing and supply. We see this type of economy appear to varying degrees in dictatorships, communist entities and even far right political systems. The justification for this level of control is often underpinned by the ideas that the state has the best of intentions for the people and is the most capable of allocating resources in an equitable manner.

Conversely, a market (or open) economy has much less centralisation and gives control to the individuals and firms. In this case the market will dictate the price and supply by means of finding an equilibrium for goods and services.

In reality, modern economies are a mixture of the two, with various levels of central control present even the most open of market economies. Governments, by their very nature will always exhibit some level of control, regardless of their political leanings, and this will naturally have an effect on any economy. We will see the manifestation of this when we discuss money supply later in the chapter.

Classical Economic Theory examines an economy based on:

- Resources
- Land

Classical Economic Theory has a heavily microeconomic focus and deals with the idea that if individuals and firms are allowed to function in self-interest without interference, then the market itself will become efficient. Classical Economic Theory held sway from Adam Smith's *Wealth of Nations* in the eighteenth century to around the end of the Second World War in Europe where new approaches were developed to deal with a more complex economic environment in post-war Europe. The reader would be justified in asking, given human beings have fundamentally changed very little (in terms of core nature) in this relatively short period of human history, why are there so many models? The simple answer is that as boundaries and borders change and demand changes, there is a change in the way in which individuals, organisations and nations perceive the world around them and how they believe things should be done. Additionally, and critically, over time, resources become more scarce/plentiful for some than for others, and new individuals or entrants to a market bring their own cultural, historical, philosophical and religious perspectives. Thus it is important to look in more depth at some of the key figures in the development of economic thought and models.

Adam Smith

Smith was a Scottish Philosopher (1723–1790) and is considered the 'Father of Economics'. In 1776, in his book *An Enquiry into the Nature and Causes of the Wealth of Nations*, Smith put forward the idea that an 'Invisible Hand', a driving force in the economy brought about by competition and self-interest had the effect of benefiting society.

Adam Smith introduced the idea of absolute advantage, where a country or firm can produce a product more efficiently than others, that is, using fewer resources to produce the same amount of goods. This raises the question about whether a country that can produce all goods at a lower cost than another country should trade at all, because if a country can produce everything cheaper, then trade would make no sense at all. As the British Empire spread and involvement migrated from merely trade to colonisation, the prominence of the idea of absolute advantage made way to comparative advantage, with different parts of the empire having a specialised advantage in producing certain goods, as well as the opening of new markets.

David Ricardo

Ricardo was a British Political Economist (1772–1823), tellingly a man of his time with roots in Britain, Portugal and the European lowlands; he believed in nations specialising in production of products and trading with nations who specialised in the production of other products. His approach, as outlined in his book *Principles of Political Economy and Taxation* (1817), developed an idea called Comparative Advantage. In his famous example, Portugal was better at producing wine than Britain, and Britain better at producing cloth than Portugal, so trade should occur between these countries in these goods. According to

Ricardian Theory, a comparative advantage occurs when a country can produce goods or services at a lower opportunity cost than another country. If a country can specialise in this, then there will be an increase of economic welfare. The mechanism by which this takes place is known as specialisation and to understand this, we must understand opportunity cost.

Reminder

Opportunity Cost: As every resource can be used in different ways, an opportunity cost is essentially the value of a benefit that must be given up in order to do something else.

At its essence, comparative advantage speaks to a country allocating resources (land, materials, labour, skills) in such a way as to gain a specialised advantage in producing one or more particular products and therefore, over time, becoming more efficient in the production of these goods and services. It therefore stands to reason that free trade will allow for the production of more for less use of resources, thus benefiting all parties concerned.

The Ricardian Model is limited by the fact that it focuses primarily on labour as the primary input to production. Ricardo's thinking is the basis of neoclassical trade theory as it significantly increases its reliance on mathematics and analysis. Ricardo, as a successful stockbroker, also was among the first to articulate the significance of money supply and its effect on inflation. We will discuss this later in the chapter.

A modern example of this is the outsourcing of call centres to India, a nation where multilingualism is the norm and a university graduate is relatively cheaper to employ than a graduate from the UK, for instance. India, therefore, will be said to have a comparative advantage in delivering a service of call centres over the UK.

International Trade Theory

The discussion around Smith and Ricardo and advantage all lead us to International Trade Theory, which is actually a collection of theories that explain the phenomenon of the exchange of goods and services between people or entities in two different nations.

It would be prudent at this point to understand what a nation is. For the purposes of economic theory, a nation can be defined as a market which is governed by the same set of laws and that uses the same currency to trade.

Models:

- Adam Smith's Model: Trade takes place on the basis of countries exercising absolute advantage over one another.
- Ricardian Model: Trade takes place based on Comparative Advantage.

- Hecksher-Ohlin (H-O) Model: Countries export goods that are abundant and import goods that are in relatively short supply.
- New Trade Theory: Focus on increasing returns to scale, examining the effect in the long term of an increase of outputs and inputs. This theory incorporates highly mathematical models and can be used as a basis for protectionism of certain infant economies.

