# A Reconsideration of Full-Cost Pricing

## Methodological Aspects of Marginalism and Theoretical Explanations of Pricing Behaviour

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# Preface

When I first learned about the phenomenon that most firms set their prices by applying a profit mark-up on full costs, I was sceptical if this topic would lend itself to a fruitful research question. My doubts were not grounded in my conviction that the issue was not highly interesting, let alone important. Rather, I expected that such a vast body of ideas and economic research had already been done on the subject that there would hardly be any "new land to conquer".

With patience, my supervisor Ekkehart Schlicht repeatedly asserted to me that by and large, there barely exists any mainstream economic research on why firms use this pricing method and not another, and what economic implications are entailed by this pricing behaviour. I found it hard to believe him. Given the importance of a thorough understanding of pricing behaviour for economic research in many areas of the field, how could this phenomenon not have been subject to extensive research?

I believe I have, in the course of this project, found some answers to this question, having greatly benefited from working with Kenneth Coutts, a leading expert in the field. Yet a part of me is still puzzled by the fact that something so fundamental to economic theory as the pricing decision has not been studied to an appropriate extent. Contemporary mainstream economists rely on the principles of marginalist price theory whenever pricing behaviour needs to be modelled in micro- or macroeconomic settings. Firms are assumed to be profit maximizers, and thus equate marginal revenues and marginal costs to find the price/output combination which yields optimal profits. This neoclassical framework can be extended to incorporate various other scenarios such as costly information, specific market settings or assumptions on growth and innovation. While optimal strategies under these extensions are studied quite rigorously in mainstream economics, these models are generally treated as if they generated reliable positive predictions for reality. In this sense, economists

rest on the general validity of the postulates of marginalist price theory. Yet as I will argue, this faith is not grounded in empirical confirmation, but rather in questionable theoretical reasoning and probably the lack of an alternative that is as easily and generally applicable. That economists rely blindly on marginalist theory has not always been the case. In the first half of the 20th century, evidence of actual pricing behaviour of firms was discussed to a significant extent among economists and the validity of marginalist price theory was called into question. After a fierce debate, proponents of marginalism were successful with their defence strategy and a generalized version of neoclassical economics emerged as the victor of the controversy. This approach has since then been the exclusive theoretical framework for industrial pricing in mainstream economics.

Since the controversy ended, empirical research has continued to provide evidence for cost-plus pricing behaviour. Most firms set their prices by adding a profit mark-up to a full-cost base that includes fixed overheads which should be, according to neoclassical postulates, disregarded for the pricing decision. These cost estimates are often derived by traditional costing systems that crudely allocate common and joint costs to individual products and have been criticized for leading to distorted cost measures. As will be shown in this work, these aspects of pricing behaviour have implications both for the profitability of individual firms and the aggregate behaviour of prices in the market. The motivation if this research project is thus threefold.

Firstly, I seek to reassess the aforementioned controversy on marginalist price theory to determine whether the loss of interest in studying the details of the pricing decision due to a reliance on the validity of marginalist price theory is justified. As I will discuss in Chapter 1, entitled "Marginalist Price Theory and Full-Cost Pricing", the debate on cost-plus pricing, and with it the concern for the development of fitting theoretical approaches to accurately represent the pricing decision, ended prematurely. Not only have supporters of marginalist price theory failed to put forward convincing empirical evidence for the validity of their approach, but also remain their theoretical justifications incomplete and unsatisfactory in several respects. Furthermore, empirical and theoretical investigations regarding the foundations of the marginalist approach fortify the view that economists should have little reason to exclusively resort to marginalist pricing theory for conducting research. In the discussion of the problematic

aspects of the prevailing theoretical framework, some alternative possibilities are outlined regarding research strategies that may lead to a price theory that is more coherent and consistent with reality.

The second motivation for this work is to shed light on some of the aspects that are responsible for the wide use of full-cost pricing, and the related prevalence of cost allocation techniques in management accounting. In Chapter 2 and 3, prevailing pricing methods are studied using two different approaches. Chapter 2, entitled "On the Persistence of Absorption Costing", examines the pricing and costing behaviour of firms within a framework of institutional economics. It is shown that full-cost pricing techniques have been institutionalized due to historical, political and economical reasons during the end of the 19th and the early 20th century. Up to the present day, institutional factors stabilize its persistence against pressures for change despite apparent economic inefficiencies. Yet it will be shown that an obvious argument along the lines of path dependency and institutional lock-in effects does not suffice to explain why firms continue to use supposedly inefficient costing systems when more advanced systems such as Activity-Based Costing are widely available and have been heavily propagated during the last 20 years. Instead, it will be argued that a range of institutional stabilizers, namely psychological fallacies, auxiliary functions of cost allocations and the external effect of financial accounting regulations deter management accounting change towards more modern approaches. Through this investigation, it will become clear that pricing is governed by many other aspects besides purely economic forces, a fact that is not recognised in the marginalist approach.

Chapter 3, entitled "Cost-Plus Pricing and Uncertainty", investigates the pricing decision in the context of demand uncertainty. For this purpose a model is developed that, at first glance, resembles a pure neoclassical formulation of cost-plus pricing. Yet in the course of the chapter, a theoretical approach of modelling the pricing decision is introduced that aims at an actual description of firm behaviour, rather than resorting to instrumentalist as-if justifications. The model distinguishes between the two most common forms of cost-plus methods, namely variable and full costing. It is recognised that firms are characterized by incomplete knowledge about their market environment and thus rely on rules of thumb. In this setting, a justification for the wide use of full-cost pricing emerges. It is shown that under settings of both monopoly and

imperfect competition, full-cost pricing can be a more robust strategy in an uncertain market environment in terms of expected profits than a mark-up pricing method that corresponds to the marginalist pricing postulates. Thus both investigations of the pricing decision in Chapters 2 and 3 demonstrate that a deviation from the prevailing standard of marginalist as-if reasoning can yield new insights into the economics of the pricing decision.

The third motivation that I followed with this work relates to the methodology of economics. As has been insinuated above, most economists rely on marginalist price theory and do not engage in investigations of actual pricing behaviour. I want to put forward an argument that an investigation and recognition of inner-firm decision processes, such as pricing, can be a valuable approach for economic research. For example, the importance of internal costing systems for the behaviour of firms has not been recognized by most economists. Firms use these systems to generate, process, and evaluate information about business operations. As a consequence, these management accounting systems play a crucial role in the firm's decisions and can thus lead to aggregate economic effects. To demonstrate this, Chapter 4, "Price Dispersion, Inflation and Cost-Plus Pricing Heuristics", establishes the connection between the choice of the internal costing approach and the well documented but not yet fully understood phenomenon of the positive relationship between relative price dispersion and the rate of inflation. By using a modified version of the pricing model developed in Chapter 3, the implications of an inflationary shock are considered. While no increase in the dispersion of relative prices occurs if firms calculate prices using variable costs, a full-cost rule increases individual price variance and thus the overall dispersion of prices in the market. This study thus exemplifies that specifics of the pricing approach in general, and the choice of the costing system in particular, can be brought into connection with well recognised economic phenomena that are not yet fully explained.

The four chapters of this thesis are self-contained and can be regarded as autonomous articles. They each provide their own introduction and discuss the literature relevant to their respective research question. Furthermore, they also outline the basic concepts that are central to the treatment of the respective topic. As such, discussions of fundamental aspects of cost-plus pricing, and full costing in particular, recur throughout this work. While the chapters may be read individually in any order, the reader may benefit from following

the proposed structure. Chapter 1 initiates readers unfamiliar with the discussions surrounding cost-plus pricing with the topic and gives an overview on previous research on the topic. Furthermore, Chapter 4 analyses the link between price dispersion and inflation using the behavioural model developed in Chapter 3. Although the approach is discussed in sufficient detail in Chapter 4, readers interested in a closer look at the model design may benefit from studying Chapter 3 beforehand.

# 1 Marginalist Price Theory and Full-Cost Pricing

## 1.1 Introduction

The pricing of goods and services is of central importance for the success of an enterprise and for the efficient operation of economic systems as a whole. As a consequence, one would expect a large existing body of economic research concerning the pricing decision and that, as a result, the factors that govern industrial pricing would be fairly well understood by economists. Yet the majority of the profession is, by and large, ignorant of how firms actually determine their prices. Relying on the postulates of marginalist price theory, most economists have deemed it unnecessary to study the complexities of the pricing decision and thus treat the firm as a "black box".

Economists were not always so convinced of the adequacy of marginalist price theory. In the first half of the 20th century, some researchers brought forward empirical evidence that suggested that firms use pricing methods not even remotely resembling the marginalist calculus of equating marginal costs with marginal revenues. Instead, many firms were found to rely on "cost-plus" methods, where they add a mark-up to a cost base that often includes fixed cost elements. The discovery of this evidence for "full-cost pricing" led critics of the prevailing framework to proclaim the end of marginalist price theory and consequently gave rise to a heated controversy. Eventually, marginalists won the argument by generalizing the neoclassical approach along instrumentalist lines and thus absorbing the full-cost principle into their framework, thus seemingly cleansing the standard pricing model of any inconsistencies. Ever since then, marginalist price theory has prevailed in mainstream economics and the issue of the theoretical representation of the pricing decision seems to be resolved.

The aim of this introductory chapter is, on the one hand, to describe how the dominance of marginalism came about in the course of the full-cost pricing controversy of the 20th century. On the other hand, I seek to shed light on the question of whether this prevailing reliance on the validity of marginalist price theory is justified given its theoretical foundations and the empirical accordance of its predictions with reality. In addition, I will discuss methodological issues of the mainstream approach and how future research on pricing behaviour could be conceptualized to lead to scientific progress in our understanding of what governs the pricing decision. In this sense, this introduction provides the background and motivation for the following chapters, where I try to investigate industrial pricing along more realistic lines.

The chapter is organized as follows. First, we will lay out the terminology used in this and the following chapters and discuss the different forms of cost-plus pricing. Then, the full-cost debate and its fusion with the marginalist controversy will be outlined. After a discussion of important empirical studies and theoretical approaches presented by anti-marginalists in the wake of the controversy, we will focus on the defence strategy of the proponents of marginalist price theory and describe how the full-cost pricing controversy came to an end. After a short survey of research on cost-plus pricing that took place after the debate, we will focus on some of the aspects that call the validity of marginalist theory into question. In particular, we will discuss the instrumentalist understanding of marginalism that prevails in contemporary mainstream economics. The chapter concludes with a discussion of possible methodological reorientation strategies and an explanation of the research agenda of this work in relation to the arguments brought forward in this chapter.

## 1.2 On Terminology

As a starting point, it seems worthwhile to discuss some aspects of the terminology we will use throughout this work. Most importantly, we need to clarify what we are referring to when discussing marginalist price theory and neoclassical economics. It is also necessary to define the scope of this and further analyses in terms of market characteristics. Furthermore, the term cost-plus pricing may seem self-explanatory at first, but it will be shown that it subsumes a variety of techniques which we need to distinguish.

### 1.2.1 Marginalism and Neoclassical Price Theory

Although "neoclassical economics" and "marginalism" were used synonymously until the early 1950s (Lee, 1984, p. 1108), they are usually treated as distinctive concepts in contemporary discussions. Marginalism is a body of theory which postulates maximization by using marginal concepts, which are associated with a specific change in the quantity of a service or good. It disregards measures of total quantity. Relating to the firm, marginalism postulates the maximization of profits where marginal costs are equal to marginal revenues.

Neoclassical economics can be understood as a more general framework that includes marginalist concepts and incorporates definitions of supply, demand, costs, equilibrium, scarcity and economic efficiency. It assumes rational individuals with given preferences over outcomes and that actions are taken independently by individuals under full and relevant information. Consumer utility maximization and profit maximization by firms are central elements to the neoclassical framework. Yet it can incorporate more diverse concepts, such as satisficing and the use of rules of thumb under situations where this is rational due to uncertainty and costly information. Neoclassical price theory thus incorporates not only marginalist concepts, but also managerial or behavioural theories of the firm, which can be seen as an extension of the core body of the neoclassical framework.

Furthermore, we need to set the scope and frame of the following analysis. In general, we will refer to markets in which firms have some sovereignty on the prices they charge. This means we explicitly exclude the case of perfect competition and pure forms of quantity competition. The general analysis will apply to monopoly and oligopoly markets, forms of monopolistic competition and market structures that share some aspects of those mentioned before. The analysis focuses on industrial pricing. We will generally set the scope to include manufactured goods and services that are priced by business entities.

The definition of the relevant time horizon is crucial for the results of an analysis on pricing. Strategies that are optimal in the short run can be detrimental if used as a long-run directive, and vice versa. The incorporation of a long-run perspective might lead to a very different evaluation of the merits of a full-cost pricing approach. As Gordon (1948) argued, full-cost information might play

a crucial role in long-run business decisions. Yet in line with most of the theoretical work on pricing, we will generally analyse the pricing decision in a short-run framework, i.e. we assume that there are some fixed factors of production whose cost is unavoidable and thus treated as sunk.

