Part I

Why Investments Matter

1 Introduction

1.1 INVESTMENTS: THE FORGOTTEN VALUE LEVER

Much of the current management literature focuses on a limited set of "classical" value levers, such as cost reduction, sales optimization or mergers & acquisitions, thus neglecting another core value lever: capital investments (Capex).

That capital investments receive such limited attention is all the more surprising when one considers just how vitally important they are to the economy as a whole and to business in particular. In 2007, more than $11.8 trillion was spent on capital investments globally – more than the combined GDP of Japan, China, India, South Korea, and Taiwan (or Germany, France, Italy, Spain and the UK). Not only is the sum invested enormous, but its influence on long-term company performance is critical. Since the early 1990s, asset-heavy companies in the S&P 500 have increased their average return on invested capital by 3.8 %. Our analysis indicates that about half of this increase (48 %) is related to investment activities (Figure 1.1).

Investments are important not only in optimizing the asset structure of a venture but also for enabling the introduction of new products or for introducing structural cost reductions.

Managers know that the value of an investment is not a "given" that results in an inevitable rate of return. A wide range of variables influences the outcome both positively and negatively. Understanding these variables is therefore critical in assessing the likely performance of an investment.

The experiences from a range of capital investment optimization projects show that there is significant value creation potential in optimizing capital investments. Results achieved across a wide range of optimization projects demonstrate this potential to be of the order of 15–40 % of the return on an investment. This value potential arises from three core improvement levers for investments: reductions in the amount of capital invested, acceleration of the production ramp-up, and increases in the operating cash flow during the productive life of an investment (Figure 1.2).

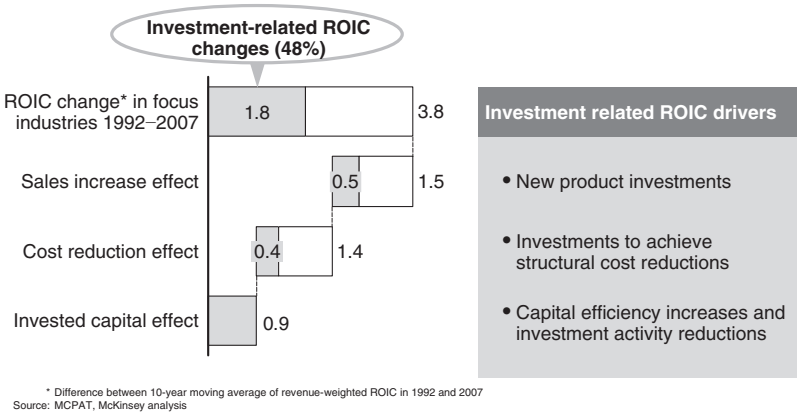


Figure 1.1 Drivers of the increase in ROIC, 1992–2007

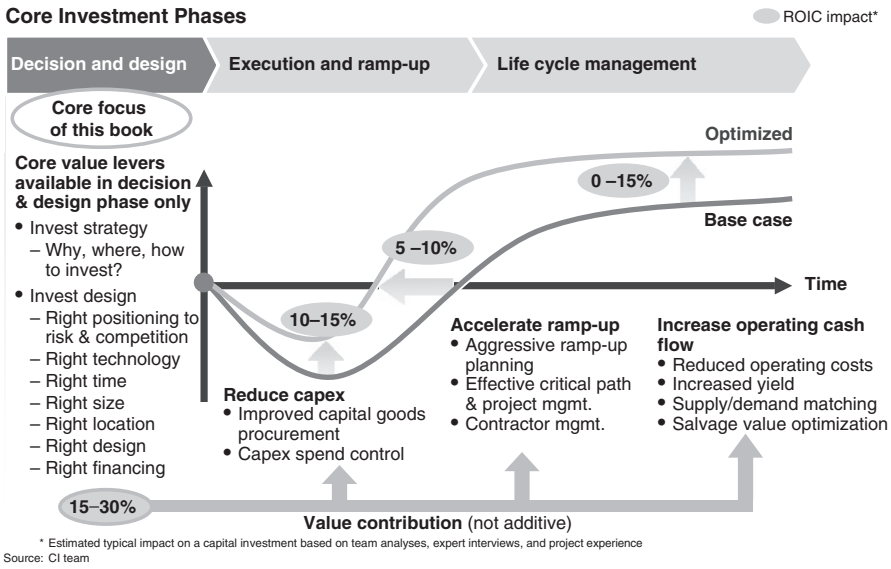


Figure 1.2 Core value levers for optimizing capital investments

1.1.1 The early bird catches the worm

Once a project progresses from the design phase to the execution and ramp-up phase the potential for optimizing the investment narrows, as much of the cash has already been spent or committed. The decision and design phase, therefore, is of critical importance to the performance of any capital investment. This phase provides the largest value creation opportunity for investing companies. The crucial questions managers are faced with in this phase are, of course, "Where, when and how to invest?", "How do we design the investment so as to ensure an optimum return?" and "What is the best way to finance the investment?"

The decisions made in this phase determine the boundary conditions for the business assets – and a significant part of its ROIC – for many years to come. Despite the importance of these decisions, it is rare to find them managed well from the outset. One of the reasons why companies continue to struggle with the design and execution of large capital investments is that their often discrete nature makes it difficult for companies to build up and maintain investment management competency in-house. A second reason is that, despite the wealth and depth of material on financial investment valuation and assessment, there is currently little or no hands-on, practical advice for capital management and optimization written from a top management perspective. To a large extent, managers are left leaning on their own experience, pulling together the best team they can find within their organization.

This surprising lack of practical management advice has been one of the main reasons prompting us to write this book: decision-makers need the best possible advice to aid them in making decisions on large investments. We intend this book to fill this gap and to provide a strategic manual on large fixed capital investments. It has a holistic approach to the topic, one that is both strategic and practical in its perspective.

In researching this book, we have invested a significant amount of time and effort in collecting and analyzing the information that forms the basis of the ideas that shape it. In the course of this work we have made extensive use of the wealth of knowledge and experience

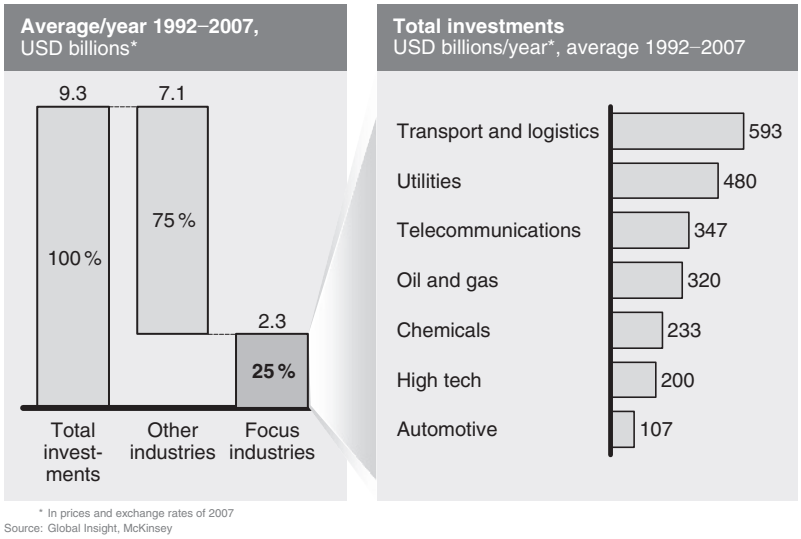


Figure 1.3 Share of investment of the asset-heavy industries under review[1]

present within McKinsey & Company – based on more than 500 capital investment-related engagements for many of the world's leading companies. These efforts have contributed to building up the capital investment practice within McKinsey.

We hope not only that this book will be interesting and readily digestible for the reader but that the ideas within it will serve to sharpen management's focus on the impact capital investments have on the wellbeing and growth of their companies – whether the companies concerned are already leaders in their field, or aspire to become so.

CAPEX Excellence is addressed in particular to the top management of companies which are based in asset-heavy industries – and especially to managers faced with the challenges of making individual or portfolio capital investment decisions and who are responsible for managing these capital assets over their entire asset lifecycle (this includes CEOs and CFOs, as well as senior managers in the business planning, financial, management accounting and control functions). We hope *CAPEX Excellence* will also be of interest to graduate management students, as well as to all those who want to gain a deeper understanding of the core strategic choices companies face when making and implementing large capital investment decisions.

Throughout the book we use many industry-specific examples, focusing in particular on seven asset-heavy industries (our "focus industries"): Utilities, Oil & Gas, Telecommunications, Transportation & Logistics, Chemicals, High Tech, and Automotive. Together, these seven industries account for about 25 % of all global annual investments (Figure 1.3). However, this is not to suggest that we think the book's relevance will be limited to these sectors alone. Other capital intensive industries, such as Steel, Aluminium, or Pulp & Paper, also face very similar challenges, so hopefully the insights here will be relevant to these industries too.

Finally, whatever your particular industry, we hope that, as the reader of this book, you will benefit from our industry and company analyses of what constitutes best practice in capital strategy.

[1]The largest contributors to "other industries" are real estate (24 %) and public and social services (17 %) which we do not include as focus industries since they are driven by either private or public players rather than companies.

1.2 A BIRD'S-EYE VIEW OF THE BOOK CONTENT

CHAPTER HIGHLIGHTS

This chapter is an executive summary outlining the subject matter of all three parts of this book for readers who want a quick overview of the contents.

- Part I: The introductory section highlights the importance of capital investments and provides an overview of investments across the globe, industries and time.
- Part II: This core section covers the major strategic choices in investment decision, such as where and when to invest and which technology to choose, as well as how to design and finance large capital investments.
- Part III: The closing section places individual investment decisions within the context of the overall capital allocation decisions companies are faced with when shaping their investment portfolio.

Though we hope most people will choose to read this book from cover to cover, all the chapters have been designed to stand alone, enabling the reader to study any individual chapter independently of the others. To aid the reader, wherever appropriate, we have included references to topics which are covered in more detail elsewhere in the book.

1.2.1 Part I: Why investments matter

The importance and structure of capital investments

In this chapter we examine how investments are a prerequisite for growth and what determines their structure and timing. Today about 20 % of the world's GDP is spent on capital investments. Eight out of the 10 fastest growing economies have investment intensities well above the global average. The correlation between investment and growth is even clearer in the world's emerging economies, which achieve more than twice the average economic growth with almost twice the capital intensity.

Not only is investment critical at the national level but getting investments right at the company level makes an enormous difference to a company's value creation. During the last 10 years roughly half the S&P 500's growth in return on invested capital (ROIC) has been related to investment activity.