International Trade Factors

There are strategic reasons for countries not to adopt free trade. In the sphere of defence, for instance, it would be ill advised to outsource the security of a nation to another nation as this would potentially invite an existential threat to emerge. The economic reasons for protectionism are no different.

Thinkbox 2: Two Views of Scottish Nationalism

Given that the UK nuclear deterrent fleet is based in Scotland, what would Scottish independence mean for those involved?

Look also at the potential effects of Scottish Independence on UK markets and oil in <http://www.neweconomics.org/blog/entry/scottish-independence-uk-dependency>

Where does this leave the present concept of liberal Internationalism, where global issues are regulated by supra-national bodies like the UN?

A nation will often introduce a variety of mechanisms to protect its own industries in their infancy. Where it is acknowledged that specialised advantage is a valid factor, there is also the notion that nations would like to gain a more specialised advantage in the production of certain goods and services. As technology develops at an increasingly fast rate, foresight would determine that gaining an increased specialised advantage in, say, making components for mobile phones would allow an economy to benefit from the exponential growth of mobile phones. Nations will, therefore, utilise tariffs and other protectionist tools to protect industries in their infancies.

Essentially, this is a discussion of sovereignty. The question of whether a nation can truly dictate its own economy is of great import as we have seen recently with the Brexit vote in the UK, where, among the reasons for the vote for Britain to leave the EU is the shaky perception that the UK no longer holds any ability to control its economy (interestingly, it is arguable whether this will change much because the national economies are so intimately intertwined that Brexit might make very little difference to the reality of the situation, bar the alteration of some minor laws).

The prominence of multinational organisations often means they can circumvent local laws, be they regarding tax, employment or even data usage, an example of how strong organisations can be in influencing the direction of an economy. This is discussed further in the next chapter.

Consumer Choice

As we have alluded to earlier in the chapter, understanding consumers and their behaviour is also critical when looking at any economy. This includes price elasticity or how consumers and producers look at price. The price elasticity of demand:

- is way of indicating how sensitive the quantity of a good demanded is with regard to price and
- gives the percentage change in quantity demanded in response to a one-per-cent change in price.

Factors that affect elasticity of demand include availability of substitutes, the definition of the good or service, percentage of income that is expendable, necessity, longevity (shelf-life) of the good or service, brand loyalty and the identity of the purchaser. The price elasticity of demand is balanced by the price elasticity of supply:

- Measure of responsiveness of the quantity supplied of a good or service to change its price.

Factors that affect elasticity of supply include availability of materials, production factors, complexity of production, inventories and capacity.

Supply and Demand

The amount of availability and requirement for a product or service in a market.

The classic supply and demand curve illustrates in a simple way the impact on equilibrium price of availability and need (Fig. 1).

The equilibrium price occurs when supply and demand are balanced and market equilibrium is where the market price is established through competition, where the amount of goods or services sought by buyers is equal to the amount of the same produced by sellers (Table 1).

Utility: A Measure of Satisfaction

Although it would be safe to assume that people want as much utility as possible, there must also be taken into consideration the saturation point of utility. In economic terms, this is referred to as a Diminishing Marginal Utility. Shortly 'the more they have, the less an additional unit of utility will mean to them'. Diminishing Marginal Utility is a highly subjective field of study, hard to quantify, yet critical when it comes to understanding demand. How much is enough?

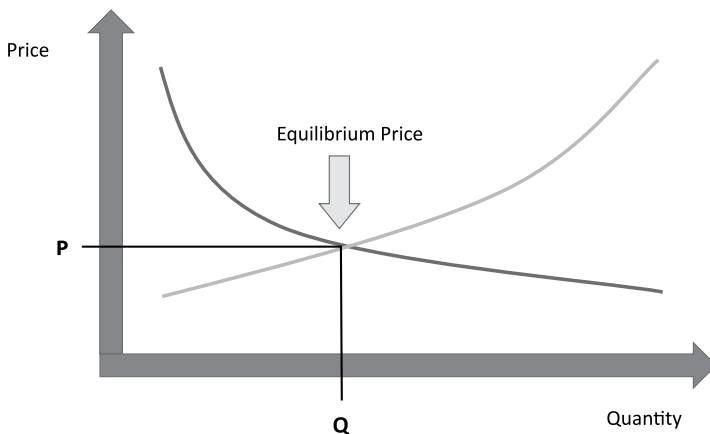


Fig. 1: Supply, Demand and Equilibrium.

Table 1: Equilibrium Price Change Table.

Supply	Demand	Effect	Equilibrium Price
Unchanged	Increase	Shortage	↑
Unchanged	Decrease	Surplus	↓
Increase	Unchanged	Surplus	↓
Decrease	Unchanged	Shortage	↑

Scarcity: Increasing Demands on a Finite Resource Base

Many believe that the greatest challenge facing humanity is an exponentially increasing population and this in turn implies increasing scarcity. Alternatively, an increasingly efficient allocation and innovative use of resources can work to solve problems of scarcity. Scarcity in the short term is usually dealt with through Price mechanism as opposed to government planning, although in extreme cases, the latter is often used, for example, how the South African government tackled the 2018 water crisis in Cape Town (1).

Externalities and Corrections

Externalities. These are factors outside of supply and demand that effect price:

- Environmental factors
- Pollution factors