### 1.2.2 A Typology of Cost-Plus Pricing

This section aims at defining and distinguishing forms and meanings of what is generally referred to as cost-plus pricing. Several terms are used in this context, sometimes in an interchangeable manner. In addition to the term "cost-plus pricing", the terms "mark-up pricing" and "full-cost pricing" are often used in the same context. Speaking in the most general terms, cost-plus pricing is the method of setting a price through the application of a (mostly multiplicative) margin $(1 + \alpha)$, with a mark-up $\alpha$ on a unit cost base $c$:

$$p = (1 + \alpha)c \tag{1.1}$$

We can use this formulation to further clarify the different denotations. First, the terms "mark-up pricing" and "cost-plus pricing" are equivalent. "Mark-up pricing" emphasizes the application of the margin without defining the base, which, for the lack of an alternative, we will assume to be some form of unit cost. Meanwhile, "cost-plus pricing" explicitly refers to a cost base, onto which a mark-up is added. As a consequence, I will use these two terms synonymously in this work.

Cost-plus pricing is thus driven by two elements that determine the price: the cost base and the applied mark-up. As we will see below in the discussion of the full-cost pricing debate, economists often did not regard the two components as being independent from one another. For example, proponents of the full-cost principle often claimed that most firms set their prices using both a full costing base and a fixed profit mark-up.

The cost measures that are often referred to in the description of costing bases, such as "direct costs" or "overheads" are not part of the marginalist terminology but originate from the field of cost accounting. Although we will cover these cost measures in more detail in Chapter 2, the cost categorization into direct and indirect costs seems crucial for the following discussion. While

direct costs can be directly traced to individual products, indirect costs, or overheads, are calculated as a per-unit contribution of the coverage of common or joint costs that are initially not directly attributable to products. Examples are indirect labour costs for supervising and management staff, indirect materials that are used for multiple products, factory rent, or fuel and power. Note that direct and variable costs, and, respectively, indirect and fixed costs, are not equivalent. The categorization of direct and indirect costs is based upon the traceability of costs to individual products. In contrast, variable and fixed costs are distinguished according to the variability of costs with output. In most cases, direct and variable, and thus indirect and fixed costs are not equivalent.

Following a classification brought forward by Lavoie (2001, p. 22), varieties of cost-plus pricing can be subdivided into three categories. In the first variant, *Kaleckian mark-up pricing,* the cost base used is unit prime cost (unit direct costs), which usually consists of direct and thus attributable labour costs and the costs of intermediate goods and raw materials. A second category is referred to as *normal-cost pricing,* which emphasizes that the cost-plus procedure rests on a cost base that reflects unit costs at a normal level of output. As such, prices depend on conventional measures of costs used by accountants, such as normal or standard costs that are generally invariant with output in the short run. Related to this concept is the "normal price hypothesis", which states that prices do not react to short-run changes in demand or costs (Nordhaus and Godley, 1972; Coutts et al., 1978). We will focus on the third variant, *full-cost pricing*. The relevant cost base used under this method is actual average unit costs which decline with output. Yet in general, much of our analysis will be transferable to the other two methods of cost-plus pricing. For example, in our analysis in Chapter 3, I will discuss differences between full and variable costing strategies. The main focus of our work is on the different magnitudes of costing bases, which can be broadly categorized into variable/direct costing on the one hand, and normal/standard and full costing on the other hand. Of course, many other forms of pricing approaches exist, such as *target-return pricing,* which I will not discuss in greater detail due to the limited scope of this work.

The definitions of full-cost pricing differ. Consider, for example, the account given by Hall and Hitch (1939, p. 19):

> The formula used by the different firms in computing 'full cost' differs in detail [...]; but the procedure can be not unfairly generalized as follows: prime (or 'direct') cost per unit is taken as the base, a percentage addition is made to cover overheads (or 'oncost', or 'indirect' cost), and a further conventional addition (frequently 10 per cent) is made for profit. Selling costs commonly and interest on capital rarely are included in overheads; when not so included they are allowed for in the addition for profits.

In contrast, Dorward (1987, p. 52) states that

> The practice of allocating overheads is often referred to as full-cost pricing, by which a net profit margin is added to a costing base made up of direct costs plus overheads.

If full costs are calculated, a share of indirect costs are aggregated and then divided by an overhead allocation base (also called cost driver) that determines the contribution of each produced unit of output. Often, measures like labour hours or machine hours are used as a cost driver. Dividing the aggregated overheads by the cost driver, the firm obtains a rate per hour that it can then multiply by the average labour or machine hours required to produce the product. With this, the firm obtains the allocated overheads per unit that, added to direct unit cost, become the full cost of a product onto which the profit margin is added.

The two quotes given above demonstrate the fuzziness in the definition of full-cost pricing. Both statements refer to overheads that play a role in the calculated price. The difference is that Hall and Hitch seem to see these overheads as a part of the mark-up that is applied to the direct cost base, whereas Dorward regards overheads as part of the costing base. Evidently, these two definitions do not imply the same thing. Since it is widely accepted in the accounting literature to see overheads as a part of the cost base, namely as an addition to direct or variable costs, we will use Dorward's definition when we refer to full-cost pricing. To clarify, consider the following definition of full-cost pricing, which we will generally adhere to:

$$p = (1 + \lambda)(c + f) \tag{1.2}$$

where $\lambda$ is the profit mark-up under full costing, $c$ is a measure of direct, variable or standard costs and $f$ denotes allocated unit overhead costs.

In general, full-cost pricing methods are thus a subset of cost-plus or mark-up pricing techniques. We can further distinguish between full-cost pricing in the broader sense and in the strict sense. In the broad meaning, which we will generally refer to, the term "full-cost pricing" only describes the costing base used for the mark-up calculation. No further initial assumptions are made regarding the behaviour of the profit mark-up. As a consequence, and as will be shown below, full-cost pricing in the broad sense does not rule out profit maximization or the application of marginalist methods. The latter case, which I will call the "strict full-cost principle", and which was the prevailing concept during the full-cost pricing controversy, describes an understanding of full-cost pricing which not only refers to the type of cost base used, but also includes assumptions on the profit mark-up $\lambda$. As we will discuss below, Hall and Hitch and other proponents of the strict full-cost principle asserted that prices set in a full-cost manner tend to be stable. The prices "will be changed if there is a significant change in wage or raw material costs, but not in response to moderate or temporary shifts in demand" (Hall and Hitch, 1939, p. 33). This was interpreted by other authors as an unresponsiveness of the profit mark-up to minor changes in demand. This assertion made by proponents of the strict full-cost principle probably heated up the debate on full-cost pricing the most, as it challenged the fundamental insights of marginalist price theory, most importantly profit maximization. Moreover, it established the strict full-cost principle as an autonomous theoretical approach that yielded different implications for economic theory than the prevailing standard approach.[1] The strict interpretation of full-cost pricing thus does not only refer to a specific cost base that is used for the pricing decision, but also entails an alternative theoretical draft to marginalist price theory, which sees prices as determined in a fundamentally different way as specified by neoclassical economics. This "full-cost doctrine" emerged in the first half of the 20th century and experienced its demise as an al-

[1] For example, if demand declines, a price set through a strict full-cost procedure will rise. This is because, assuming constant marginal costs and an invariant profit margin, non-variable overheads will be distributed among a smaller number of products, causing the price to rise. For the same reason, rising demand would lead to falling prices. In addition, percentage changes in average costs should correspond to the same percentage change in the price (Lee and Irving-Lesserman, 1992, p. 286).

ternative to marginalism in the 1950s, while full-cost pricing in the broad sense remained accepted as an empirical fact that was understood to be compatible with a generalized neoclassical framework. In the following section, this rise and fall of the strict full-cost principle will be discussed.

## 1.3 The Full-Cost Doctrine and the Marginalist Controversy

### 1.3.1 The Beginnings of the Full-Cost Controversy

The discussion on price theory during the first half of the 20th century, that would later be known under the term "full-cost controversy" had its debut with the publication of the aforementioned article by the Oxford-based economists Hall and Hitch (1939). In their work, entitled "Price Theory and Business Behaviour", they presented the results of a survey accompanied by interviews among 38 firms, of which 33 were in the manufacturing business. The large majority of the firms were found to set their price in the following way: first, an ex-ante estimate of average costs was derived. On this cost base, two percentage margins were added to arrive at the final price. The first was a mark-up to cover overhead costs which could not be directly attributed to products; the second had the function of a profit margin. The authors called this "full-cost pricing" and insisted that it was a "rule of thumb", which could only lead to profit-maximizing prices in the neoclassical sense by accident (Hall and Hitch, 1939, p. 113). Furthermore, they asserted that managers did not make any implicit or explicit attempt to estimate demand elasticities or other factors that would reflect the demand situation for the price setting process. Additionally, they included sunk costs (in the form of fixed overheads) into the pricing decision and were reluctant to alter prices if market conditions changed. All these answers Hall and Hitch received from managers seemed - at least at first glance - to be at odds with the postulates of the predominant economic doctrine, namely that prices are determined optimally so as to equate marginal costs and marginal revenues and thus to maximize profits.

The results obtained through their survey motivated the authors to develop their own explanation of the price-setting process, the "kinked demand

curve".[2] This theory assumed that firms were, with their current price-quantity combination, situated at a kink on their firm-specific demand curve. A change in prices would have asymmetric consequences: if the firm raised its price, it would be the only firm to do so; its competitors would leave their prices as they were, leading to a substantial loss of demand for the firm that adjusted its price upward. So, the firm demand curve is highly elastic above the current position. For a reduction of the selling price, Hall and Hitch assumed that all firms would follow this move, making the firm demand curve highly inelastic below the kink. As a consequence, the firm was actually situated at a local equilibrium of optimal profits, which was stable over a range of cost- and demand fluctuations, since for small shocks it did not pay off to change the price. This was also the case for all other firms in the market; hence, once the kink was established, there was no price competition in the market. The connection of the kinked demand curve to the full-cost principle was that the optimal price at the kink was arrived at by the full-cost calculation and lay significantly above marginal costs.

The concept of the kinked demand curve as proposed by Hall and Hitch was highly problematic.[3] The location of the kink was random, as was therefore the corresponding. Its stability was only possible as a consequence of some form of implicit or explicit collusion. In addition, firms were actually profit maximizing, which was again at odds with the statements the authors recorded from their interviews with managers. Furthermore, the use of a demand schedule in their proposed theory seems to be sharply at odds with their proposition that managers in their survey did not take demand factors into account.

#### 1.3.1.1 Empirical Evidence

Before we focus on the full-cost controversy that started after the publication of Hall and Hitch's article, it seems worthwhile to give a short survey of other

[2] In the same year, a different formulation of the kinked demand curve was published by Sweezy (1939).

[3] A detailed discussion of the problems associated with the kinked demand curve as proposed by Hall and Hitch and Sweezy can be found in Stigler (1947). He summarizes his analysis with respect to the Hall and Hitch version of the theory as follows: "This full-cost principle is apparently the result of tacit and open collusion, consideration of long-run demand and costs, moral conviction of fairness, and uncertainty of effects of price increases and decreases". (Stigler, 1947, p. 433)

empirical work that was brought forward in the wake of the debate and that proved that Hall and Hitch's initial findings reflected a general empirical regularity.

Between 1939 and 1960, more than thirty studies appeared that affirmed Hall and Hitch's initial proposition that firms use cost-plus methods in the pricing process (Lee and Irving-Lesserman, 1992, p. 281). For example, in Great Britain several studies reported the use of cost-plus pricing in a variety of industries. Blackwell (1954) reported the use of cost-plus pricing in the book publishing industry, Pool and Llewellyn (1958) came to the same conclusion in the hosiery business and Balkin (1956) gave a detailed account of these practices in the clothing industry. Fogarty (1943) showed that landlords used cost-plus pricing methods when fixing rents and prices. Pearce (1956) and Pearce and Amey (1956) showed in a detailed case study of two firms the prevalent use of full cost as a calculatory base. Later research on pricing behaviour was not solely concentrated on the UK. Fog (1960) undertook a survey among 139 Danish firms and found that the majority of firms apply full-cost pricing but also adjusted prices according to demand and competition factors in a final step.

One of the few empirical explorations that was seen as supporting the marginalist view was Earley (1956). In a survey among 110 large U.S. firms that were rated to be "well-managed" by the American Institute of Management, more than 80 per cent tended to "differentiate cost-price ratios to reflect major factors recognized in marginalist analysis" (Earley, 1956, p. 56). These typically could be described as practicing "marginalism on the wing" rather than being either short or long-run profit maximizers.