Investment patterns vary widely between industries. The most investment-intensive industries are Transport & Logistics, Utilities, Telecommunications, and Oil & Gas, followed by Chemicals, High Tech and Automotive (the industries which are the primary focus of this book).

Investment is also highly cyclical, with a regular pattern of boom followed by bust. We observe that – while unpredictable in specific site and timing – industry cycles are far from random displaying clear cycle frequencies around 5, 10, and 30–40 years.

We conclude Part I with a brief examination of why investment volumes are likely to continue to grow in coming years, despite any short-term economic problems.

1.2.2 Part II: Getting investments right

Part II focuses on the strategic choices that companies and decision makers are faced with when making investment decisions, and provides a number of frameworks and strategies to deal with these challenges.

Chapter 2: Right positioning: Managing an asset's exposure to economic risk

We examine how the degree to which an investment asset is protected against economic risks largely determines its achievable return on investment. The degree of an asset's exposure varies: the lowest levels of exposure are conferred by exclusive access to critical resources or a natural monopoly-type situation; the highest levels are derived from leveraging commercial advantages, such as strong brands or a superior distribution network.

The core of this chapter focuses on the use of an "asset exposure scoring metric". This allows companies to quantify the degree of exposure their investment asset is likely to be subject to. The metric enables the investment to be benchmarked against the expected returns of competitors or other investments.

We close by examining a number of strategies available to companies for managing their asset exposure, looking at how companies create public-private, win-win outcomes, or go "asset light" in highly exposed markets.

Chapter 3: Right technology: How and when to invest in a new technology

Technological innovation is a critical challenge for companies. Though no company can afford to ignore technological developments, switching too early can leave it highly exposed. In this chapter we focus on how companies can determine the right timing for making the transition to a new technology.

We show that the right moment for making such a transition is not, as commonly thought, at the point when the value created by the new technology exceeds that of the existing technology, but at a significantly later point. The exact point depends both on the degree of technological risk as well as the company's appetite for risk.

We show how to determine the optimum switching point and provide an enhanced metric for measuring the value created by investments in new technology.

Chapter 4: Right timing: How cyclicality affects return on investments and what companies can do about it

Cyclicality destroys value and increases the risk of bankruptcy or investment failure. In this chapter we examine the underlying causes of cyclicality in economic systems, how it is driven by imbalances between customer demand and the available production capacity of the market, and show what companies can do to counteract it.

We examine how the time delay between the point at which companies react to differences between supply and demand and that at which these changes actually happen underlies economic cycles. We look at underlying causes of complex cycle patterns and why some cycles are stronger than others, before examining how price sensitivity and company responses to cyclicality can actually aggravate the cycle.

In the final section of this chapter we look at the various options companies have for counteracting cyclicality and how some companies can, in effect, leverage cyclicality to their advantage.

Chapter 5: Right size: Balancing economies and diseconomies of scale

In this chapter we show how defining the optimum size for an investment requires the identification of the investment "sweet spot" – the point at which diseconomies of scale begin to exceed economies of scale.

It is commonly understood that the economics of fixed costs improve with larger production volumes. We enlarge this discussion of scale effects to include, among other issues, a look at technical scaling laws, and how the "chunkiness" of capacity additions impacts higher capacity utilization.

While scale effects are often incorporated into the assessment of large investment projects, diseconomies of scale are almost always neglected. In consequence, companies often underestimate complexity costs, loss of flexibility, and the increasing risks associated with large investments. We show how this leads to a bias favoring assets that are larger than the optimum size.

We suggest a structured approach to assessing diseconomies of scale that takes into account *scale costs* as well as *economic risks* associated with scale increases. We consider a wide range of cost and risk effects, such as increased logistics costs, supply chain limitations, and increased management complexity.

Chapter 6: Right location: Getting the most from government incentives

Government incentives can have a significant impact on the longer-term returns of an investment and are often a major consideration when deciding on an investment's location. Often, however, there is very little transparency about the range of incentives available and the conditions attached to them. In this chapter we shed some light on the various categories and types of incentives that are available.

To help companies identify the incentives that are appropriate to their business case we provide a general framework which classifies the structure of the various investment instruments. We also provide an overview developed through an international screening of the incentives instruments available around the world.

We examine the impact incentives have on the business case in terms of their cash contribution and provide a simple framework to help investors select the appropriate types of incentives.

Chapter 7: Right design: How to make investments lean and flexible

In this chapter we show how lean thinking and principles can be extended from operations into investment design. We illustrate how this can enable investors to carry out the execution of investment projects in a time-efficient and resource-efficient manner, overcoming many of the limitations typically found in production plant design.

This approach, rather than focusing on a single investment, puts in place a standardized "investment system" which enables the company to bring the new capacity to market faster and at lower cost while increasing the asset's flexibility. This flexibility is necessary to cope with changing customer needs and short product lifecycles.

The outline of the investment system includes a look at the technical set of tools and practices, the required management infrastructure, and an outline of the required mindsets and behaviors. We discuss the main elements of a lean investment system in terms of defining the project objectives, design principles, and project targets, and how the design process should be optimized at the macro-, midi- and micro- levels, according to the lean principles established in the design phase.

Chapter 8: Right financing: Shaping the optimal finance portfolio

The composition of the financing portfolio is often critical to the longer-term success of an investment project. In this chapter we discuss how the project's financing can be made cost effective while maintaining the liquidity throughout the early stages of the project necessary to ensure that the repayment schedule can be met.

We examine how banks are currently at an advantage in negotiating finance due to their ability to assess and mitigate risks. This enables them to achieve very high profitability in project finance. Companies can learn much from their approach.

We show the importance of developing a thorough analysis of the likely cash flow curve over the project's lifetime. This will produce a good understanding of the project's assumptions and interdependencies.

We look at how to assess all the project's risks and to quantify their potential impact, identifying which can be mitigated and which cannot. This understanding will give companies an advantage in negotiating the project's finance.

Finally, we take a brief look at the composition of the finance portfolio and how costs can be balanced with repayment flexibility at an adequate level of confidence.

1.2.3 Part III: Right allocation: Managing a company's investment portfolio

Although there is not a one-size-fits-all approach to selecting the right investment portfolio, in the third and final part of this book we develop some guidelines to portfolio development based on the "best practices" of successful companies.

We show how such companies have four common characteristics in their capital allocation approach: 1) the alignment of capital allocation to their strategy; 2) the use of clearly-defined metrics and processes; 3) the adoption of mechanisms to avoid conscious and unconscious distortions in decision making; and 4) processes to ensure close collaboration between the corporate centre and the business units in compiling the investment portfolio.

We discuss how in a multi-divisional company the capital allocation approach is dependent on the role and involvement of the corporate center. In this regard, we illustrate the differences between "strategic architects", "financial holdings", "operators" and "strategic controllers". Taking these differences into account, we propose two different approaches to capital allocation.

TECHNICAL INSERTS

Throughout this book we will include inserts which cover some of the more technical aspects of our work. The content of these inserts will provide more details about the mathematical and analytical background to the results being discussed in the main text. It is not necessary for the reader to understand the content of these inserts in order to be able to follow the line of thought in the main text.

1.3 WHY INVESTMENTS MATTER: THE IMPORTANCE AND STRUCTURE OF CAPITAL INVESTMENTS

CHAPTER HIGHLIGHTS

In this introductory section we provide an overview of the relevance and structure of capital investments at the company, national and global levels. We investigate the drivers of national and company growth, provide a comparative overview of investments across regions and industry sectors and analyze investment behavior over time to reveal the underlying trends and causes of investment cycles.

The intent of this section is to provide the reader with a fact base to serve as a backdrop for the specific strategic choices discussed in the later chapters. Whilst reflecting some of our analytic work on capital investments, in contrast to rest of the book it is largely descriptive in nature.

1.3.1 The relevance of capital investments

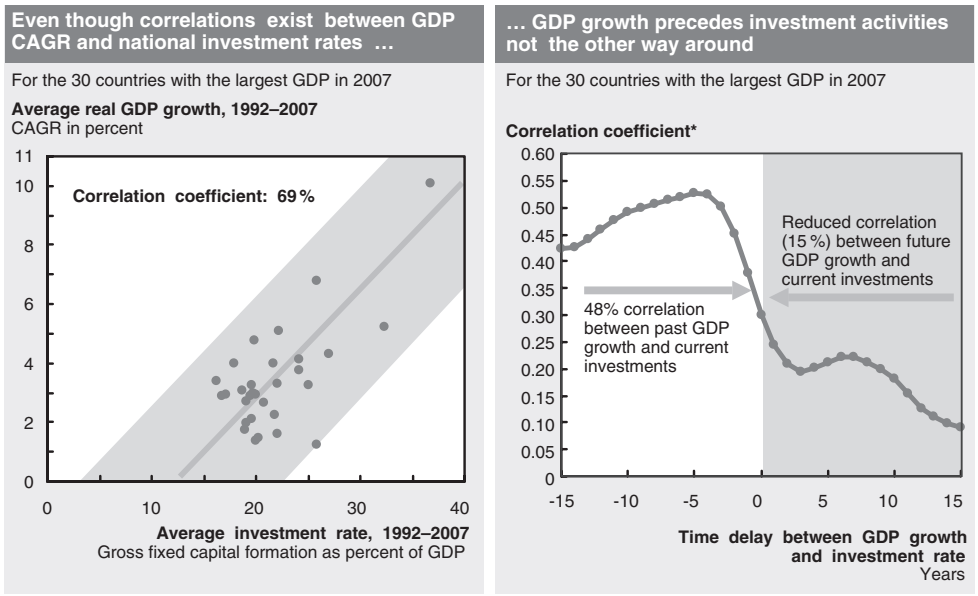
Capital investments matter for business for obvious reasons: they are a prerequisite for entering new businesses, fuelling future growth, and allowing sustained production. Beyond this, capital investments are also a main driver of economic performance at the macroeconomic as well as the microeconomic level:

- *Economic growth and investments go hand in hand.* Macro-economic analysis shows a significant correlation (∼70 %) between economic growth and investment in the top 30 most significant economies.
- *Investments drive business value creation.* Within the last decade companies have been able to significantly increase their return on invested capital (ROIC). We estimate that for the top companies worldwide (taken from the S&P 500 index) more than half their recent ROIC growth is related to investment activity.
- *Investments drive company growth.* An analysis of 25 of the top companies from the S&P 500 worldwide reveals ∼70 % correlation between growth and investment intensity. This connection between investments and long-term company growth is also supported by fundamental microeconomic considerations.