#### 1.3.1.2 Early Theoretical Attempts Towards the Strict Full-Cost Principle

Overall, the 1939 article by Hall and Hitch was, as Mongin (1990, p. 238) puts it: "path-breaking, but highly incomplete in its implicit modelling".[4] Despite

[4]It is worth noting that Hall and Hitch (1939) were not describing something that was altogether new. As Heflebower (1955, p. 361) and Wied-Nebbeling (1975, p. 31) point out, both concepts long had their place in business school texts and related business literature. Additionally, Lee and Irving-Lesserman (1992, p. 280) make account of numerous earlier studies in the UK that described cost-plus pricing as the dominating procedure among firms. In the next chapter of this work, this will be described in more detail. For example, several government reports were published in the wake of the Profiteering Act (1919 - 1920) that described normal-cost pricing for a large variety of products. In fact, as shown by Edwards (1937), firms had been using varieties of cost-plus procedures since at least 1850.

its methodological shortcomings both in its survey and modelling technique, it constituted the starting point of a fiercely fought controversy that took over a decade to quiet down. The publication of the article was followed by a number of works that picked up the full-cost principle. For example, R. F. Harrod published an article in the same year that tried to reconcile the results of Hall and Hitch's work with profit maximization.[5] He argued that, even if firms set their prices by using rules of thumb and without consciously taking factors into account that neoclassical theory predicts they should, profit maximization could emerge as a consequence of an evolutionary selection process where price-setting rules that lead to higher profits replaced heuristics that were less profitable. However, he remained silent on the exact conditions and mechanisms of such a process. Interestingly, Harrod released a second work that was related to the full-cost principle in 1952 where he replaced the assumption of profit maximization with the full-cost principle as a theoretical concept, thus embracing full-cost pricing in the strict sense. Like the most recognized theoretical work during that time on the subject, P. W. S. Andrews' "Manufacturing Business" (1949), the model rested on the assumption that firms try to deter potential entry rather than maximizing their short-run profits.[6]

The book by Andrews (1949) arguably contains the best-known full-cost price theory connected to the strict full-cost principle, and was, at the time, presented as an alternative to marginalist price theory. Andrews based his approach on the results of his empirical research (which he was not able to publish because some of the surveyed firms in his sample had not agreed). He argued that managers set their prices on the basis of average direct costs of the product. The difference between the average direct costs and the price was termed "costing margin" in his model, which he described as "the amount which he [the businessman] thinks he can take from the market without giving possible competitors an opportunity to cut into it (or his share of it) in the long run" (Andrews, 1949, p. 174). He assumed average direct costs to be constant in the

[5] Concerning the prevalence of profit maximization, Harrod wrote: "Anyone seeking seriously to challenge this would be regarded as a hopeless sentimentalist" (Harrod, 1939, p. 1).

[6] The model presented in Harrod (1952) could only partially explain observed price-setting behaviour. While the price set by firms equalled their average cost, they did not add a profit mark-up on these costs, thus trying to deter market entry. So while giving an explanation for the cost base used by firms, it lacked an account for the empirical phenomenon of positive profits. For a more detailed discussion of the model see Mongin (1997).

short run and to have an L-shaped slope in the long run. Andrews considered the costing margin to be stable over time; it was derived by what the manager would consider to be a "fair" gross profit margin and the market situation in the long run. The margin was thus determined with a stable long-run perspective, while short-run adjustments would undermine long-run market shares. Implicitly, his theory contained several marginalist elements that would later lead his critics to argue that his model was nothing more than neoclassical price theory in a different formulation. Mainly, these marginalist ingredients were concentrated in the determination of the costing margin. For example, margins were assumed to fall in the case of decreasing demand (Andrews, 1949, p. 165) or more competition (Andrews, 1949, p. 253). As his critics pointed out, most notably A. Robinson (1950), the inclusion of market demand again influence on the costing margin, along with its adjustments if the market environment changed, leads to the suspicion that this costing margin would be the maximum difference between the unit direct costs and the price that the manager thinks the market can bear. Additionally, he argued, the process of adjusting the costing margin according to the experience of the manager appears to be the discovery of a demand schedule. Thus, along with the assumed equality of average direct costs and marginal costs, Robinson argued that there was no difference between Andrews' formulation and the result of neoclassical price theory in a stable or mature oligopolistic market. This argument was also made by Silberston (1951) and Kahn (1952). According to Lee and Irving-Lesserman (1992, p. 288), Andrews failed to make it more explicit that in his model, entrepreneurs followed other pecuniary motives than profit maximization in the neoclassical sense. He did not state another objective, nor make it clear that the determination of the costing margin was different from the optimal mark-up defined by marginalism. Curiously, he did not make any attempt to defend his theory or the strict full-cost principle as an alternative to neoclassical profit maximization.[7]

[7] Lee and Irving-Lesserman (1992) give a more detailed account of the reactions to Andrews' work.

### 1.3.2 The Marginalist Defence

The debate on full-cost pricing also became intermingled with an ongoing controversy in the American Economic Review, later to be known as the "marginalist controversy". The debate had its beginning with Lester (1946), who criticized marginalism in the context of labour markets and showed its shortcomings with empirical data. The debate on cost-plus pricing became an integral part of the marginalist controversy, in which Hall and Hitch, among other mostly British economists, saw the occurrence of cost-plus (or full-cost) pricing in business as an empirical fact that contradicts marginalist price theory.[8]

At the time that the attacks on marginalism were launched with the release of studies like Hall and Hitch (1939), neoclassical price theory consisted of three subcategories, namely the theories of perfect competition, monopoly, and imperfect competition, which had been developed very recently by Chamberlin (1933) and Robinson (1933). In all three subtheories, firms were assumed to maximize profits under the given mode of competition. Further aspects of pricing that are commonly referred to today, such as behavioural or managerial approaches, were not present. Other motives besides the short-term maximization of profits, such as limit pricing theories, were also not included, as these were partly based on the work of Andrews (1949), as (Lee and Irving-Lesserman, 1992, p. 275) point out.

The wide array of evidence of prevailing cost-plus pricing methods in business was seen as a fact that drew the validity of the neoclassical framework into question. Proponents of the neoclassical approach were required to react to the evidence brought forward. As Mongin (1990) identifies, defendants of marginalism had three basic routes to defend their position: dismissal, reform and absorption into the existing neoclassical framework. In the following, I will discuss each of the three possible stances.

#### 1.3.2.1 Dismissal

A first and obvious option was to criticize the methodology of the empirical research and the validity of the data. This approach was taken occasionally. For example, A. Robinson (1939) expressed his skepticism regarding Hall and

[8] Mongin (1990, 1997) and Lee (1984) give overviews of this aspect of the marginalist controversy and the role of full-cost pricing in the debate.

Hitch's results since they did not include a questionnaire or a detailed description of the interviews with the questioned managers. Others, such as Kalecki (1943) or Machlup (1946) claimed that Hall and Hitch and others who employed a survey technique to study business behaviour did not properly disentangle the way that managers talk about their behaviour and the way they actually behave (Lee and Irving-Lesserman, 1992, p. 279). Edwards (1952) specifically criticized the empirical work of Andrews (1949), since Andrews did not include any adaptations made to prices after they were calculated on the basis of the conventional cost statements.

Apart from these few examples, the strategy of dismissal seems hardly to have been a viable option in the light of the vast empirical evidence of cost-plus pricing behaviour that had emerged after the publication of Hall and Hitch's article and this line of defence was thus not followed widely.

#### 1.3.2.2 Reform

Modification of the existing theories would have been another option for marginalists. In part, this strategy is intertwined with the last one, absorption. As Lee (1984, p. 1122) argues, the full-cost pricing debate stands in connection to (and might have fostered) the emergence of a variety of alternatives to the strict marginalist neoclassical model in the late 1950s and early 1960s, such as the theory of satisficing by Simon (1955) or the related behavioural theory of the firm by Cyert and March (1963). Mongin (1990) argues against this point; he puts forward that it was not a reformed version of the theory of the firm that left the marginalist controversy as the victor, but the form of marginalism employed during and before the controversy started, namely the concepts developed by Joan Robinson and Edward Chamberlin. Nevertheless, for absorption of the full-cost principle to be feasible, a partial reform at least of the understanding of neoclassical price theory was necessary. Before the controversy on full-cost pricing emerged, the as-if character of marginalist methods was not as explicitly formulated as it is today. As Lee and Irving-Lesserman (1992, p. 278) explain in some detail, it was a common belief that firms - consciously or unconsciously - applied marginalist methods. This means that the marginalist model was seen not only as predicting the effect of the behaviour of firms with regard to price and quantity decisions in a correct manner, but even as ac-

curately describing the actual behaviour and considerations of firms. We will discuss this distinction between the realistic and the implicit understanding of marginalism below.

#### 1.3.2.3 Absorption

The main route that was taken by proponents of marginalist price theory was to absorb full-cost pricing into the existing neoclassical framework. This of course required that full-cost pricing was seen as an empirical fact, rather than a theoretical construct that poses an alternative to the common profit maximization hypothesis. The aim of this strategy is to argue persuasively that the valid evidence on cost-plus and in particular full-cost pricing does not stand in contradiction with the marginal theory of prices. The marginalists thus argued for an understanding of full-cost pricing in the broad sense, and dismissed its strict definition. Embedded in the defence of marginal analysis was of course the notion of profit maximization. It was not before some years after the debate that alternative theories, which employed marginalist methods while abandoning the traditional profit maximization hypothesis came to light, such as the sales maximization model by Baumol (1959) or the maximization of managerial utility (Williamson, 1963).

The absorption strategies of marginalists were quite diversified. These different means of advocacy probably reflect their different understandings of marginalism. In general terms, I will define two positions on marginalism into which its proponents and their respective defence can be categorized.

The first stance, which Mongin (1990) calls "ex ante reconciliation", and which could also be called the "realistic" approach, relates to an understanding of marginalism as a description of actual behaviour of decision-makers. The defence of marginalism in this category rests on the claim that individuals optimize some objective variable and that full-cost pricing behaviour can be explained by some reformulations as a maximization of profits along marginalist lines. For full-cost pricing to be compatible with marginalism, it is, in this view, not necessary to claim that the result of the behaviour of firms is the objective maximization of profits. Rather, marginalism describes the behaviour and/or motivation of firms, which might ground their considerations on false information of costs and demand and therefore fail to objectively maximize profits.

The second stance taken by marginalists can be described as the "instrumental approach" to marginalism, or, in the words of Mongin, "ex post reconciliation". The difference to the realistic approach stems from the different underlying methodology: according to the instrumentalist approach, actual behaviour of firms is not relevant for the validity of marginalist theory. Only the theory's ability to predict the outcomes - in the case of pricing, the observed price/quantity combinations given the cost and demand functions - decides upon its worth. Rather than describing the behaviour of firms, marginalism as seen in an instrumental way thus describes the *effect* of the behaviour of firms. This view on the methodology of marginalism was most prominently defended by Milton Friedman, but was also adopted by the majority of marginalists during the full-cost pricing debate. Note also that justifications of marginalist predictions that stem from market dynamics and its interaction with the firm, such as the idea of a selection process, can be categorized as an instrumentalist defence. In addition, it is noteworthy that the difference between the two stances can be attributed to what they were trying to achieve: while the realistic stance tried to salvage the neoclassical framework through the validation of the marginalist reasoning as a phenomenon encountered in reality, the economists following the instrumentalist approach tried to save marginalism through its value as a tool of analysis within neoclassical price theory. It should be kept in mind that these views on marginalism are not mutually exclusive, nor dependent on each other to be valid. Furthermore, the defendants of marginalism cannot be classified strictly into one category, but usually resorted to arguments accountable to both the realistic and the instrumentalist understanding.

### 1.3.3 The Absorption Strategy in Greater Detail

During the full-cost controversy, most marginalists argued in the direction of an absorption of the full-cost pricing evidence into the neoclassical framework. In the following, we seek to examine this approach in more depth.

#### 1.3.3.1 Realistic Marginalism

From today's point of view, the realistic approach to marginalism seems to be rather a dead end. Instrumental reasoning played such an important role during the defence and subsequent fortification of the neoclassical approach that

it clearly shows up in the understanding of today's mainstream economics, where realism in the sense described above plays a rather minor role. Yet, in the wake of the marginalist controversy, an understanding of marginalism as a realistic description of the behaviour of decision-makers can be found. For example, Machlup (1946, p. 519) argues that marginalism describes the "logical process of 'finding a maximum"', explicitly stating that marginalism holds as long as managers aim at maximizing profits, i.e. try to equate marginal costs with marginal revenues, even if the information that they have to base their decisions on is faulty or incomplete.[9] Note that in this realistic approach, Machlup would hold marginalism to be true if subjective profit maximization prevailed. In this sense, as long as the firm tries its best to equate its subjective estimates of marginal revenue and marginal costs, it behaves as predicted by marginal analysis, without the necessity that the firm actually reaches the global maximum of its objective profit function. This can be termed subjective profit maximization, as opposed to objective profit maximization as understood by instrumentalists. Another line of argument followed by Machlup was that full-cost pricing is the optimal strategy in a long-term oligopolistic context, especially with a collusive element (Machlup, 1946, p. 543), but also in an oligopolistic situation where the firm lacks knowledge and uses its own average cost as "a clue to demand elasticity" (Machlup, 1946, p. 543). Referring to Hall and Hitch (1939) and Lester (1946), Machlup did not see the marginal theory of the firm as "shaken, discredited or disproved by the empirical tests" (Machlup, 1946, p. 553).

Fritz Machlup was not the only one whose defence was at least in part a realistic one. In his review of Andrews (1949), A. Robinson (1950, p. 777) argued that the concept of long-term perfect competition could explain full-cost pricing, since in a long-term perspective, it is rational for firms to set their price according to the level of minimum average cost, plus a mark-up of "normal profit". In general, as Gordon (1948, p. 276) points out, much of the realistic approach to reconciliation lay rooted in long-run explanations, fully ignoring the strong short-term predictions of marginal analysis.

[9] In fact, Machlup argues that there hardly is such a thing as a true cost or revenue function, since it is impossible to determine them objectively for the indefinite future.