Investments are a core driver of economic growth worldwide

In 2007, a total of more than $11.8 trillion – 23 % of the world's GDP – was spent on investments. When analyzing the changes in GDP for the 30 countries with the largest GDP, we find a correlation of up to 69 % between changes in the GDP growth and the gross fixed capital formation – a surprisingly high correlation given the wealth of factors that influence economic growth (Figure 1.4).

A word of caution is in order, however: investment and growth are rather like the proverbial chicken and egg: it is difficult to distinguish what is cause and what is effect due to the multitude of interdependencies between the two. It is interesting to note, however, that GDP growth precedes investment activity, not the other way around as one might expect. One reason why this might be the case is that a large fraction of a nation's private and public investments is typically spurred by economic growth, rather than the other way around. Also important in



* Correlations of 5-year moving averages of investment rates and time-delayed real GDP growth between 1972 and 2005
Source: Global Insight, McKinsey

Figure 1.4 Correlation between GDP growth and investment rate

explaining this phenomenon is the tendency to invest pro-cyclically – an effect that we will investigate further in Chapter 4.

Regardless of whether it is the rate of economic growth that drives the level of investment or vice versa, the observed correlation is a clear indication of how closely economic growth is linked to investments – be they private or public in nature.

Investments are a core driver behind recent ROIC increases

Over the past 20 years we have observed a paradigm shift in how companies are run: the maximization of profits is no longer regarded as their key target. Value creation has taken over as the core metric of company success. Companies create value by investing capital at rates of return above their cost of capital. While value has been advocated by economists for a long time, it has only found widespread application in recent years, supported by the advent of modern spreadsheet applications. Return on invested capital (ROIC), together with other value metrics such as economic value added (EVA) and net present value (NPV), is now used widely as a value creation metric both by companies and by company analysts.

This new focus on ROIC appears to have had a significant impact on performance in that there has been a substantial increase in the ROIC achieved by top companies over the past 15 years. The median ROIC of S&P 500 companies rose strongly in the period 1992 to 2006, rising from 11 % to 26 % (Figure 1.5). This is all the more remarkable since the recent ROIC increase has not been accompanied by an increased rate of growth in sales. Sales growth has remained within its historical band during the last decade (ignoring the excursion around the year 2000).

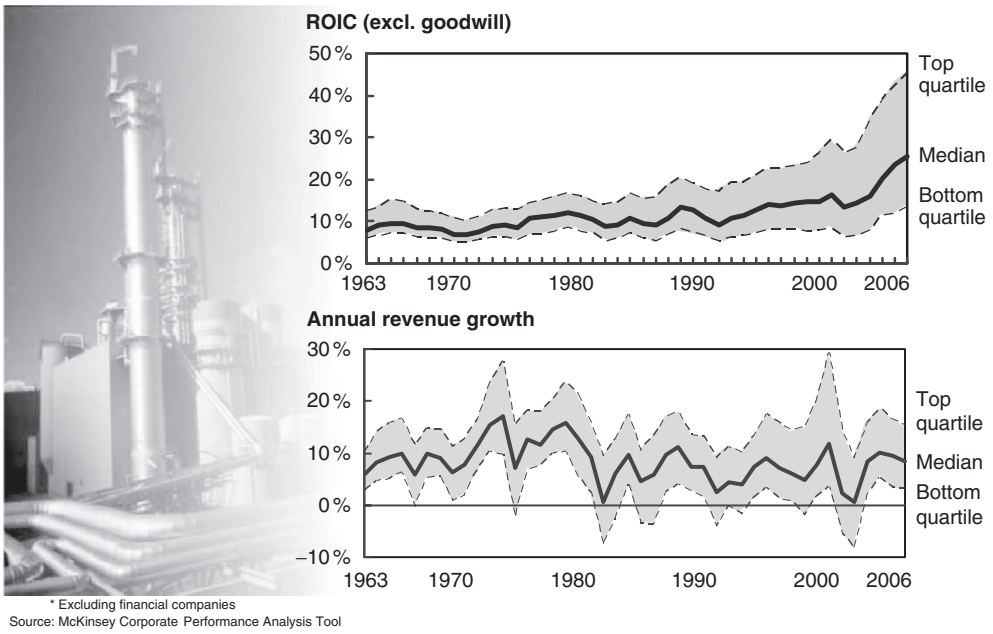
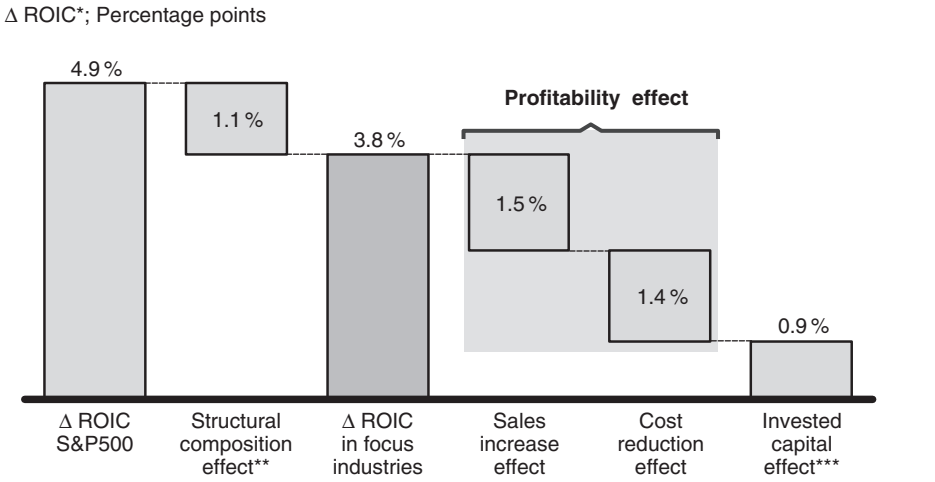


Figure 1.5 ROIC and revenue growth rates in the S&P 500, 1963–2006

The recent increase in ROIC growth also seemed relatively robust until recently. Even the dot.com meltdown at the turn of the millennium only slowed ROIC growth temporarily, before it gained renewed momentum in 2002. This ROIC increase has been helped in part by the structural changes that have taken place in the composition of the S&P 500, which now favours less capital intensive industries in the tertiary sector, such as services and IT. However, after separating these less capital intensive industries from the more capital intensive ones, we find that only a third of the recent ROIC increase is associated with structural changes. Roughly two thirds of the total increase (3.8 %) arises from ROIC increases within capital intensive industries, such as utilities, telecommunications, transport and logistics, oil & gas, chemicals, automotive, and high tech (summarized as "focus industries" in Figure 1.6).

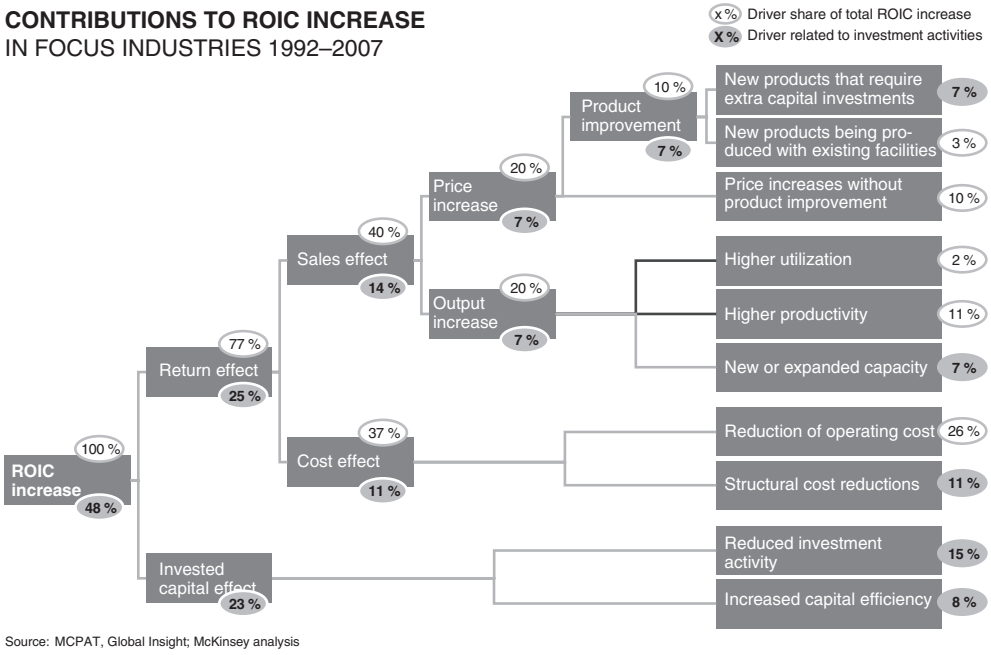
Capital investments have been a major driver of this increased value creation. We estimate that 48 % of the recent non-structural ROIC increase is investment related. This can be broken down further (see Figure 1.7). One quarter of the increase is driven directly by reductions in the level of invested capital relative to net profits. This increase in capital efficiency is fuelled in part by the increased awareness of value metrics, such as ROIC, and in part by the de-capitalization that took place in the mid- and late-1990s through the increased use of "capital light" approaches, including the new leasing approaches of airlines and restructuring in the utilities sector.

The other three-quarters of the recent increase in ROIC derives from the growth in corporate profitability. This enhanced profitability is driven both by increased sales and by cost reductions, with both drivers providing almost equal value contributions. This is interesting, since many executives seem to resort to cost reduction efforts rather than sales enhancement programs as the primary lever for increasing company performance.



* Difference between 10-year moving average of revenue-weighted ROIC in 1992 and 2007
** Due to structural composition of S&P 500 index, which also contains asset-light industries like Services and IT that naturally have a higher ROIC than the asset-heavy focus industries; excludes financial companies
*** Invested capital growth below NOPLAT growth, leading to a relative decrease in invested capital
Source: CPC calculation, MCPAT, McKinsey analysis

Figure 1.6 Components of the ROIC increase between 1992 and 2007



Source: MCPAT, Global Insight; McKinsey analysis

Figure 1.7 Drivers of ROIC increase and investment contribution

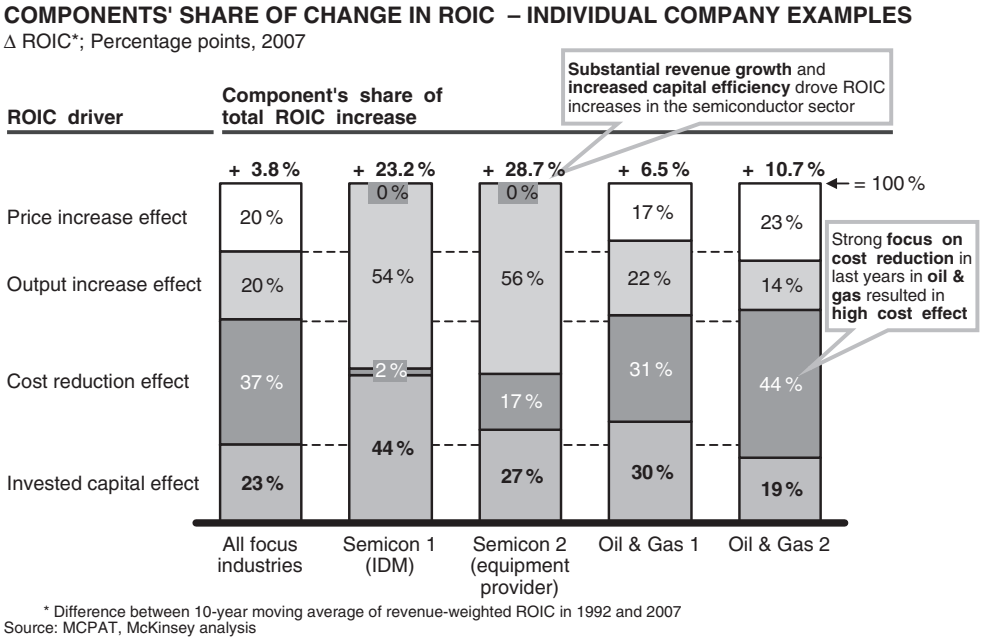


Figure 1.8 Individual ROIC drivers are influenced by industry- and company-specific factors

Not all profitability enhancements require new capital investments. Often, however, fresh investments do go hand-in-hand with sales enhancement or cost reduction programs. We estimate that sales or cost-related investments contribute 26 % to the ROIC increase out of the total 48 %.

Looking at this general picture at a higher level of granularity reveals a somewhat more textured pattern. From investigating individual companies in a variety of industry sectors it is clear that the specific combination of factors responsible for the overall ROIC increase differs substantially from industry to industry and company to company (see Figure 1.8). Whereas leading semiconductor companies have achieved ROIC increases between 20–30 %, based mainly on higher output volumes as well as increased capital efficiency, leading companies in the oil and gas industry have largely resorted to price increases and cost reductions to achieve ROIC gains between 5–10 %.

If we look at a greater level of detail, even in industries in which the overall picture appears fairly uniform, there can nevertheless be substantial differences at the individual company level. For instance, while two leading companies in the semiconductor industry achieved similar ROIC increases overall and both companies realized half the increase through sales growth, with a large contribution from increased capital efficiency, there were nonetheless significant differences between them. While in the case of the equipment provider cost reduction played a substantial role in achieving these gains, this was not the case for the integrated device manufacturer. We see a similar pattern in the oil and gas sector, where the contribution from cost reductions and capital efficiency gains once again varies significantly between companies.

In summary, over the past 15 years, companies have been able to significantly increase their value creation through higher returns on their investments. Since only the smaller part of this

increase can be attributed to changes in the industry structure, the greater part appears to result from how companies have adjusted their own behavior, with investments playing a major role in achieving the increase.

Company success relies on capital investments

Given how important investment is for growth overall, is this also true at individual company level? To answer this, we need to look at the nature of company growth. If a company intends to grow it has two avenues by which to do so: it can either expand its revenues through acquisitions (inorganic growth) or by selling more goods (organic growth). The delivery of most goods requires some level of investment upfront, no matter how the investment is used, whether this is to install a new production line for a car manufacturer or to extend an airline's plane fleet. It is therefore reasonable to expect some degree of correlation between the revenue growth and the capital expenditure of a company. This correlation is likely to be far from perfect, however, due to the numerous other factors that affect company growth, such as the impact of business cycles, changes in customer preferences and – most importantly – acquisitions. Nevertheless, with 50–65 % of M&A activities reported to fail to deliver on expectations (depending on the time period analyzed)[2], investments are likely to add significantly more value and in a predictable manner. A recent growth decomposition analysis by McKinsey has shown that 69 % of large companies' revenue growth on average is due to organic growth, the remaining 31 % being delivered by inorganic growth through M&A activities.[3]

There is a further challenge in establishing the nature of this relationship, however. Even if we were to assume the absolute dependence of growth upon investment (which we do not), it would be expected that the spread, timing and impact of the many small and large investments that a company makes over many years, all of which affect its growth in any one given year, would blur the picture significantly and make any correlation harder to establish. Indeed, when we analyzed 25 out of the top 50 companies worldwide[4] for the period 1988–2005, the period for which capital expenditure and revenue figures are available, this is what we found: the data show a considerable amount of spread. However, we also found a clear correlation, of up to 69 %, between revenue growth and investment intensity (Figure 1.9).

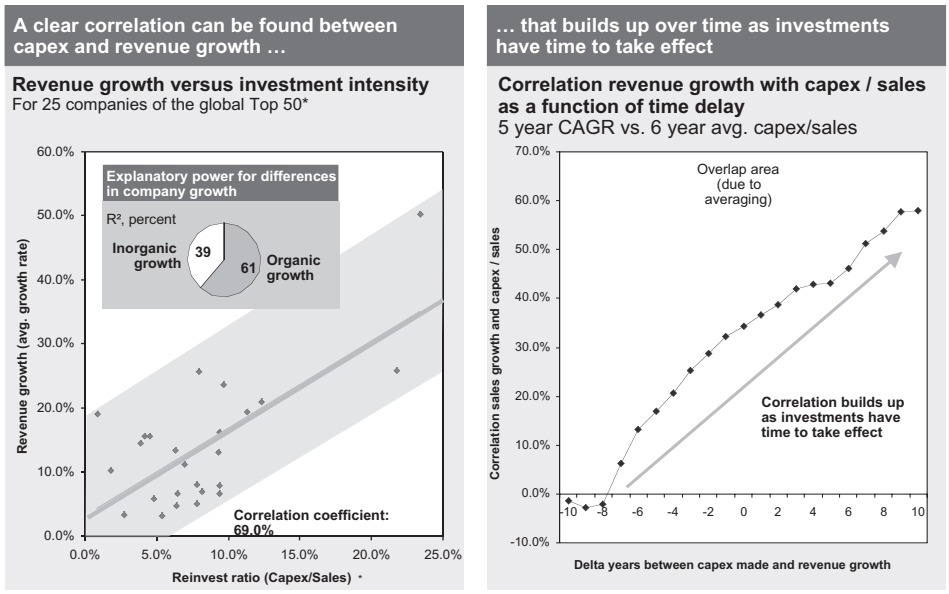
This correlation takes time to unfold, however. Typically, before the full impact of the investment can be seen in a company's results, a period of between six and 10 years needs to elapse. One of the main reasons for this delay is the lead time between the start of an investment and its production ramp-up. For example, the time that elapses from the initial investment of a new semiconductor fabrication plant (a "fab") to that at which the investment reaches full production, is of the order of 3–4 years. The most productive years in the life of a semiconductor fab will be 5–10 years after the start of production. It can therefore reasonably be expected that in most cases there will be a delay between the time an investment is made and when the impact of that investment shows up in company growth.

This presents the CEO with a number of difficult questions. The average CEO tenure has declined significantly in recent years, dropping from around nine to six years. This makes managing investments more problematic, as the CEO is unlikely to witness the full benefits of the investments they are responsible for. Neither do CEOs any longer have the luxury

[2] Dobbs et al. (2007).

[3] Viguerie, Smit, and Baghai (2007).

[4] Taken from the S&P 500 index.



* 5 years time gap to allow investments to take full effect, 25 S&P 500 companies where capex and revenue figures are available for 1988-today
Source: Global Insight WMM (2005), McKinsey & Company - Growth initiative, CI Team analysis

Figure 1.9 Correlation between investment and revenue growth

of sequencing consolidation and growth in the companies they manage, moving through a consolidation phase before fostering future growth. Due to the likelihood that their time in the role will be limited, there is now an imperative for them to launch growth programs at the outset. Only in this manner are they able to demonstrate the benefits of their actions while they are still in charge.

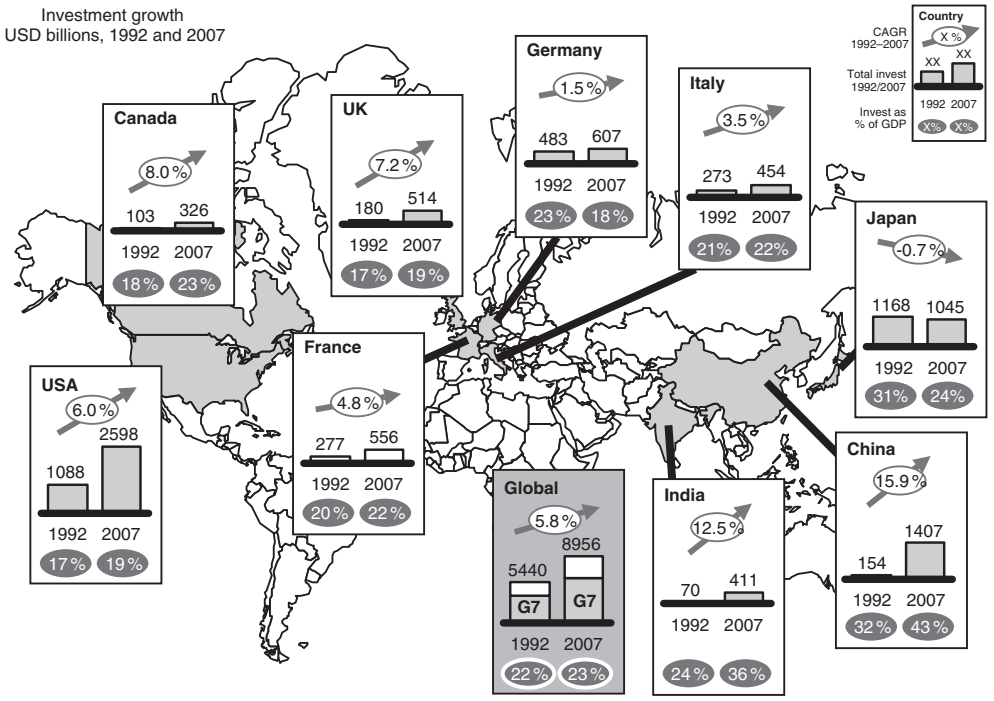
Basic microeconomics asserts the conclusion that higher investment rates support increased growth for a simple reason: A higher reinvestment rate allows faster output growth. If the investing company is able to sell the additional output in the market the investment will enable revenue growth in the future, which in turn will raise value creation if the company is able to reach an acceptable level of profitability on the additional production volume.