#### 1.3.3.2 Instrumentalist Marginalism

As has been pointed out before, the majority of participants in the debate who argued in favour of marginalism can be attributed to an instrumentalist approach to marginalism. In this view, the model of neoclassical price theory does not describe the behaviour of firms (and individuals for that matter), but only the outcomes of their behaviour. The decision processes and prior motivations of firms are not of interest. A representative example is the work of Wiles (1950). He constructs a model where in the short run, the firm's subjective marginal cost curve is constant over the relevant range (and rising near full capacity), and marginal revenue is horizontal as a consequence of the firms reluctance to adjust prices in the short run. The firm decides upon a short-run price and quantity combination where marginal revenue lies above average unit costs and thus exceeds marginal costs, a fact that is at variance with standard theory, since this strategy is not profit maximizing. Wiles' explanation is grounded on the notion that the firm misconceives its marginal cost and marginal revenue functions. In the case of marginal costs, it fails to take extra costs of production into account, such as overloading or overtime, which causes the marginal cost curve to rise. Marginal revenue, on the other hand, is in truth falling, as the firm cannot serve all customers when it is producing close to its capacity limit. This may result in a loss of long-time customers, which in turn has a negative effect on revenues. These true marginal cost and revenue curves intersect at the point where the firm has set the price. Thus, without consciously knowing it, the firm is maximizing its profits.

Evidently, this model raises more questions than it tries to answer. Wiles does not explain why the firm fails to recognize the true cost and revenue functions, nor the price rigidity that drives the model's results in the short run. But it vividly depicts the view of a large group of marginalists: the firm may not employ any logic that resembles a consideration of costs and revenues along marginal lines, but the economist can use the tools of marginalism to accurately describe and predict the firm's choices.

Within the instrumentalist line of defence, the pricing formula became reformulated as stated in expression (1.3). This is the neoclassical formulation of the mark-up mechanism:

$$\begin{aligned} MR &= MC \\ p(y) + \frac{\partial p(y)}{\partial y} y &= MC \\ p(y) &= \frac{1}{1 - \frac{1}{\epsilon}} MC \\ p(y) &= \frac{\epsilon}{\epsilon - 1} MC \end{aligned} \tag{1.3}$$

where $p(y)$ is the inverse demand function, $MR$ and $MC$ denote marginal revenues and costs, respectively, and $\epsilon = -\frac{\partial y(p)}{\partial p} \frac{p}{y}$ is the price elasticity of demand. The price is set as an optimal mark-up, which only depends on the elasticity of demand and is applied on the marginal cost base. This equation summarizes the major absorption argument used by the supporters of marginalism.

The suggested equivalence of full costing can be easily demonstrated by using similar algebra. If $MC + f$ are full costs with $f = \frac{F}{q_e}$ being fixed costs allocated to products using an expected quantity measure $q_e$, then the pricing rationale under full costing could be represented using the elasticity of demand:

$$\begin{aligned} p(y) &= \frac{MC\epsilon}{(\epsilon - 1)(MC + f)} (MC + f) \\ p(y) &= \frac{\epsilon}{\epsilon - 1} MC \end{aligned} \tag{1.4}$$

In the full-cost pricing case, a smaller optimal mark-up is thus multiplied by a larger cost base, leading to the same optimal price as under a mark-up on marginal costs. This algebra demonstrates, in a nutshell, the underlying absorption of the evidence of full-cost pricing into the marginalist framework. This equivalence of full-cost pricing to neoclassical formulations in standard theory will be picked up in Chapter 3 of this work when pricing behaviour in the presence of uncertainties is discussed.

#### 1.3.3.3 Heflebower's Account of Full-Cost Pricing

In 1952, Richard Heflebower gave a talk on full-cost pricing at the Conference of Business Concentration and Price Policy, to which he was explicitly invited as an expert on the field of pricing to shed some light on the controversy. From

today's perspective, his contribution can be seen as having played a major role in the debate on full-cost pricing coming to an end - to the benefit of neoclassical economics. His reconciliation strategy can be described as follows. First, he presented empirical evidence from manufacturing businesses that suggested that marginal costs are constant over the relevant range of output (Heflebower, 1955, p. 370). If this were the case, he argued, price changes should only occur if demand elasticity or marginal costs change. Curiously, he omitted a discussion of fixed overheads that were commonly allocated to products. Of course, if fixed costs were assumed to be greater than zero, Heflebower's argument of the equivalence of marginal and total average costs would no longer hold. He continued by claiming that prices reacted to changes in demand - a fact that Hall and Hitch actually never doubted and one example of the many misinterpretations that full-cost pricing witnessed.[10] For this purpose, Heflebower showed that, while posted list prices remained unchanged, actual transaction prices (final prices that included concessions, handling fees, etc.) or other product-related variables such as product specifications reacted to demand changes. Supposedly, Heflebower now had all arguments he needed to construct a reconciliation of cost-plus pricing into the neoclassical framework. In his view, through constant marginal costs and the following equality to average unit costs, firms were using the right costing base when applying a full-cost rule to set prices, while the added mark-up reflected changes in demand and solely depended on the elasticity of demand.

His presentation was extensive and well prepared, and the reactions of the audience were very positive. The majority of the profession accepted Heflebower's arguments, as can be seen by Ronald Coase's comment:

> I had the impression, at the end of reading his paper, that if the full-cost principle was still standing it was only because it was sup-

[10] Hall and Hitch argued that, when deciding upon the profit margin, firms included considerations regarding demand, along with possible reactions of competitors and other factors. However, they maintained that a change in prices would mostly not occur for minor changes in demand. Their concept of the kinked demand curve supported this idea and could give an explanation for the observed price rigidity. The sluggish reaction of prices to demand changes thus stemmed rather from the observed price rigidity than from firms' ignorance of demand factors. In retrospect, it seems curious that marginalists triumphed on the dismissal of a statement that was never actually made by supporters of the full-cost principle. An example of this can be seen in the review of the Hall and Hitch article by Kahn (1952). More detailed discussions of the rhetoric of the debate can be found in Lee and Irving-Lesserman (1992) and Mongin (1990).

> ported by two old gentlemen, one of whom was certainly Demand and the other of whom looked uncommonly like Marginal Analysis. It is clear from Heflebower's masterly survey that many of the arguments used by supporters of the full-cost principle are in no way inconsistent with orthodox economic theory. (Coase, 1955, p. 393)

Heflebower's account of full-cost pricing thus summarized the arguments that were previously brought forward for an absorption of full-cost pricing into the neoclassical framework. From today's point of view, it can be seen as marking the end of the full-cost pricing debate.

#### 1.3.3.4 The Lack of Empirical Verification

Despite its detailed and thorough analysis, it seems surprising that Heflebower's contribution led to a settlement of the controversy. The empirical evidence he presented added interesting aspects to the debate rather than giving rise to a settlement of the argument. He convincingly showed that demand plays a role in the price setting process - hence refuting the strict version of the full-cost principle. Other than that, his account does but little to defend marginalist principles. Several points that are necessary for a convincing reconciliation are missing from Heflebower's assessment of the problem. First, even though he shows the reactivity of prices to demand fluctuations, he provides no arguments for the actual convergence of mark-ups and prices towards the profit-maximizing level. Insofar as his arguments are concerned, the empirical evidence of final prices varying with demand could also be interpreted as supporting the hypothesis that firms satisfice in regard to their profits. Secondly, the flatness of the marginal cost curve in the relevant range might explain some part of the observed price stickiness, but Heflebower fails to provide an explanation of how the inclusion of irrelevant fixed costs into the pricing decision can be reconciled with standard theory.

#### 1.3.3.5 Inconsistencies in the Marginalist Defence and the Birth of Implicit Marginalism

In general, defendors of the standard theories of pricing commonly used universal arguments that fit with only part of the empirical evidence on full-cost pricing. Heflebower's account is a good example for this: while he focused

on the (in)variability of prices with demand, he largely neglected the inclusion of indirect fixed overheads into the pricing decision. This "existential reasoning along with only partial concern with the data" (Mongin, 1990, p. 245) was, however, not solely employed by marginalists. Supporters of the full-cost principle also resorted to this line of existential argument in their attack on standard theory. Their firm belief that full-cost pricing was generally incompatible with any marginalist model exemplifies this.

Despite the rhetoric of the debate, it also seems hardly comprehensible that the discussion was not carried out on more empirical grounds. While opponents of standard theory launched their attack motivated mostly by empirical findings, the marginalist answer was - to a large extent - theoretical in nature. But even in the most instrumentalist view of economic science, the ultimate verification of a theory, and the elimination of competing explanations, lies in the empirical evaluation of the predictive powers of the hypothesis in question. With the neoclassical reformulation of the mark-up rule (see (1.3) and (1.4)), both camps had the necessary specification and common ground to empirically validate whether the predictions of standard price theory matched with observed prices, quantities and elasticities. Yet such research was not conducted by either side during the controversy.

A reason for the lack of empirical research on the topic might stem from the understanding of marginalism that emerged during and after the controversy between the 1930s and 1950s. Supporters of the neoclassical doctrine were convinced that their theoretical reasoning sufficed to salvage marginalism, and profit maximization in particular, by showing that prices reacted to factors that were also deemed relevant in the neoclassical theory, such as the elasticity of demand. Proving the tendency of prices to react to a demand shock in the predicted direction led the supporters to the conclusion that this tendency will ultimately result in attainment of the global maximum of profits. An example for this reasoning, described by Mongin (1990, p. 247), can be found in A. Robinson's critique of Andrews' "Manufacturing Business" (1949), where the latter stated that entrepreneurs decide rationally on whether or not to undersell their competitors. Robinson commented:

> I find it hard to distinguish this balancing of the advantages and disadvantages of price cutting and of expansion from the balancing

> process which the theories of imperfect competition have assumed. (Robinson, 1950, p. 778)

While the theories of imperfect competition explicitly assume profit maximization, Andrews' formulation suggests only a reasoning of incremental rationality. The weighing of the (dis)advantages of decision alternatives does not suffice for the conclusion that a maximization routine underlies this decision process. The behaviour described by Andrews could, in this vein, also be interpreted as entrepreneurs aiming at satisfactory profits, as first described by Simon (1955). Indeed, satisficing is not the only reasoning that could serve as an underlying principle in this example. The entrepreneur could also limit his range of possible alternatives and search for a maximum within this subset (a case of simplified optimization). Confusions of incremental reasoning with global maximization were common in the debate on full-cost pricing and also underly many of Friedman's arguments, such as the analogy of the billiard player discussed in greater detail below. The success and wide acceptance of Heflebowers arguments against the strict full-cost principle are also related to this reasoning.

Mongin (1990, p. 247) sees this "benign marginalism" - namely "the view that agents make decisions after balancing advantages and disadvantages in some rational way, conjoined with the (false) belief that this is all that marginalist decision-making says" - as the main motor that led to a lack of interest in an empirical approach to the controversy and brought about the reconciliation of full-cost pricing with standard theory.

Furthermore, the emergence of an explicit as-if methodology, as promoted by Friedman (1953) and embraced by mainstream economics, shifted the focus away from the detailed study of decision-making processes to a concern with observable outcomes of these processes. Secured by the shortcut of benign marginalism, the as-if methodology gave a seemingly capable excuse that no further inquiry into the difficult subject of price setting behaviour was required. As a consequence, research efforts have been devoted to other fields of economics, since the mainstream of the economic profession sees the current formulation of the pricing problem as sufficient. The benign understanding of marginalism, together with the difficulties of constructing a price theory that is as widely and generally phraseable as neoclassical price theory, and the strong

methodological focus on instrumentalism, can be seen as the main reasons why comparatively little empirical and theoretical work was devoted to research on the fundamentals of the pricing decision during and after the controversy.

### 1.3.4 The End of the Full-Cost Pricing Debate

Given the numerous shortcomings of the pro-marginalist arguments and only partial treatment of the available evidence, it seems surprising that the described defence strategy succeeded and, above all, led to a drastic loss of interest in theoretical research on pricing behaviour. After all, in his much-acclaimed defence of marginalism, Heflebower himself stated in the last sentence of his article that "the task [..] still remains, that of the development of satisfactory, empirically verifiable models" (Heflebower, 1955, p. 392). Ronald Coase also comes to a similar conclusion in his comment on Heflebower:

> It [marginal analysis] is clearly not the whole story and there is need for much more research on business behaviour. But we should not be disappointed if a good deal of economic theory turns out to be usable after our investigations are completed. (Coase, 1955, p. 394, comment added)

This call for additional research on the topic - shared by both marginalist and anti-marginalist factions - was never answered in the scale one should expect given the importance of the subject for the theory of the firm and many other branches of economics. The interest of economists in price setting behaviour, especially in the US, dried up. The empirical phenomenon of full-cost pricing, and even more so its role as an conceptual alternative to marginalism, lost the attention of the majority of the profession. While there were certainly a number of insightful research projects since the debate ended, their quantity seems rather small in the face of the importance of the question. After all, a thorough understanding of the ways prices are set is essential for economic analysis and prediction.

As a relict of the debate and the absorption of full costing into marginalism, cost-plus pricing is now commonly employed in macroeconomics (e.g. New Keynesian DGSE models), where firms set their prices on marginal costs in a profit-maximizing way. The neoclassical formulation of the mark-up rule is

often also briefly mentioned in standard textbooks in the discussion of pricing theory.