1.3.2 The structure of capital investments

Having looked at the fundamental relevance of investments to economic success, we will now examine how the structure of investment varies across geographical locations, across industries and over time.

A geographical perspective

Looking at the geographical distribution of investments worldwide, it is clear that there are significant differences in the pattern of investments between different regions, countries, and industries. The question we will attempt to answer here is whether these differences have a significant impact on the development of the various economies.



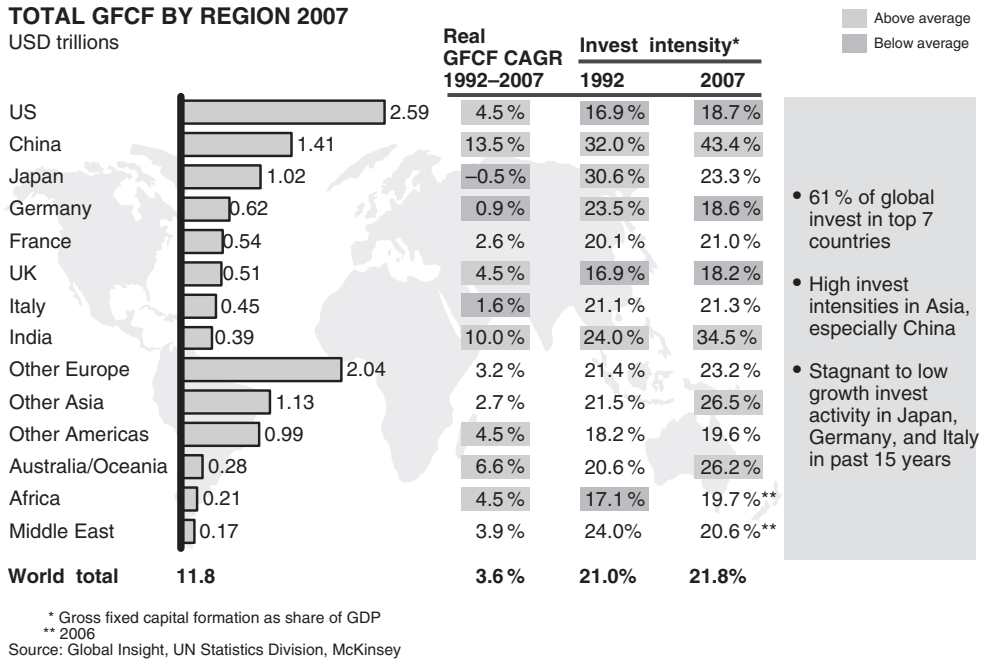
Source: IMF (World Economic Outlook Database, April 2008), Global Insight

Figure 1.10 G7, India, China and global investment growth, USD billions,1992–2007

It seems natural to start from a top-down global perspective of investments (see Figures 1.10 and 1.11). Global investments are still driven largely by the seven biggest economies, which account for more than 60 % of the total fixed capital formation (whereas all of Africa accounts for only 2 %). Overall, Asia is gaining ground, outpacing the growth of Europe and the Americas. We will take a somewhat closer look at the anatomy of Asian growth later; suffice to say for the moment that despite the increasing importance of the emerging Asian economies, such as China and India, almost three quarters of the recent ROIC increase has been realized in the developed economies rather than in the emerging ones.

Taking a look at the list of the top investor countries (Figure 1.11) we are not surprised to observe that the US is still in the lead, even increasing its investment intensity slightly, rising from 17 % in 1992 to 19 % in 2007. In second place, China has taken the position formerly held by Japan. China has fuelled its rapid economic expansion (achieving 13.5 % average GDP growth in the period 1992–2007) through a record investment intensity, which rose from an already extremely high level of 32 % in 1992 to a staggering 43 % in 2007.

Despite the economic crisis in the second half of the 1990s, Japan, in third place, has maintained a comparatively high investment level of 24 % in 2007, well above the global average. While for the US and China increased investment was turned into economic growth, for Japan it was not. Nevertheless, based on this high investment intensity, Japan continues to maintain a leading position in new technology. Germany, in fourth place, achieved a high level of investment connected to its reunification in the early 1990s. Since then it has seen its investment intensity drop, falling behind that of the US and its European neighbours,



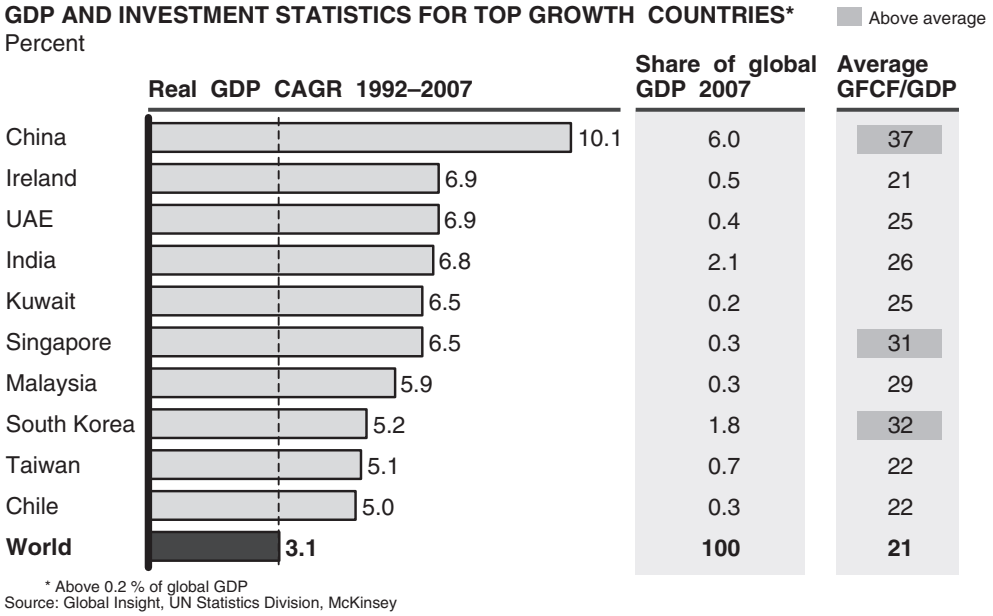


Figure 1.11 Global overview of investments (GFCF – Gross Fixed Capital Formation)

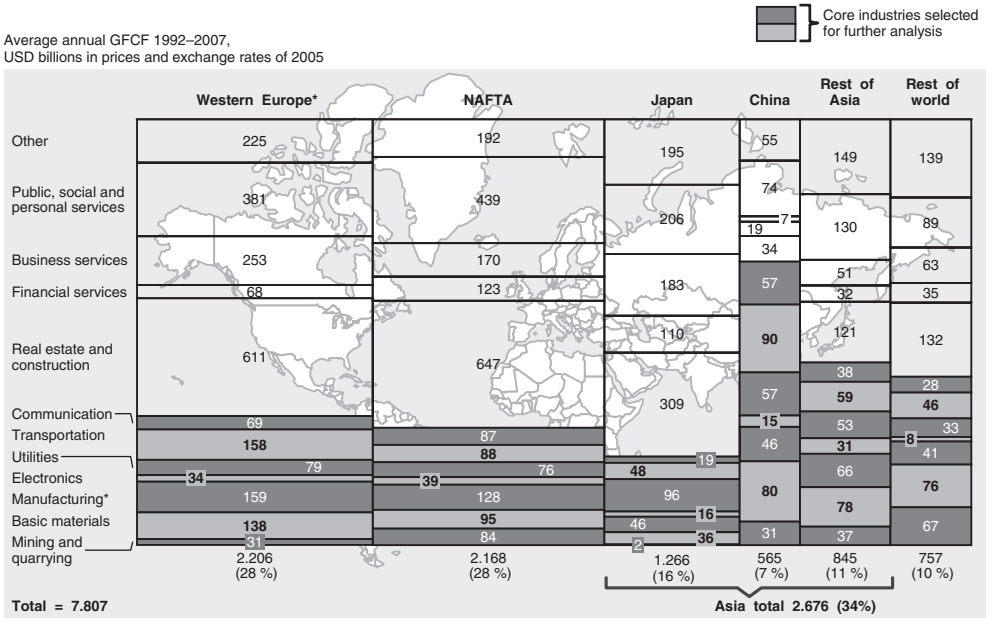


Figure 1.12 Global investment map

such as France and Italy. There are several reasons for this decline, including the increase in consumptive expenses in the eastern part of the country and reduced economic growth rates.

When the countries of the world are ranked in order of their growth during the period 1992–2007, rather than in terms of their absolute investments, we find that in all of the top 10 fastest-growing countries that this strong growth is connected to an investment level well above the global average. Three of the top 10 (China, Singapore, Korea) have fuelled their growth with an investment intensity above 30 % (Figure 1.11).

To obtain a more comprehensive overview of investments worldwide we have created a global investment map by region and industry (Figure 1.12). A quick comparison of the data reveals that Asia has become the largest investment region, accounting for 34 % of global investments. NAFTA and Western Europe[5] together contribute 56 % of total investments globally and are characterized by a similar investment pattern, although Western Europe and Japan invest more in manufacturing than does NAFTA, which invests more in the service sector.

Overall we find that the level of investments in emerging economies – starting from a lower base – is outpacing that of established economies (Figure 1.13). The emerging economies are growing twice as fast as the established ones, an evolution enabled by an investment intensity which is 50 % higher.

While this overall trend is not unexpected, it is interesting to take stock of some of the details that exemplify the links between economic growth and investments. In Asia, China is

[5] EU 15 plus Norway and Switzerland.

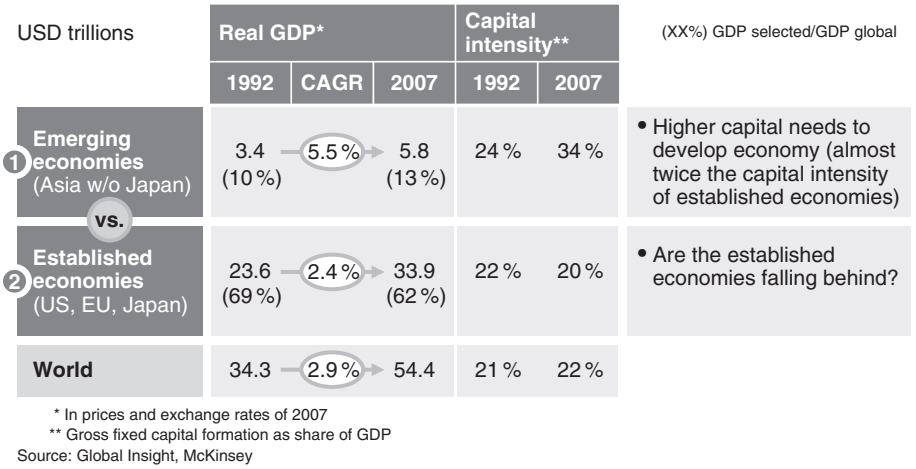


Figure 1.13 Differences in capital intensity between the emerging and established economies

ahead of India in terms of its level of investment. China's capital intensity rose from 32 % in 1992 to an astounding 43 % in 2007. During the same period, India was able to raise its former investment level of 24 % up to 34 % in 2007, also well above the global average. But while China's GDP more than quadrupled in the period 1992–2007, India achieved just half this rate of growth, raising its GDP by 165 %. Nevertheless, India has been able to accelerate its growth rate from annually 5 % to 9 % in the recent past.

In the established economies, although the US and the EU 15 displayed an almost identical level of investment in the period 1992–2007 ($1.9 trillion a year in the US compared to $2.1 trillion per year for the EU 15), the US has grown its investments at almost twice the rate of the EU 15 (at a CAGR of 4.5 % compared to 2.7 %). This goes hand-in-hand with the faster economic growth of the US.

At the overall level, the structure of investments in the US and Europe still show substantial commonality – in contrast, say, to that of the less developed economies. However, in the US there is nonetheless a perceptible shift from manufacturing towards electronics and real estate and housing that is not so apparent in Europe. In Europe, especially in Germany, a significantly greater share of investments go into manufacturing. Europe also invests more in business services, including accountancy and financial advice, while in the US the level of public sector investments is higher, reflecting the higher level of commitment to defense expenditure. At a more granular level, the US and Europe should not be considered monolithic blocs, of course. In Europe, for example, both Ireland and the UK have achieved above-average economic growth. In both cases this has gone hand-in-hand with increased investment intensity.

To summarize: during a period that has witnessed increasing economic integration across national boundaries, when outsourcing and off-shoring have become widely practiced in an increasingly global economy, there are nevertheless still significant differences in the investment structures of the world's largest economies, not only between regions but also within regions. In this complex landscape, where to invest remains a crucial question for companies.

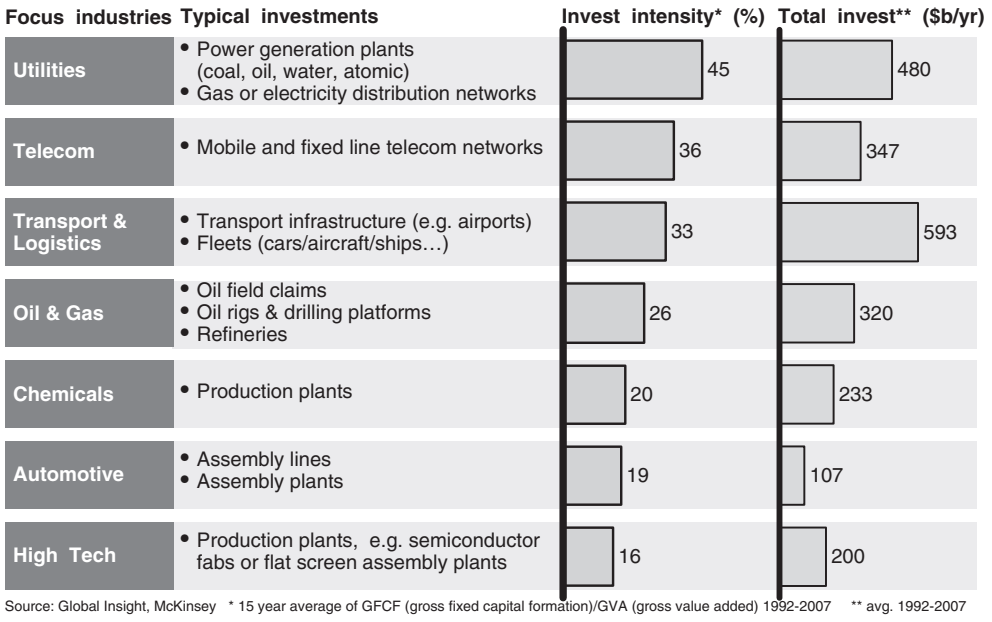


Figure 1.14 Industry investment profiles

Investment profiles across industries

We have identified seven industries that show a combination of high investment intensities and high levels of total investments (see Figure 1.14)[6]. We will draw upon these industries throughout this book for examples that illustrate the investment challenges and solution approaches.

The type, intensity and total investment volume vary widely between these focus industries. Whereas investments in utilities, such as power generation and water supply, are driven by fairly predictable increases in long-term demand or regulatory changes, investments in the high-tech sector are driven by sudden changes in technology and the highly cyclical nature of the markets. Overall, during the period 1992–2007, the investment intensity in utilities was the highest of the industries studied (45 %), whereas the highest total investment was in transport and logistics (an average of $593 billion per year).

1.3.3 Time dependence of capital investments

Looking at the overall pattern of global investments from the 1970s onwards we see a cyclical pattern not unlike that of the global economic cycle. Looking a little closer, we observe that a typical investment upturn lasts for about 5–8 years, followed by a period of stagnation of about three years (Figure 1.15). Of course, there are many variations to this pattern. There were longer upturns during the periods 1983–1990 and 1992–2000, with a shorter period of stagnation in between.

[6] And are not of a private or public nature such as real estate or public and social investments

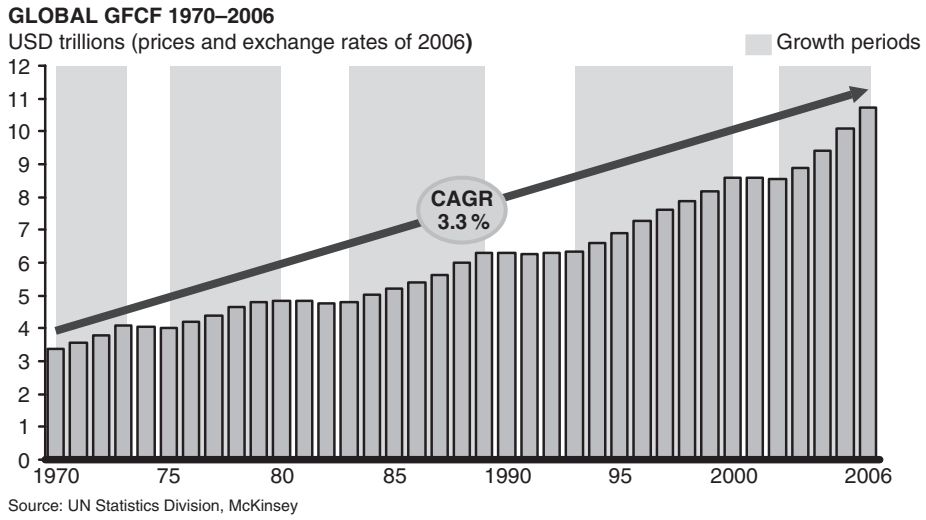


Figure 1.15 Global investments timeline

Even though this periodic behavior is not inevitable, after a prolonged phase of growth, any adverse economic incident is more likely to start a slowdown. The latest upturn started in 2002. Since we started writing this book, we have started to see the beginnings of another economic slowdown, in this case triggered by the subprime debt crisis in the US.

This is not to suggest that all economies follow the same cycle. Distinct differences between regions become visible when we look at national economies (see, for instance, Figure 1.16).

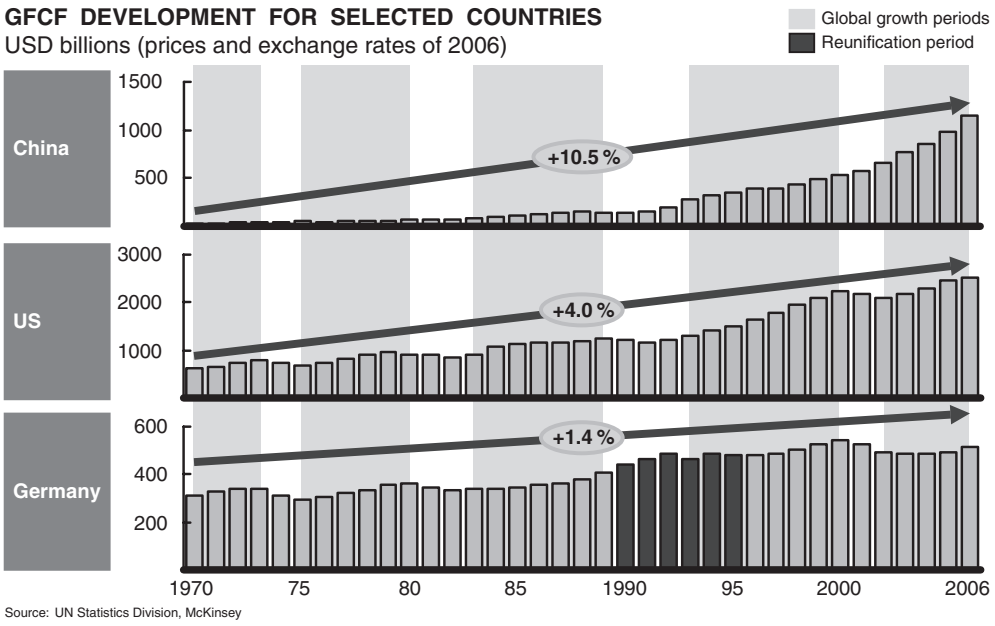


Figure 1.16 Comparison of national investment with global investment cycles

As already pointed out, while the US grew its investments at a solid CAGR of 4.0 % during the period 1970–2006, Germany, in contrast, saw only a meager growth of 1.4 % a year during the same period. As a result, the US has more-or-less tripled its total investment volume over the last 30 years, whereas Germany has only increased its investments by ∼40 %. Starting from a very low level, China's investment volume has grown to exceed $1100 billion, making it the world's second biggest investing nation.