## 1.4 Further Research on Full-Cost Pricing

While the interest of the mainstream of the economics profession in studying the pricing decision was mostly gone after the end of the controversy, some groups continued to explore industrial pricing and cost-plus practices in empirical, theoretical and experimental research. This section aims at giving a brief overview of research connected to cost-plus pricing in general, and full-cost pricing in particular. As we will survey the literature in more detail in the later chapters, this overview will be kept fairly brief and is by no means exhaustive.

Empirical evidence from after the full-cost pricing debate continued to replicate initial findings. Fabiani et al. (2007) found in a large survey among European firms that most firms continue to employ a cost-plus method to set their prices. In addition, Table 1.1 gives an overview of surveys conducted in various countries to identify what share of firms use full/absorption costing information for the pricing decision. As can be seen, full costing is used by the majority of firms in most of the countries that were examined.

In addition to the survey evidence, econometric research was also conducted which related to cost-plus pricing. The previously mentioned normal price hypothesis, which asserted that prices do not react to short-run fluctuations of costs and demand, was repeatedly confirmed in studies by Neild (1964); Nordhaus and Godley (1972); Coutts et al. (1978) and Lee (1994). A study by Martin (1997) suggests that prices are determined by marginal costs, rather than average or normal/standard costs. Research by Rushdy and Lund (1967) and Olive (2002) suggests that prices do react to demand fluctuations. Also, econometric research has been carried out to study the responsiveness of domestic prices to foreign competition (e.g. Coutts and Norman, 2007). Microeconometric research on pricing behaviour in specific industries was, for example, conducted by Barback (1964), Heien (1980), Park and Lohr (1996) and Considine (2001).

Insights relating to full-cost pricing were also generated in experimental economics, where it was repeatedly found that individuals not only regard relevant marginal costs for the pricing decision, but are also influenced by sunk

| *Study* | *Country* | *Share of Full-Costing Firms (%)* |
|---|---|---|
| Skinner (1970) | UK | 70 |
| Atkin and Skinner (1977) | UK | 63 |
| Mills (1988) | UK | 71 |
| Drury et al. (1993) | UK | 84 |
| Shipley (1983) | UK | 59 |
| Govindarajan and Anthony (1983) | US | 82 |
| Shim and Sudit (1995) | US | 60 |
| Israelsen et al. (1996) | Denmark | 40 |
| Saez-Torrecilla et al. (1996) | Spain | 49 |
| Lukka and Granlund (1996) | Finland | 31 |
| Ask et al. (1996) | Sweden | 58 |

Table 1.1: Shares of Full Costing Firms

costs in the sense that they tend to set prices above the optimal level to recoup fixed expenses. This behaviour has been termed "sunk cost fallacy" or "get-evenitis". Examples for such experimental studies are Waller et al. (1999); Buchheit (2004); Offerman and Potters (2006); Friedman et al. (2007) and Buchheit and Feltovich (2008).

Theoretical advances in studying both the the reasons for the prevalence of cost-plus pricing methods and the implications connected to the phenomenon have also been made. While mainstream economics has continued studying pricing strategies within the marginalist framework, a considerable body of literature has emerged on cost-plus pricing from other fields than mainstream economics. Such research was conducted by either scholars in the discipline of (management) accounting, or economists of rather heterodox orientation, most notably those attributable to the school of Post Keynesian Economics. Research

regarding cost-plus pricing by management accountants has been extensive. As explained in greater detail in the following chapter, the inefficiencies related to full costing were widely discussed by management accountants, most prominently by Johnson and Kaplan (1987) and led to the development of concepts of more sophisticated internal costing systems, such as Activity-Based Costing (ABC). Furthermore, the prevalence of full costing was brought into connection with several aspects of the theory of the firm. For example, Balakrishnan and Sivaramakrishnan (2002) explain how full-cost pricing may be an optimal strategy in a situation of capacity constraints. Zimmerman (1979) and Thépot and Netzer (2008), among others, stressed the control function that allocated overheads can have on managers if their behaviour can not be perfectly observed. Other research studied cost-plus pricing in a context of game theory (Grant and Quiggin, 1994), a multi-product environment (Burgstahler and Noreen, 1997) and with the setting of an iterative adaptation of the profit mark-up (Hanson, 1992). While most research on cost-plus pricing in management accounting is done within the neoclassical framework, a strand of institutional research, e.g. Ahmed and Scapens (2000), explains the prevalence of cost allocation as a result of historical circumstances, an approach which we will also cover in the next chapter.

Post Keynesian price theory aims at pursuing a rather realistic modelling strategy with regards to the pricing decision. It recognizes that information is costly to obtain, and that firms operate under uncertainty and in oligopolistic markets. The aim of profit maximization is generally replaced by a multitude of goals that relate to the firms survival and attainment of power in the market environment. It also recognizes the importance of cost-plus pricing methods and has an emphasis on the concept of normal-cost pricing which computes unit costs as direct costs (and possibly overheads) at some conventional level of output (Lavoie, 2001, p. 23). Marginal costs are generally assumed to be constant and average total costs decline with output. Post Keynesian theories of pricing also stress the importance of investment decisions on price setting (e.g. Eichner, 1973; Harcourt and Kenyon, 1976) and maintain that prices are administered by firms rather than determined by competitive forces and are thus generally not market-clearing (Means, 1972).[11]

[11] A more detailed overview on Post Keynesian price theory can be found in Lavoie (1992) and Lavoie (2001).

Outside of Post Keynesian circles, cost-plus pricing was occasionally the focus of theoretical research efforts in economics. Notable are studies by Fraser (1985) and Pasche (1997), who studied implications of cost-plus pricing strategies under uncertainty. In Chapter 3, we will discuss their work in greater detail. The use of cost-plus heuristics in the pricing decision has also been recognised in the approach of the behavioural theory of the firm (Cyert and March, 1963). As mentioned before, some models in modern macroeconomics also assume cost-plus pricing behaviour in imperfectly competitive markets, but do so from a marginalist perspective.

When theoretical research on pricing in mainstream economics is conducted, it focuses mostly on applying the marginalist pricing framework in various settings in both micro and macroeconomics, rather than further examining the pricing process. Thus, while interest in the pricing problem was never lost, most economists did not extend their research efforts to how firms actually determine their prices, but rather to what how optimal marginalist strategies would look like in various settings. In the discussion of the marginalist controversy above, we have already determined several problematic aspects of the absorption of the full-cost pricing doctrine into the neoclassical framework and the conceptualization of implicit marginalism. In the following section, I seek to further assess if the reliance on marginalist price theory of most contemporary economists is justified.

## 1.5 Issues Related to Marginalist Price Theory

Above, we have already identified some shortcomings of the marginalist defence. Here I argue that the means of modelling pricing behaviour in contemporary mainstream economics - best described by the term implicit marginalism - as a positive theory is problematic in several aspects. How economics came to settle on this view of pricing was discussed in the previous section. I now would like to put forward several aspects, both theoretical and empirical, that show the problems of the currently predominating approach.

In the above discussion of the marginalist controversy, we could already identify two distinctive understandings of marginalism. On the one hand, marginalist price theory can be seen as a realistic description of the motivation and the behaviour of firms. On the other hand, and rather reflecting the view

of the majority of economists today, marginalism describes the effect of the behaviour and abstracts from the pricing procedure per se. In the following, we will examine both this implicit/instrumentalist understanding of marginalist pricing and its realistic interpretation, and discuss possible issues with both approaches.

### 1.5.1 The Realistic Understanding of Marginalist Price Theory

From today's perspective, it is fairly obvious that marginalist price theory, as an actual description of the methods and deliberations of firms used in the pricing process, is problematic. As Coase (1973, p. 98) puts it:

> It would be utopian to imagine that a business man, except by luck, could manage to attain this position of maximum profit. Indeed it may cost more to discover this point than the additional profits that would be earned.

Even if managers were conscious of the concepts of equating marginal revenues with marginal costs to find the optimal price, it is hardly possible to correctly identify these curves in reality at a given point in time. On the demand side, frequent changes in the price elasticity due to shifts in relative prices and/or the disposable income of consumers, as well as changes in the behaviour of competitors make it - in most situations - close to impossible to obtain an exact estimate of the elasticity of demand which is necessary for determination of the optimal level of the profit mark-up. On the cost side, it has been pointed out repeatedly (Eiteman, 1945; Dorward, 1987) that in the presence of joint production processes, the identification of marginal costs of individual products is technically impossible. From this follows that a conscious attempt to maximize profits and to set a price that is solely influenced by the elasticity of demand and the marginal costs of production is most likely unsuccessful.

During the full-cost controversy, defendants of marginalism such as A. Robinson or Machlup stated that marginalist methods served as an appropriate description of reality if managers aimed at maximizing profits, even if the point of maximum profits might not even be attained. Without discussing the value of such an understanding of marginalism as providing a pricing frame-

work that corresponds with observed pricing behaviour, it may be worthwhile to investigate whether firms actually aim for a strict maximization of profits as a pricing objective.

Case study evidence by Barback (1964) suggests that strict profit maximization is not an objective of firms. Furthermore, Lanzillotti (1958) asserts in a detailed case study among 20 firms that they follow a multitude of objectives at once; as their main pricing goal, half of the firms stated that they tried to attain some predetermined level of profit or return on investment. Six firms responded that their main objective on pricing was to increase or maintain their market share. In a mailed survey among 1775 UK manufacturing and service firms by Jobber and Hooley (1987), roughly 40 per cent of respondents stated "profit maximization" as their prime pricing objective, while 26 per cent responded that they tried to attain some target level of profits. Other, less common objectives included market share attainment or maximization, sales revenue maximization and ensuring adequate cash flows. Interestingly, they found that profit maximization is significantly more common among small and mid-sized firms than in large firms, which in turn more commonly aim for market share attainment or maximization and target profit attainment.[12] An additional finding was that those firms that had profit maximization as their prime objective indeed attained higher profits and return on investment (ROI), while the firms with the aim to maximize or attain market share fared better in that aspect than firms with other objectives. Sales maximization as a prime pricing objective, however, had a negative impact on both profits and ROI.[13] Samiee (1987) interviewed 192 US and foreign-based firms about their pricing behaviour. Here, the highest-ranked objectives were roughly evenly distributed between "satisfactory ROI", "maintain market share" and "specified profit goal" with about 20 per cent of responses each. "Profit maximization" was only chosen by 10 per cent of firms as their prime pricing objective. In an econometric study, van Dalen and Thurik (1998) examine the price-setting be-

[12] As the authors point out, this finding must be interpreted carefully. It might be that the aim to increase/attain market share might be in line with long-run profit maximization if economies of scale, learning effects or market dominance play a significant role in the relevant market.

[13] This corresponds with the results of Baumol (1959). In his formulation, managers want to maximize sales because this enhances their internal power and control, which can have a negative impact on profits.

haviour of Dutch flower exporters. They find that, despite the firms employing strategies that are consistent with mark-up pricing, most firms charge prices below the profit-maximizing level and have a tendency to pursue maximum sales revenues. Some, mostly smaller firms, are found to set prices higher than the profit maximizing level.

To summarize, the empirical evidence on profit maximization as a main objective for pricing decisions is ambiguous and certainly not strong.[14] We thus can conclude that a realistic understanding of marginalism is most likely inadequate for describing actual pricing behaviour. On the one hand, obvious constraints regarding information gathering and processing capabilities will render firms unable to consciously apply marginalist methods. On the other hand, even in the highly debatable understanding of marginalism suggested by Machlup and others, that an attempt at profit maximization is already sufficient to justify the use of the marginalist framework, empirical evidence is discouraging. In this sense, marginalism is unlikely to offer either an explicit description of the behaviour of firms, or their motivation.

As a consequence, we will, for the remaining part of this section, focus on the implicit understanding of marginalism and its possibility for serving as a valid tool for economic theorizing on pricing behaviour. As argued before, this implicit understanding of marginalism draws on the notion that the aim of marginalist price theory is neither to describe the actual behaviour nor the motivation of firms, but only the observable *effect* of their behaviour.

Of course, as has been pointed out in the previous section, this view is generally accepted by economists and it is the implicit, rather than the explicit understanding of marginalism that predominates. As a consequence, we will focus on the instrumentalist view of marginalism.

### 1.5.2 Implicit Marginalism and Friedman's Defence

In this section, I discuss the implicit understanding of marginalism that emerged in the course of the marginalist controversy and has, since then, pre-

[14] It should not be seen as an obvious argument against profit maximization in practice that the term "profit maximization" is seldom given as a response by managers. If the stated objective is a "target rate of profit", it could very well be that this rate is the result of a rationale of profit-maximization: perhaps the firm identified this target rate of profit as the one that is maximally attainable, leading to de-facto profit maximizing behaviour.

vailed in orthodox economic theory. The foundation of implicit marginalism was coherently summarized by the following statement by Langholm (1969, p. 10):

> The marginal theory of price was never intended to serve as a blueprint for entrepreneurial decision making or indeed to describe or explain in detail what actually takes place in the firm. It is of the nature of an explanatory device on a much higher level of abstraction, permitting only broadly generalized deductions about the aggregate effects of entrepreneurial behaviour. Its merit as such was never a fully settled question. But obviously, it takes more to disprove it than demonstrating that actual price makers do without marginal reasoning. The crucial question is whether the prices reached in a different way, reproduce aggregate effects which are predictable in the marginal system.