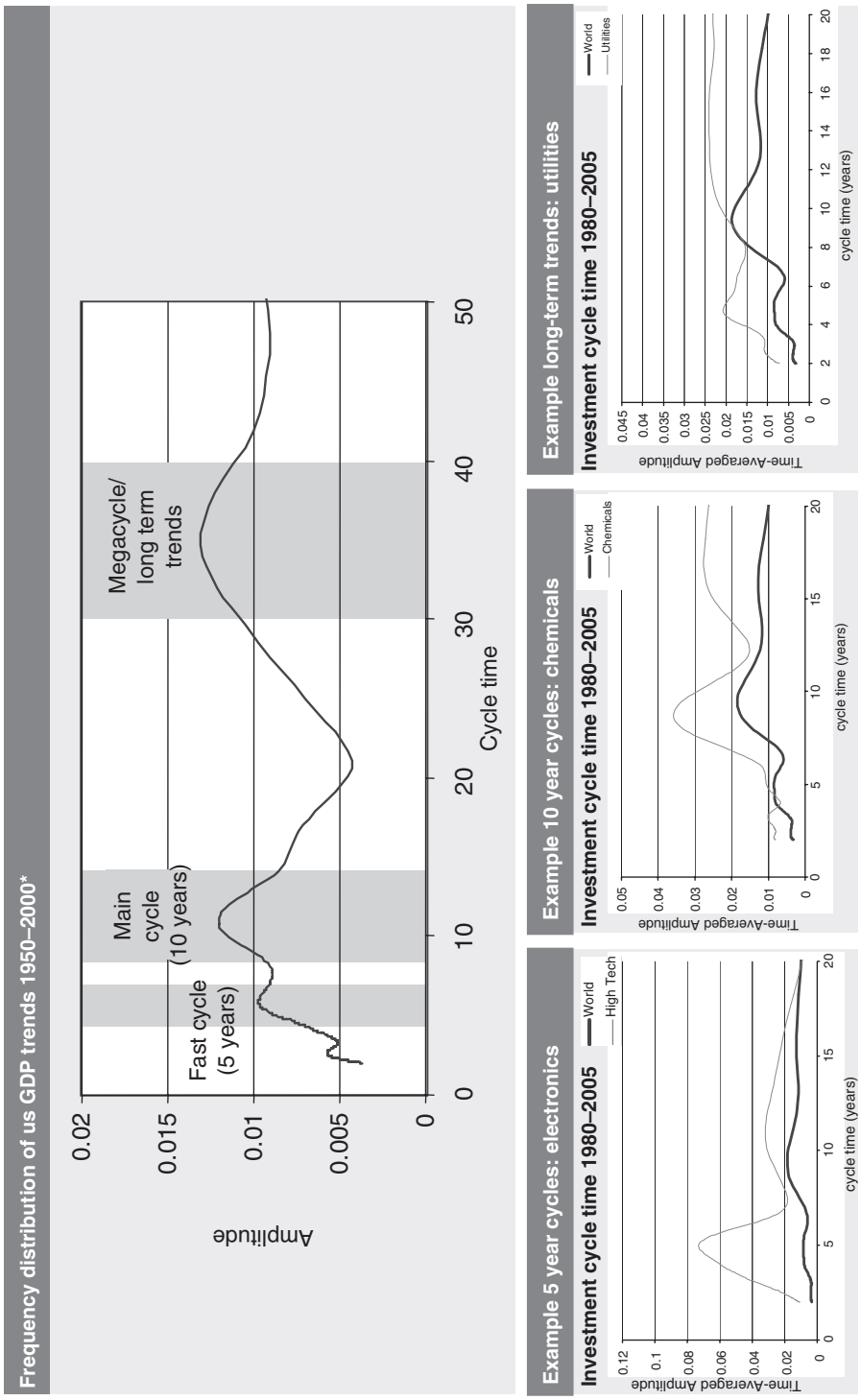
Common sense suggests that the GDP fluctuations cannot be predicted from historical data – and rightly so. All the time correlations are quickly blurred by the incoherence of actions of individuals responding to such information in the deals they make. This leaves little room for arbitrage that could potentially exploit historical patterns. However, this does not mean that there is no structure to economic evolution. Quite the contrary: for instance, the frequency distribution of US GDP trends show characteristic cycle patterns.

- The **classical economic cycle** centers on a cycle frequency of **10 years**. These cycles are connected to the ebb and flow of investments, which are themselves a response to the ups and downs of the economy. They were first observed and described by Clement Juglar in the middle of the 19th century.
- A second, **shorter, five-year cycle** accompanies this 10-year cycle. It is partly driven by aggressive investment cycles in fast-growing industries such as semiconductors but is fuelled mainly by inventory fluctuations. It was first characterized by Joseph Kitchin in 1923.
- **Megacycles of 25–45 years** complete the picture. These megacycles are a superposition of infrastructure investment cycles that exhibit frequencies of up to 25 years (as described by Nobel Laureate Simon Kuznet in 1930) and "grand supercycles" or Kondratieff waves of 45–60 years (first identified by Nikolai Kondratieff in the 1920s).

We have applied the method of wavelet transforms to derive the frequency spectrum of economic cycles from the observed timelines. For an overview of this method we refer the interested reader to Appendix 1.1 at the end of this chapter.

A greater understanding of the texture and nature of these cycles can be gained by looking at individual industries. While the cycle of the electronics industry is dominated by a five-year peak, a pronounced 10-year peak governs the economic cycles in the chemical industry. The utilities industry is more complex in this respect, however, and is characterized by a mix of short, four-year fluctuations and a broad spectrum of longer-term frequency components. Overall this is not surprising, considering the differences in the underlying businesses of the two industries, such as the rapid succession of product generations in the electronics industry versus the extended lifetime of utility assets (of 20–30 years and longer). The pattern in the utilities industry is also influenced by overhaul cycles of between two and four years.

A pressing question for many business leaders in the present economic climate is: how is investment evolution at the industry level linked to that of the economy as a whole? In order to investigate this question we have compared investment growth at the industry level to that of the growth of the economy as a whole over a period of more than 30 years. This analysis reveals a clear but far from perfect correlation of 60 %. The fact that both timelines seem to be linked is not unexpected. It is reasonable to assume, for instance, that public and private investment budgets are managed, at least in part, in proportion to the total available budget. However, further examination shows that the investment timeline amplifies the various ups and downs of the GDP: changes in investment growth are more than three times as pronounced as those in GDP growth. This is true both in the established economies as well as in the emerging ones.



* Continuous Wavelet Frequency spectrum based on Gaussian derivative wavelet transform

Source: CI team analysis

Figure 1.17 Wavelet analysis of the overall and industry investment timelines

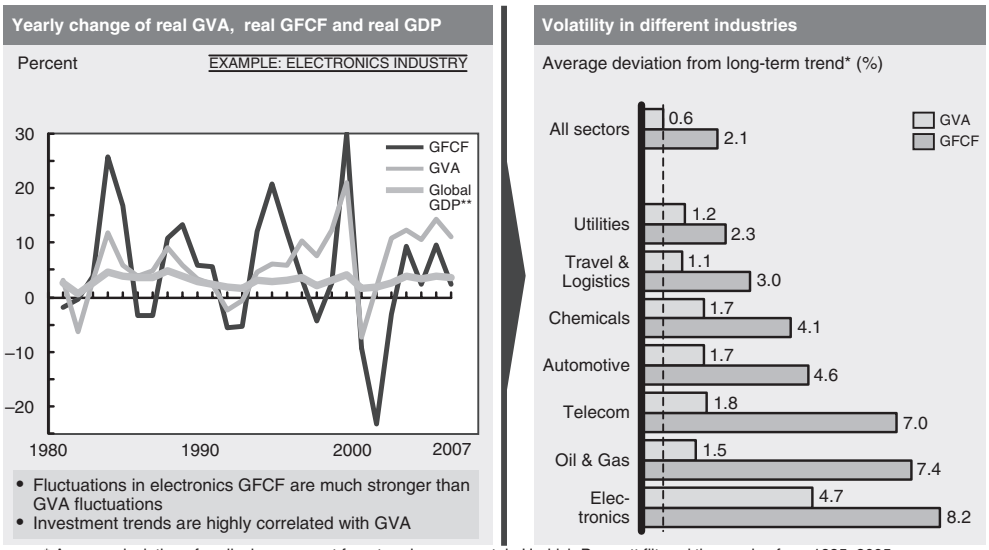


Figure 1.18 Investment (GFCF – Gross Fixed Capital Formation) volatility compared to industry value add (Gross Value Add = Revenues – Cost of Goods) and GDP volatility

Figure 1.18 depicts the value added and investment volatilities overall, as well as that for a selection of industry sectors. The investment (GFCF) volatility across all sectors is 3.5 times higher than that of the gross value added (GVA) measured over a 20-year period from 1985–2005. This amplification effect is even more pronounced if we look at individual industries. The volatility of the electronics industry's GVA is almost eight times that of the economy as a whole; the investment volatility in the electronics industry is even higher, at 14 times that of the economy. This volatility can have drastic economic consequences. One laminate producer,[7] for example, which serves the electronics industry, encountered an 80 % revenue drop during 2001–2002 due to buffer effects along its value chain. Thus, if the economy sneezes, the electronic industry catches a cold and the electronics investments goods sector is likely to suffer from severe pneumonia.

Company investments tend to show a similar pattern of amplification. Companies often experience difficulties in reducing costs sufficiently quickly to align themselves with the cycle so, instead of cutting costs, they tend to postpone or abstain from investing during downturns, since it is often easier for them to reduce investments than to reduce recurring costs. Typically, therefore, investments tend to follow cash availability and react more strongly to market fluctuations than revenues.

We will examine the underlying forces behind the cyclical aspects of investments in more detail in Chapter 4.

[7] Laminate producers manufacture the laminate plates used in the fabrication of printed circuit boards. Typically, a laminate consists of one or more layers of epoxy resin and metal fused together by pressure and/or heat.