In the following section, we will focus on the question of whether we should rely on the validity of marginalist price theory to deliver viable predictions of industrial pricing. Being probably the most prominent figure in the instrumentalist view on marginalism that allowed its implicit understanding, we will concentrate with the methodological contributions of Milton Friedman, first and foremost on his 1953 article "The Methodology of Positive Economics".

#### 1.5.2.1 Neoclassical Economics, Marginalism and Instrumentalist Reasoning

In order to correctly assess this question, we must first further clarify the exact aim and scope that underlies marginalist price theory. In the past, it seems that a major proportion of the anti-marginalist attacks were more or less easily refutable by marginalists since they aimed at a realistic interpretation of marginalist price theory. Such an attack could be easily deflected by a reformulation of marginalist principles along the instrumentalist interpretation.

Probably the most cited defendor of the maximization hypothesis along the lines of instrumentalism is Milton Friedman. His methodological work had a significant impact on economic research as a whole, and its underlying mindset can still be recognized in the profession today. Many of the arguments in defence of marginalism, most notably by Machlup (1946), use a logic similar

to what Friedman made explicit in his work of 1953. Interestingly, both the leading voices around the Oxford Economists' Research Group, such as Hall and Hitch, Andrews or Harrod, and Milton Friedman were - although out of completely different motives - unsatisfied with the theory of imperfect competition developed by Robinson (1953, first published 1933) and Chamberlin (1933). The former were unsatisfied with the theory's lack of "realism", in that sense that the assumptions the theory made, such as taking it as given that managers followed some sort of marginalist rationale, were not an accurate description of reality. Friedman, on the other hand, criticized it for the inclusion of "realistic" assumptions as a starting point for building a theory of the firm.

Friedman's basic assertion is that, for an economic model such as the neoclassical framework to be applicable and useful, only the performance of the model's ability to predict the effects as observed in reality matters. Specifically, he sees the task of positive economics as to

> provide a system of generalizations that can be used to make correct predictions about the consequences of any change in circumstances. Its performance is to be judged by the precision, scope, and conformity with experience of the predictions it yields. (Friedman, 1953, p. 4)

In this understanding, neoclassical theory not describes firm behaviour, but rather represents it. Most commonly, Friedman's arguments were understood as being instrumentalist.[15] In its purest form, an instrumentalist theory is not concerned with the real effects and interactions that lead to a certain outcome. It is only supposed to accurately predict the outcomes, not the mechanisms that lead to the observed state of reality. The economic agent - in this case the firm - is seen as a "black box". Behaviour is not to be explained by theory, but only predicted and replicated. In other words, "hypotheses and theories are viewed as instruments for successful predictions" (Boland, 1979, p. 511). As Boland (1979) argued, Friedman's argumentation is logically sound within this instrumentalist view of science.[16] Friedman's view on the methodology of economics has been intensely debated and criticized, but still remains widely

[15] For a more detailed interpretation focusing on realistic aspects in Friedman's approach, see Cruccolini (2010).

[16] Boland sees this as the main reason why "every critic of Friedman's essay has been wrong" (Boland, 1979, p. 503).

present in mainstream economics and his defence of these principles can be seen as the main justification for assuming profit maximization. We will not cover the merits and disfunctions of Friedmans work in general here, for this would widely exceed the scope of this work. Nevertheless, it is important that we outline Friedman's view of marginalism and the kind of evidence that is, in his opinion, sufficient to refute its predictions.

Friedman argues that testing whether assumptions of a theory are true is irrelevant for testing the validity of a theory. Even more so, he asserts that the falsity of assumptions does not matter if the conclusions of the theory are true (Friedman, 1953, p. 18). In this vein, he continues by discussing the possibility that a false assumption can be used for a theory that explains the observed phenomenon correctly. In his view, this is the case: as long as the observed phenomenon is correctly predicted by the logical deductions of the argument that rests upon one or more false assumptions, the use of these false assumptions is acceptable. This is where his famous "as-if" argument on the behaviour of individuals emerges. That is, as long as the effect of the behaviour that is observed would result under the behaviour that we assume, this behavioural assumption can be used even if this assumption is false. In this sense, the theorist does not state that individuals behave as assumed, but that the effect of their behaviour is as if they acted as assumed. To visualize this point, Friedman supplied an analogy to a professional billiard player, initially brought forward in Friedman and Savage (1948):

> Consider the problem of predicting the shots made by an expert billiard player. It seems not at all unreasonable that excellent predictions would be yielded by the hypothesis that the billiard player made his shots as if he knew the complicated mathematical formulas that would give the optimum directions of travel, could estimate accurately by eye the angles, etc., describing the locations of the balls, could make lightning calculations from the formulas, and could then make the balls travel in the direction indicated by the formulas. Our confidence in this hypothesis is not based on the belief that billiard players, even expert ones, can or do go through the process described; it derives rather from the belief that, unless in some way or other they were capable of reaching essentially the same re-

> sult, they would not in fact be expert billiard players. (Friedman, 1953, p. 21)

Friedman thus argues that the billiard player does not consciously use Newtonian physics to calculate the necessary speed and angle of his shot but rather uses his intuition, experience and developed heuristics to assess the problem. Nevertheless, the effect of his play, the accuracy and the effectiveness are as if he would solve the game by calculating according to the laws of physics. Thus, a theory that describes the actions of the player given a problem he faces with physical equations and with the assumptions that the billiard player uses these tools, fulfills the demands Friedman poses on a theory: it correctly predicts the effect of the billiard player's moves. The assumption that he employs the physics equations is thus most probably unrealistic, but correctly serves the purpose of constructing a model that predicts the outcome of the player's game.

#### 1.5.2.2 As-if Argumentation and the Justification of Profit Maximization

As established above, marginalists argue that firms maximize profits, whether managers do so consciously or not does not matter. What matters for supporters of this view is that the neoclassical theory of the firm correctly predicts the effect of the behaviour of firms. It is thus of no use to criticize marginalism with evidence of firm behaviour that proves that firms do not apply marginalist methods consciously. To refute marginalism, it is necessary to show that the effect of the behaviour of firms is not correctly represented by the neoclassical theory of the firm. If we could prove empirically that firms do not maximize their profits, we would have a strong argument against the method of marginalism. Yet any motivational or behavioural observation we make at the firm level does not suffice to refute marginalism. Perhaps the attractiveness of marginalism and its deductions stems from the fact that, due to the imposed ignorance of individual motivations, this line of reasoning becomes immune to a large variety of attacks (Boland, 1979, p. 511). For example, the general statement that individuals are maximizers is, as Boland (1981), argues, hard to verify or to reject. As an universal statement, it claims that it is true for all decision-makers, which is not verifiable. At the same time, it is not possible to prove that the statement is false because a (possibly) true counter-example of

the form "this decision-maker does not maximize anything" is not verifiable. From this general irrefutability stems the strength of the defence of implicit marginalism: as the framework of orthodox pricing theory was transformed from a largely realistic to an instrumentalist understanding during the full-cost debate, it became more general and thus less vulnerable against theoretical and empirical attacks.

The critique that arose during the marginalist controversy, namely that researchers took it as counter-evidence that decision-makers did not seek to maximize profits nor think in marginalist ways, was, as seen by Friedman, bound to fail. He writes:

> A particularly clear example is furnished by the recent criticisms of the maximization-of-returns hypothesis on the grounds that businessmen do not and indeed cannot behave as the theory "assumes" they do. The evidence cited to support this assertion is generally taken either from the answers given by businessmen to questions about the factors affecting their decisions - a procedure for testing economic theories that is about on a par with testing theories of longevity by asking actogenarians how they account for their long life - or from descriptive studies of the decision-making activities of individual firms. Little if any evidence is ever cited on the conformity of businessmens actual market behavior - what they do rather than what they say they do - with the implications of the hypothesis being criticized, on the one hand, and of an alternative hypothesis, on the other. (Friedman, 1953, p. 31)

This, as brought forward by other writers such as Machlup (1946) or A. Robinson (1939) was one of the main lines of defence against the proponents of the full-cost principle.

In defence of marginalism, Friedman demands that theories be empirically tested for their worth, in the sense that

> theory is to be judged by its predictive power of the class of phenomena which it is intended to 'explain' [...] the only relevant test of the validity of a hypothesis is comparison of its predictions with experience.(Friedman, 1953, pp. 8-9)

To show that the maximization hypothesis (in the case of firms) passes such a test, Friedman argues along several lines. The first, which I will discuss in greater detail below, is his assertion that market processes lead to a survival of firms that are - consciously or not - maximizing their returns. In this sense, maximization can be seen as being enforced by the market. An "even more important body of evidence" (Friedman, 1953, p. 22) is in his view the "countless applications of the hypothesis to specific problems and the repeated failure of its implications to be contradicted". He also points out that the continued use and application of the hypothesis, along with the lack of a coherent and accepted alternative, serves as an indicator of the worth of the hypothesis. Underlying this argument is a quite optimistic view of scientific progress. Clearly, the mere fact that a methodology is used frequently does not allow for any statements about its worth or ability to predict phenomena in reality. Or, in the words of Herbert Simon: "[Economists] believe that businessmen maximize, but they know that economic theorists satisfice" (Simon, 1979, p. 495).

#### 1.5.2.3 The Selection Argument

The second theoretical argument that Friedman uses to defend the marginalist maximization hypothesis is based on a selection process. He writes:

> Confidence in the maximization-of-returns hypothesis is justified by evidence of a very different character. This evidence is in part similar to that adduced on behalf of the billiard-player hypothesis – unless the behavior of businessmen in some way or other approximated behavior consistent with the maximization of returns, it seems unlikely that they would remain in business for long. Let the apparent immediate determinant of business behavior be anything at all – habitual reaction, random chance, or whatnot. Whenever this determinant happens to lead to behavior consistent with rational and informed maximization of returns, the business will prosper and acquire resources with which to expand; whenever it does not, the business will tend to lose resources and can be kept in existence only by the addition of resources from outside. The process of "natural selection" thus helps validate the hypothesis – or, rather, given natural selection, acceptance of the hypothesis can be based largely

> on the judgment that it summarizes appropriately the conditions for survival. (Friedman, 1953, p. 22)

This "evidence" seems to be questionable if Friedmans own claims are adhered to:

> Viewed as a body of substantive hypotheses, theory is to be judged by its predictive power for the class of phenomena which it is intended to "explain". Only *factual* evidence can show whether it is "right" or "wrong" or, better, tentatively "accepted" as valid or "rejected". (Friedman, 1953, p. 8, emphasis addded)

Friedman proclaims that factual evidence is required to validate a theory. In case of the justification of the as-if hypothesis, he actually treats his *theoretical* consideration of the selection process that he has in mind as *factual* evidence. Despite this questionable argumentation, we will - for the sake of the argument - suppose that the selection argument would, if valid, be sufficient to establish confidence in marginalist price theory. In this section, we thus consider the problems of Friedman's selection argument as a defence of marginalist price theory.[17]

The argument given by Friedman suggests that there is a form of "natural selection" present in competitive markets that weeds out firms displaying sub-optimal behaviour and thus ensures the survival of only those firms that, by chance or not, behave in a way that maximizes their profits. As such, Friedman assumes that competition is so fierce that none but the optimal behaviour can persist. But how exactly should this selection process work? Returning to the analogy of the billiard player, a consistent application of Friedman's selection argument would mean that only billiard players would participate in professional competition that manage to sink in all balls with the first strike. Clearly, this is impossible even for the most advanced players. Thus no matter how hard the competition may be, it is not ensured that perfect play prevails. Herbert Simon formulated this insight by using an analogy to biology:

> [T]he objections [against profit maximization] rest on the assumption, much stronger than any in biological Darwinism, that only

[17] Our analysis draws heavily on the work of Vromen (2009), who discusses the details of Friedmans selection argument.

> profit maximizers can survive. Again, it is clear that the issue has to be decided by empirical inquiry. In the biological world at least, many organisms survive that are not maximizers but that operate at far less than the highest achievable efficiency. Their survival is not threatened as long as no other organisms have evolved that can challenge the possession of their specific niches. Analogously, since there is no reason to suppose that every business firm is challenged by an optimally efficient competitor, survival only requires meeting the competition. In a system in which there are innumerable rents, of a long-term and short-term duration, even egregious suboptimality may permit survival. (Simon, 1997, p. 283)

Along these lines, evolutionary theorists have demonstrated that a selection process as envisioned by Friedman might lead to quite different results than a prevalence of profit-maximizing firms and competitive markets. For example, Blume and Easley (2002) show in an evolutionary general equilibrium model that while a selection process might lead to a survival of profit-maximizing firms, this equilibrium is not pareto-optimal. Furthermore, if capital markets are added, growth rates of firms may not be solely influenced by their success and profit maximizers are not favoured by the selection process. Indeed, one could argue that growth ensures the validity of the selection argument: if firms are more successful than others, they acquire more resources which they can use to reinvest and to expand, thus outgrowing their inferior competitors. Yet this argument is refuted not only by Blume and Easley's findings. Dosi (2007) shows empirically that there is no connection between relative productivities and growth. This contradicts the supposition that more efficient firms grow more than their less efficient competitors.

Another related problematic aspect of Friedman's selection argument has been put forward by Nelson and Winter (1982). They criticize Friedmans statement that the determinants of firm behaviour are irrelevant to the outcome of the selection process. For example, Winter (1964, p. 244) showed that if profitability of relatively successful firms does not lead to proportional growth, i.e. in the case where firms with high profits pay high dividends instead of using the resources to expand, then less profitable firms will not be driven out of business. Another model that shows the possible inadequacy of profit max-

imization in the context of competition was developed by Dutta and Radner (1999). Similarly, their work demonstrates that if information is imperfect and costly to gather, a strict maximization of profits might not ensure survival. In this situation, the use of rules of thumb, such as a full-cost pricing heuristic discussed extensively in this work, may be more viable. Of course, it could be argued that this does not contradict Friedmans argument: if full-cost pricing is optimal given the economic circumstances, it is the behaviour that will be selected by the competitive process. Yet the point that Winter makes is more subtle: he argues that individual behaviour of firms does determine the outcomes of evolutionary selection processes. To exemplify this point further, let us return to the underlying mechanism of the selection argument that suggests that firms with superior strategies will be, consciously or not, more successful than their competitors and might thus have increased fitness in the selection process. It is not clear that the conditions under which the evolutionary process selects the fittest firms are constant. Market environments are usually highly dynamic, and what was optimal in one period of time may be gravely inefficient in the next. Thus Friedman implies that a gradual selection process, in which successful firms obtain more resources over time and can thus outcompete less efficient firms, is invariant with respect to both the behaviour of the firm and the market environment. Winter states this argument in the following way:

> If the immediate determinants of behavior are 'habitual reaction, random chance, or whatnot,' there is no reason to believe that the firms which take actions consistent with profit maximization at one time will also take actions consistent with such maximization at all subsequent times. (Winter, 1964, p. 240)

To summarize, this short survey of some of the problems with Friedmans selection argument showed that even if we accepted a purely theoretical argument as supplying sufficient evidence for the validity of marginalist price theory, it is unlikely that this line of reasoning would be enough to restore our faith. As Vromen (2009, p. 282) fittingly puts it:

> It seems Friedman's argument had some sort of boomerang effect. In the end his argument raised more worries and doubts about the economic theory he favors than it was able to put to rest.

In order to shed light on some additional problems with the marginalist approach to pricing, we will discuss in the next section some further empirical and theoretical aspects that contribute to the claim that the prevalent method of modelling pricing behaviour is unsatisfactory.

### 1.5.3 Further Problematic Aspects of Marginalist Price Theory

In this section, I will bring forward a selection of issues that can be brought into connection with marginalist price theory. This presentation of additional problems is by no means complete, but is aimed at making it clear that the issues discussed above are not the only points of criticism that can be brought forward against marginalist price theory. In contrast to the above arguments, the following aspects are of a more empirical nature and thus correspond to Friedman's initial appeal to test the validity of marginalism by comparing its predictions to observations of reality.

#### 1.5.3.1 Cost Structures and the Eiteman's Critique

An important argument that raises scepticism in the validity of prevailing standard price theory was brought forward by Wilford J. Eiteman. In 1947, he published an article entitled "Factors Determining the Location of the Least Cost Point" in the American Economic Review. He argued that prevailing theory, which assumes firms to choose a price-output combination that is characterized by an equality of marginal cost and marginal revenue is at odds with the properties of production processes in reality.

Standard marginalist price theory describes total unit cost functions as first decreasing and then increasing in quantity. Total unit costs consist of fixed unit costs, which decline continuously with increasing output as fixed costs are divided by an increasing output, and a variable cost curve, which is usually assumed to be increasing after an initial decline with output. As, at one point, the decrease in total unit costs due to a decreasing fixed cost share is overcompensated by the increase in variable costs, the total unit cost curve is thus U-shaped and has its least cost point significantly below the maximum capacity limit. The reason for the rise in variable cost with increasing output lies in changes in the efficiency of the variable input factor. The least cost point thus corresponds to

the point of highest output per variable input factor, which, in the standard theory, lies well below the capacity limit. If output is increased beyond this point, marginal productivity of the variable factor is assumed to be decreasing ("law of diminishing returns") and thus leads to continuously rising marginal costs after the least cost point.

Eiteman's critique focuses on this aspect: why should the firm design its production process in a way that the point of highest efficiency is seldom achieved but usually surpassed in normal operation of the business? He argues that a entrepreneur would ask engineers to design the production plant in the most economical way.

If this point is taken into account, and plants are designed to reach the point of maximum efficiency near or at the capacity limit, the shape of average cost curves would be altered. For the greater part of the output range, total unit and average variable costs curves would fall, only to rise near or at the limit of capacity. Eiteman continues by arguing that engineers design production facilities

> so as to cause the variable factor to be used most efficiently when the plant is operated close to capacity. Under such conditions an average variable cost curve declines steadily until the point of capacity output is reached. A marginal curve derived from such an average cost curve lies *below* the average curve at all scales of operation short of peak production, a fact that makes it physically impossible for an enterprise to determine a scale of operations by equating marginal cost and marginal revenues unless demand is extremely inelastic. (Eiteman, 1947, p. 913)

It follows that if the point of optimal productive efficiency is near or at the capacity limit, managers will simply produce all they can sell.[18] Eiteman thus argues that the location of the least cost point of the average unit cost curve encountered in reality decides upon the validity of the marginal theory of pricing. His argument can be reformulated in the following way: if entrepreneurs maximize profits to find, given the proportions of fixed and variable inputs, the output and price combination which is optimal, why do they not initially

[18] For a discussion of the controversies surrounding pricing in the case of falling marginal costs at the time, see Coase (1946).

acquire a quantity of the fixed factor (i.e. the size of the factory, etc.) that leads to an optimal utilization of the variable input under normal workload?[19]

Five years later, following his own call for an empirical investigation of the shape of average cost curves, he published results of a survey among 366 manufacturing firms in the US. In the questionnaire, managers were presented stylized shapes of unit cost curves in relation to capacity limits. A careful survey design and detailed explanations ensured that interviewed managers understood the graphical representation of the cost curves. As Eiteman argues, it is the opinion of managers regarding the shape of their cost curves that matters for the validity of marginalism, not the true shape of the cost curves: if the manager believes his marginal cost curve to increase, he will act accordingly by choosing price and quantity combinations that may be correctly predicted by marginalist methods. If, on the other hand, he believes to be facing a constant or even falling marginal cost curve, he will not initially behave as predicted by marginalism.

Of the 366 respondents, only 18 chose a U-shape for the cost curve that is compatible with marginalist price theory. Most firms reported being subject to constant or even falling marginal costs, and faced steadily declining average cost curves up to or close to maximum capacity. In addition, he received letters from managers showing their dissatisfaction with prevailing economic price theory. A manufacturer of road building equipment wrote (Eiteman, 1947, p. 838, comments added):

> Even with the low efficiency and premium pay of overtime work, our unit costs would still decline with increased production since the absorption of fixed expenses would more than offset the added direct expenses incurred.

Another interviewed manager wrote:

> The amazing thing is that any sane economist could consider No. 3, No. 4 and No. 5 curves [average cost curves compatible with marginalism] as representing business thinking. It looks as if some economists, assuming as a premise that business is not progressive, are trying to prove the premise by suggesting curves like Nos. 3, 4, and 5.

[19] For a formal representation of Eitemans argument, see Lee (1984, p. 1125).

This exemplifies an irony of orthodox pricing theory. While postulating that firms consider and react to all relevant factors of the pricing decision in an optimal manner, either by conscious deliberation or by being selected by the evolutionary process as those "that are doing it right", firms are, in this framework, not able to design their production processes in an optimal way. Rather, they are assumed to frequently produce in a situation of an inefficient combination of production factors.

From these empirical results and his earlier theoretical work, Eiteman concluded that "short-run marginal price theory should be revised in the light of reality" (Eiteman and Guthrie, 1952, p. 838). Given his convincing critique, it seems surprising that the law of diminishing returns - and thus the assumption of rising variable costs - is an integral part of orthodox economic theory. A reason might be that older theorists observed production processes where the fixed factor was not designed by engineers, but by nature. In agriculture, mining or forestry, an expansion in the scale of operations eventually leads to a diminishing return of the variable input. Yet economists did not make the necessary distinction between these and more modern production methods, where all input factors can be adjusted according to maximum efficiency.

Eiteman's critique gathered much attention among economists. As Lee (1984, p. 1123) states, some rejected Eiteman's arguments as nonsensical, while others saw the foundations of marginalism destroyed. Curiously, in the September 1948 issue of the American Economic Review, only the negative replies to Eiteman's 1947 article were printed. As a consequence, this substantial critique of the marginalist pricing framework trailed off and is unknown to the majority of economists today.

Yet further empirical research that estimated cost functions using micro data replicates the evidence for constant or even falling marginal costs. Pioneering in this branch of research, Dean (1936; 1941*a*; 1941*b*) used data from a furniture factory, a leather belt factory and a hosiery mill to estimate cost functions. In all cases, he found a linear specification of the cost function to be significant. Further evidence for constant marginal costs in the steel industry was brought forward in empirical studies by Ezekiel and Wylie (1940) and Yntema (1940).[20]

[20]Despite this significant body of empirical evidence for non-increasing marginal costs obtained by estimating cost functions, it is not certain that all of these studies can be interpreted as lending to the conclusion that average costs are constant or falling over the whole

Troughton (1963, p. 114) concluded from his investigation that variable costs per unit "tend to fall, slightly and unevenly, over the whole range of output". Ramey (1991) found in a study of several industries that firms behave as if they were facing falling marginal cost curves, as they are more inclined to bunch production instead of smoothing it. More recently, Puty (2005) found in an empirical investigation of twenty industries in the US manufacturing sector in the 1958-1996 period that in general, unit costs exhibit a negative slope.

Following Eiteman's argument that it is decisive which shape of the cost functions managers *believe* they are confronted with for the validity of marginalist price theory, it thus also seems to be a promising approach to ask managers directly to obtain an insight into the general shapes of cost functions. Proponents of the full-cost principle have, during the controversy, repeatedly brought forward such survey evidence for constant or falling marginal costs (Hall and Hitch, 1939; Lester, 1946; Andrews, 1949). In addition, most contemporary management accounting texts assume that marginal costs are linear "within the relevant range", which refers to a "range of capacity utilization in which the firm normally plans its budget", and that firms usually use such cost measures for the pricing decision (Dorward, 1987, p. 41). A recent study by Blinder et al. (1998) strengthens the survey evidence on the non-increasing nature of marginal costs. In an extensive questionnaire on pricing behaviour, they found that only 11 per cent of firms report that their marginal cost curves are rising. In contrast, 40 per cent stated that they are facing falling marginal costs, and for 48.4 percent marginal costs were constant. Blinder thus concludes

> The overwhelmingly bad news here (for economic theory) is that, apparently, only 11 percent of GDP is produced under conditions of rising marginal cost. (Blinder et al., 1998, p. 102)

Eiteman's critique is thus supported by a significant body of evidence, and its relevance thus still prevails. Still, it continues to be disregarded by the majority of economists.

range of output up to the point of maximum capacity. As Walters (1963, p. 51) argues, many empirical estimations of cost functions did not pay attention to the point of capacity utilization at which their data was recorded. Hence it is difficult to draw conclusions from a limited range of output to the whole cost function.

#### 1.5.3.2 Profit Maximization and Demand Elasticities in Oligopolies

Counter-evidence to profit maximizing pricing behaviour was also brought forward by Koutsoyiannis (1984). He examined market elasticities for 54 industries in the US between 1958 and 1980. Arguing that market shares are constant, he is able to equate market price elasticities with the demand elasticities faced by the individual firms. In all cases, price elasticities were not significantly greater than unity. In addition, an analysis of confidence intervals revealed that in 37 industries price elasticity is below unity. As can be seen in expression (1.3) presented earlier, the price elasticity of demand must be greater than one to equate marginal revenue with positive marginal costs. If demand is inelastic at the price that the firm decided upon, the firm has an incentive to increase the price to increase revenues. According to his results, Koutsoyiannis argues that firms do not use this opportunity for higher short-run profits. He therefore refutes the hypothesis that firms are profit or sales maximizers in the short run and stresses the importance of entry prevention pricing.

#### 1.5.3.3 Prices in the Business Cycle

Another problematic aspect with regards to marginalist price theory - relating primarily to the methodological use of the framework - is the modelling of price behaviour during fluctuations of the business cycle. As Blinder et al. (1998, p. 188) argue, prices should be, according to the most basic formulation of standard theory, procyclical. As in the neoclassical framework marginal cost is an increasing function of output, and price is equal (or at least positively associated with) marginal costs, prices should rise during a boom and fall during a recession. If demand elasticity is unchanged, profit mark-ups should remain constant.

There exists some empirical support for the notion that prices and mark-ups behave procyclically (e.g. Downward, 1999; Puty, 2005). Yet at the same time, Bils (1987) and Rotemberg and Woodford (1999), among others, find mark-ups to behave countercyclically. Moreover, other empirical studies have found that prices do not change relative to normal costs over the course of the business cycle (Coutts et al., 1978).

Another empirical phenomenon is the rigidity of prices. In its most basic form, marginalist price theory cannot explain the fact that most prices only

adapt to cost or demand shocks with significant delays (Cecchetti, 1986; Blinder et al., 1998; Alvarez, 2007).