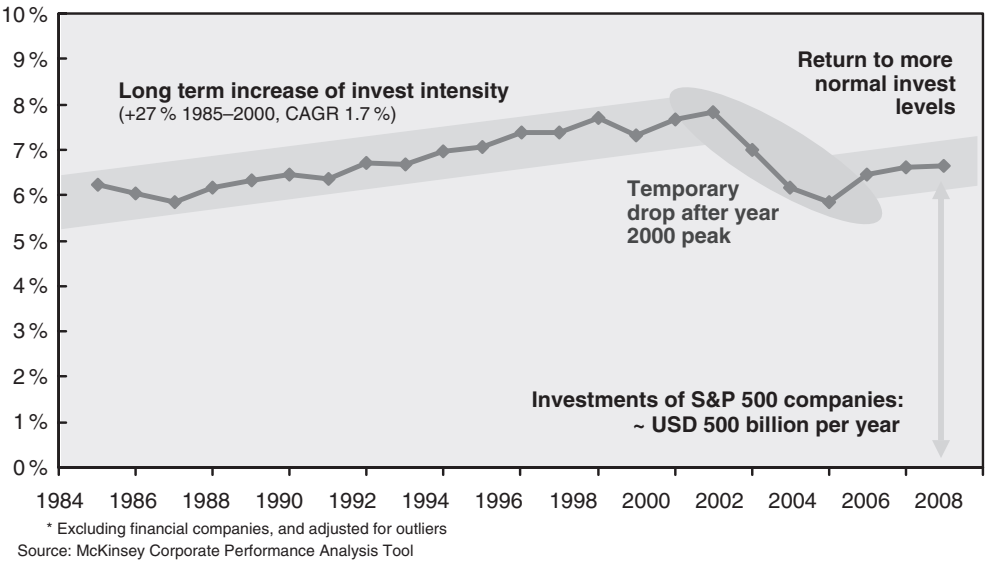


Figure 1.19 Capex levels of the Fortune 50 companies, 1998–2009

1.3.4 The future of capital investments

Despite the present economic situation, there are a number of reasons why we believe investment levels will continue to increase in the longer term. A look at the history of the capital expenditure of the Fortune 50 companies reveals increasing investment intensity over the period 1984–2000. However, there was a significant drop in overall investment levels during the downturn of 2001–04. This investment gap will need to be compensated for by increased investments at some point in the future (Figure 1.19).

Some factors that are expected to drive this investment growth are:

- The increased need for **replacement investments** in countries such as Germany and Japan, which have recently fallen behind in their long-term average investment intensity. In addition, in certain industry sectors, such as utilities, a large proportion of the generation capacity will need to be renewed at some point in the near future in order to meet increased environmental standards and/or enhanced efficiency. Within the utility sector alone, OECD and IEA estimates suggest that approximately €11 500 billion will need to be invested globally in the areas of power generation, transmission and distribution during the period 2006–30.[8]
- The **ramp-up of the emerging economies** in Asia. The accelerated growth in the rapidly growing economies of countries such as China has already led to a significant increase in fixed capital formation. We expect this trend to continue in the coming years.
- The continued trend of **globalization**, which is leading to a rebalancing of industrial capacities at the international level. This will continue to go hand-in-hand with further investments, both in the countries that take over production as well as in the countries that are off-shoring operations in order to rededicate their productive assets to new tasks.

[8] World Energy Outlook 2007, OECD/IEA.

A final example of why there will be a continuing need for increased investment levels in the coming years comes from what is maybe a less obvious source – the demand produced by global warming and the need to reduce CO_2 emissions in order to control the greenhouse effect. The sums involved in putting these problems right will be enormous. One source, the International Agency for Energy (IEA), estimates that $45 trillion will be required in investments by 2050 in order to stop global warming.

Investments have always been a core driver and enabler of economic growth. We expect them to continue to be so in the future.

1.4 SUMMARY

The first part of this book has painted a broad picture of the important role investments play for economic success at the aggregate, industry and business levels. We have seen how investment varies by industry and geography, and how the level of investment is subject to significant variation over the course of the business cycle. In Part II of this book we will focus on trying to decipher some of the underlying determinants of whether an investment is likely to be a success or a failure. These chapters seek to provide the reader with a good understanding of the most important aspects that determine whether or not a company is able to get its investment right – in terms of managing an assets exposure to competition and risk, the right choice of technology, its timing, size, location, design, and financing.

APPENDIX 1.1: WAVELET ANALYSIS: EXTRACTING FREQUENCY INFORMATION FROM INVESTMENT TIMELINES

Any timeline can be decomposed into the frequency components it contains. Consider, for example, a piece of music played by an orchestra. Each note corresponds to a certain frequency. However, the total recording (the entire piece) contains a mix of all the notes played by the individual instruments. A frequency analysis can identify the different frequencies (notes) present in this timeline and is, therefore, very helpful in separating out the individual frequency contributions. A graphic equalizer makes use of this effect by influencing only certain frequency segments, amplifying them or reducing them to influence the balance of the bass or treble components of a song.

Fourier transformations are widely used in engineering and science to obtain frequency transforms of time data. However, to yield useful results Fourier transforms require stationary sine-oscillation components with a fixed-phase relation (coherent signals) to be present. In order to perform a frequency analysis for non-stationary (incoherent) oscillations, the Fourier transforms need to be replaced with so called “wavelet” transforms. In this case a “mother wavelet” of finite duration is used to analyze the time data.

Figure 1.20 provides an example of such a wavelet transform where the sampling wavelet is an oscillation with time delays – or a “wave package” – in the form of a Gaussian derivative. The timeline under consideration is a simple sine wave of a fixed frequency but disturbed by a number of delays scattered over time. The resulting overall frequency distribution clearly shows the core frequency despite this disturbance. It also shows that the distribution tail travels across a range of frequencies. The full transformation result reveals the frequency components along the x-axis and the time information along the y-axis. The delay periods in the timeline show up as gaps in the spectrum.

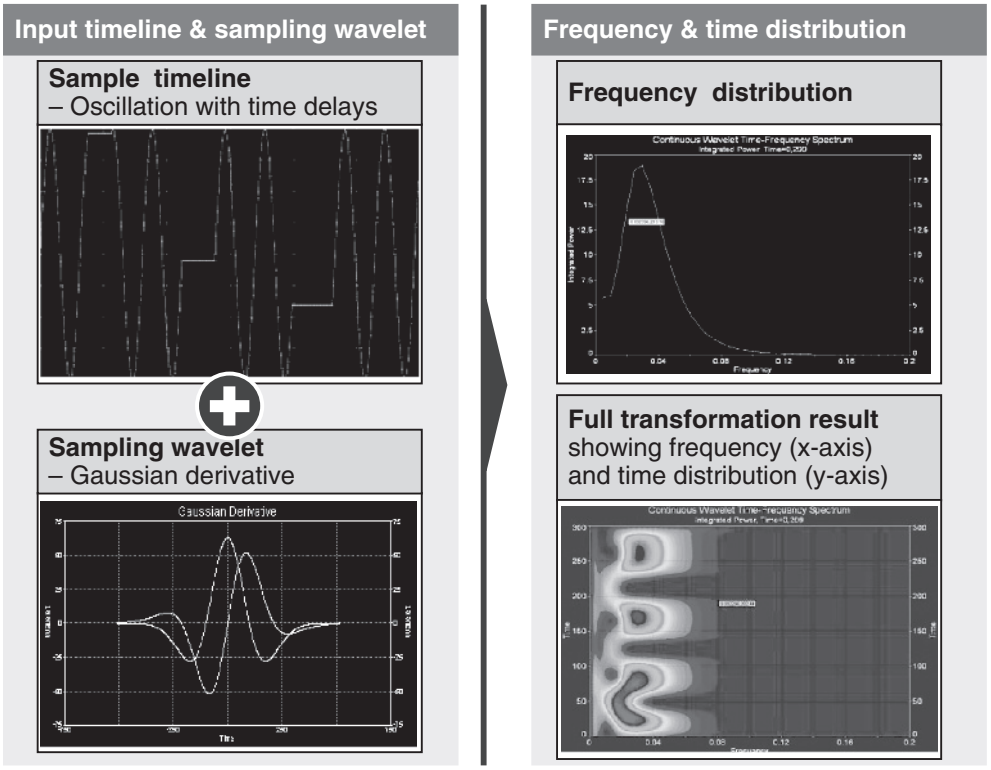


Figure 1.20 An example of a simple wavelet analysis on a sine wave with interrupts causing phase delays

Economic timelines, while often demonstrating cyclical features, cannot be represented as stationary oscillations. Therefore, wavelet transforms need to be used to extract meaningful frequency information from the time data. Although economic evolution is highly unpredictable, such an analysis is able to reveal the presence of dominant frequency regimes that govern the evolution of the economy (as typified by Juglar, Kitchin or Kuznet/Kondratieff waves).

Figure 1.21 provides an example of a wavelet analysis of GFCF development in the communications sector in the period 1980–2005. The changes in communications investments have been largely in line with the overall patterns of GFCF apart from the boom and bust involved with licensing 3G Universal Mobile Telecom System (UMTS) around the year 2000. The overall frequency transform shows two major frequency components to be present:

- A stable 10-year cycle that is visible across the whole period. This is a reflection of the overall economic and investment cycles.
- A shorter 5-year cycle with a pronounced peak around 2001. This peak is a reflection of the excursion of the industry into UMTS. While this peak does not reflect a regular pattern in the communications industry, it may well reflect the characteristic response times in the mobile segment of the industry (of around five years' duration).

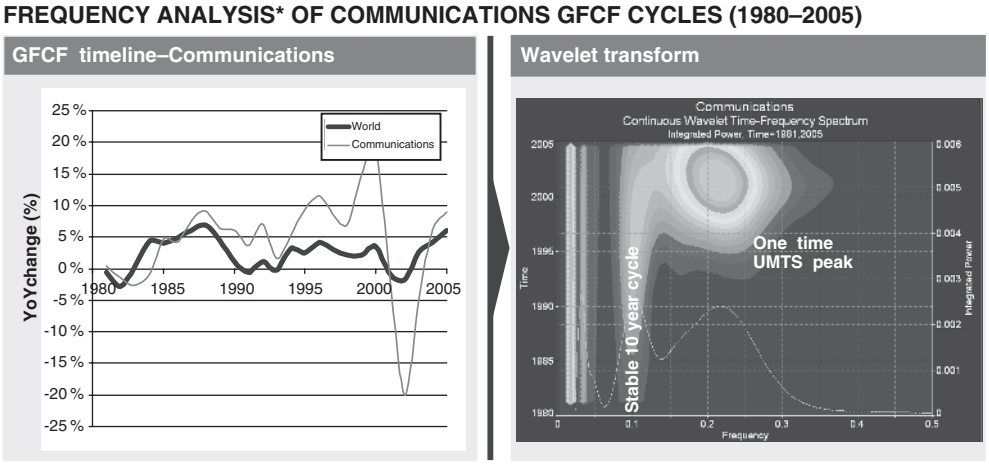


Figure 1.21 Wavelet analysis of the investment timeline in the communications industry

This analysis shows that wavelet transforms can be a powerful tool for identifying and analyzing cyclical economic patterns and can uncover the underlying characteristics of an economic system at both the microeconomic and macroeconomic levels.

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