Many more examples of phenomena that are initially not explainable by the basic marginalist pricing framework could be presented.[21] An explanation of these findings within the orthodox neoclassical theory is usually achieved by extending the basic model to incorporate additional effects within a framework of marginalist maximization (as an example, consider the menu cost approach formulated by, among others, Rotemberg, 1982). In the context of behavioural and experimental economics, this methodological approach of "neoclassical repairing" has been criticized by Güth (1995, p. 342). Although his critique aims at the utility maximization hypothesis, it is possible to draw parallels to the theory of the firm:

> Experimental economics presently experiences a [..] debate how to explain so-called 'anomalies' [..], i.e. empirical facts which do not comply with optimal decision behaviour according to monetary incentives. Very often this is done by including additional arguments of utilities [..]. Doubtlessly a lot can be learned from such attempts to explain experimental phenomena, especially when they are based on well accepted motivational forces. Very often this type of research resembles, however, a neoclassical repair shop in the sense that one first observes behaviour for a certain environment and then defines a suitable optimization or game model which can account for what has been observed.

A similar observation can be made for phenomena related to pricing behaviour. By the extension and adaptation of the basic marginalist model by additional assumptions, each fitting to the particular problem it is designed to explain, empirical facts may be accounted for but a more general understanding of the mechanisms that govern the price setting process is not attained. By extending the marginalist model, the question is rather shifted to a higher level, i.e. it is then necessary to explain which extensions of the neoclassical model play a role in which setting and what decides upon their relevance.

[21] Another example for such a phenomenon is the existence of price dispersion in competitive markets and its positive association with the aggregate rate of inflation. This will be the subject of the investigations described in Chapter 4.

For these reasons, I will argue in the next section why a more realistic approach to the theoretical approach of pricing behaviour can be worthwhile.

## 1.6 Methodological Aspects of Marginalist Price Theory

Marginalist price theory has dominated economic research on pricing for many decades. Despite evidence that raises doubts about the validity of its predictions, it does not appear liable to lose its significance in the near future. Both the generality and the vagueness of marginal theory makes it hard for critics to refute its results, or to suggest a distinct theoretical alternative. In addition, counter-evidence seems not to suffice to shake the established belief in marginalism. Eiteman's words have thus not lost their relevance even after 60 years:

> Their [marginalists] attitude is summed up in the following question: "If entrepreneurs do not determine the scale of output on the basis of marginal cost concepts, then how do they do it?", the implication being that until an alternative theory appears the marginal doctrine stands unshaken. The question is a fair one but it does not follow that absence of an adequate explanation *proves* the correctness of an existing explanation (Eiteman, 1947, p. 916, comments added, emphasis in original).

We have discussed in considerable detail significant flaws in both the empirical validity of predictions of marginalist price theory and the justification of its theoretical foundations. Yet what I want to argue is not that economists should abandon marginalist price theory. While it was shown in the above discussions that this approach has various flaws, it would be utopian to think that a different theoretical framework would be without problems. Rather, I wish to emphasize that it is a fruitful endeavour to study the processes connected to the pricing decision in more detail without an interpretation of obtained insights along the lines of an existing theoretical framework. Such an approach could lead to insights that give rise to new theoretical ideas that may contribute to a more thorough understanding of pricing behaviour.

In the existing mainstream literature on pricing behaviour, too little attention has been paid to the motivations of firms with regards to pricing. As argued above, economists are generally ill-advised to rely entirely on the validity of marginalist price theory as an instrumentalist tool for the prediction of pricing behaviour. As a consequence, the need arises to study the process of the pricing decision itself. It seems that directly asking managers would be a good starting point for gaining insights into the factors that govern the pricing decision. Yet such research has mostly been missing in economics since the early days of the marginalist controversy. An example that demonstrates that such a research method can lead to valuable results is the large survey-based study "Asking About Prices" by Blinder et al. (1998) that is mentioned frequently in this work. In a review of Blinder's publication of preliminary results, Robert Shiller writes:

> Blinder is working here to rectify the damage that overliteral interpretation of Milton Friedman's theory of positive economics has wrought in the economics profession. Many people seem to have thought that Friedman's "billiard player" analogy justifies omitting ever asking people about what they do. Friedman may be right that one cannot ask the player to explain why some shots are effective, and that a theoretical physicist could explain better. But, on the whole, I think that it would be a disastrous mistake to ask a physicist to model the behavior of a billiard player without allowing the physicist to get the player's help in the modeling process. The physicist will not understand the strategy of the game, will not know what the player's short run objective would be on a given shot, and will likely omit considerations such as english or margins of error that may be difficult to theorize about or about which the physicist does not have full information. (Shiller, 1991, p. 97)

Although some members of the economics profession have called for such a "New Empiricism" (Bergmann, 2007) or "Micro-Microeconomics" (Leibenstein, 1979), most research in the economics mainstream relies uncritically on marginalist price theory. And even if actual pricing behaviour is studied, findings are mostly interpreted and incorporated into the marginalist framework.

As an example, consider the significant body of recent empirical literature that emerged from the school of New Keynesian macroeconomics and studies

the behaviour of prices and mark-ups with a particular focus of the effect of shocks and observable rigidities (e.g. Bils and Klenow, 2004). While these empirical investigations produce valuable insights, their theoretical interpretation runs largely along marginalist lines. Economists use the obtained data to try to discriminate between different extended versions of the neoclassical pricing model, each emphasizing a particular aspect of the pricing decision. This exclusive focus on a marginalist perspective, which always aims for a rationalization of empirical phenomena along the lines of profit maximization, deters an unbiased view of pricing behaviour. An objective assessment of the relevant aspects that play a role in the pricing decision may give rise to the emergence of new and promising theoretical modelling approaches. No real insight into the behaviour of firms is generated if facts are solely interpreted along marginalist lines, since the main governing factors of behaviour are already postulated before the interpretation begins.

Furthermore, even if the validity of marginalist price theory as an instrumentalist tool were warranted, it is debatable whether this approach is fully satisfactory from a scientific perspective. Especially if market intervention is considered, an understanding of the mechanisms that generate economic phenomena is necessary for enabling economic theory to provide reliable predictions regarding policy measures. Further, if cost structures do not lend themselves to feasible marginalist pricing, as Eiteman has argued, the marginalist position must remain uunsatisfactory, even if no alternative is presented.

One of the main recurring themes of this work is the importance of accounting for the theory of the firm in general and the pricing decision in particular. It is through accounting systems that firms generate, process and employ information about their operations and come to decisions. An investigation of pricing behaviour thus must consider the features and implications of the design and use of accounting systems. We show in the course of this work not only that the accounting system can matter for the pricing decision (as demonstrated in Chapter 3), but also that the choice of costing systems used by firms can have implications for market-level phenomena that are still incompletely explained in economics. As an example, Chapter 4 shows that full-cost pricing can lead to an increase in the dispersion of relative prices under an inflationary shock, whereas this effect does not occur under variable costing.

It could be argued that the inclusion of factors that are relevant to the pricing decision, such as the accounting system, may lead to an increase in complexity that prohibits the analytical modelling approach common in standard theory. Yet an increased understanding of inner-firm decision processes might allow economists to develop models of an equal level of abstraction as current standard pricing theory that display a better fit to the empirical data and are more coherent in their foundations. In addition, some phenomena that require special ad-hoc assumptions in the marginalist framework, like price stickiness, may be elucidated quite directly from a new theoretical perspective. In contrast, the apparent initial simplicity of marginalist price theory comes at the cost of additional complications that arise through the necessary extension of the basic neoclassical framework to account for additional phenomena. The overall transparency and coherence of a modelling approach based on a more realistic assessment of the pricing decision (such as a reinterpretation of the strict full-cost principle) may prove superior to the existing marginalist price theory.

Furthermore, theoretical economists are by no means bound to using analytical models to do theoretical research. Other approaches, such as agent-based modelling and numerical simulations can handle a vast amount of complexity and permit the identification of regularities and causalities in economic systems.[22]

## 1.7 Conclusion

In this introductory chapter, we have described the rise and fall of full-cost pricing as an autonomous theoretical concept. In the process of fending off the arising attacks, proponents of marginalist price theory had to work on their own understanding of the approach they supported. As a result, marginalism was generalized and instrumentalist reasoning was used as the main defence strategy in the confrontation with empirical evidence on cost-plus pricing. We have argued that the resulting absorption of full-cost pricing into the neoclassical framework cannot be justified by the arguments that marginalists put forward.

[22] For a good overview on agent-based modelling, see Macal and North (2007*a*)or Macal and North (2007*b*).

Nevertheless, marginalist price theory has dominated mainstream economics since the end of the debate. We have discussed several theoretical, empirical and methodological aspects that emphasized that confidence in the validity of marginalist predictions is not sufficient to justify an exclusive concentration on this theoretical approach. Rather, we argued that economists should pick up the work where it ended with the marginalist controversy. What is needed is a thorough investigation of decision processes within the firm, along with the intentions and considerations that play a role for the pricing decision from the viewpoint of the decision-maker. Empirical findings then need to be objectively assessed without a mere interpretation along marginalist lines. This research on pricing is overdue and it would be surprising if no other promising insights could be obtained, both empirically and theoretically.

In this context the recognition of the importance of internal costing systems for the theory of the firm is particulary essential. They are playing a crucial role for pricing by generating and transmitting cost information to decision-makers. As we will see in the next chapter, the information that is supplied by these systems is usually biased, and it is likely that these distortions have an effect on the pricing behaviour of firms and can thus in turn lead to aggregate phenomena. For this reason alone, economists must recognize the central role of internal accounting systems for the theory of the firm.

The following three chapters aim at demonstrating that a recognition of some of the features of the pricing process - such as a reliance on inaccurate costing information or the use of rules of thumb - can have implications that differ from those the standard marginalist framework suggest. In addition, Chapter 4 shows that an incorporation of some realistic elements of the pricing decision may help to explain aggregate phenomena and thus may help to contribute to the overall understanding of economic systems more naturally than the marginalist approach that requires quite artificial ad-hoc additions in order to be reconciled with empirical data.

Yet although I aim at incorporating aspects that I have argued to be important for future developments of research on pricing behaviour, the approach followed in the remaining chapters of this work fail to comply with some of the claims that where made here. Firstly, the models in Chapters 3 and 4 rely, in their design, on many marginalist concepts. At the same time, the models are limited in their scope and generality, and focus only on specific aspects of

the pricing decision. Nevertheless, they may serve as examples that a deviation from the prevailing marginalist mindset is, even if small in scale, a worthwhile endeavour and can lead to new insights and better understanding of the complexities of industrial pricing behaviour.

The next chapter analyses an important influence factor of the pricing decision: the internal costing system. As I will argue, a thorough understanding of the price-setting process requires detailed knowledge on the methods by which firms generate, process and use cost information. By drawing on the framework of institutional economics, the continuing prevalence of full-cost pricing as a result of persistent cost allocation practices will be discussed and the historical development of full costing techniques will be outlined.

# 2 On the Persistence of Absorption Costing

## 2.1 Introduction

Like many other managerial decisions, pricing is highly dependent on cost information. The empirical evidence for costs being a major determinant of product prices is plentiful.[1] As a consequence, a study of pricing behaviour quickly turns into a study of internal costing practices.

The majority of firms rely on a full-costing approach - also termed "absorption costing" by management accountants - for internal reporting and thus for pricing of their products (Govindarajan and Anthony, 1983; Shim and Sudit, 1995). A central characteristic of this method is that costs which are not directly attributable to individual products are allocated to products using cost drivers such as labour hours that should reflect the consumption of shared resources by different products.

In the course of the last decades, the use of these overhead allocation techniques for internal costing has become the target of severe criticism by accounting and economics scholars. It is argued that due to the simplistic allocation methods, the focus on historical costs and the use of inadequate cost drivers, cost information generated by traditional absorption costing systems is "too late, too aggregated and too distorted" to be useful for pricing and other managerial decisions (Johnson and Kaplan, 1987, p. 1). This critique led to the development of more sophisticated costing approaches, most prominently Activity-Based Costing (ABC). Despite its praise and heavy advertisement by

[1] The importance of the influence of costs on prices was investigated by Nordhaus and Godley (1972); Coutts et al. (1978); Coutts and Norman (2007) and Fabiani et al. (2007). For survey evidence on the importance of internal costing systems for managerial decision-making, see, for example: Scapens et al. (1983); Drury et al. (1993) and Brierley et al. (2001).

the academic realm, practitioners were, by and large, reluctant to implement this or any other more modern costing system, and ABC diffusion rates remain low in most countries. As full-cost techniques continue to dominate internal costing, ABC is, over 20 years after its appearance, already deemed to be "yesterday's hope" (Thomson and Gurowka, 2005, p. 28).

Why does traditional absorption costing continue to be so dominant for internal reporting, despite all its apparent shortcomings? We seek to address this phenomenon by first investigating the historical development of cost allocation practices that lead to a broad institutionalization of absorption costing. By developing an institutional framework of management accounting change, it will be discussed whether these historical roots can explain the continuing persistence of cost allocation methods. As we discuss potential factors that contribute to a stabilization of allocation customs against the pressure to change, we will focus on three particular aspects: psychological fallacies in the handling of fixed costs, auxiliary functions of cost allocation and the influence of external reporting regulations on management accounting.

It will be argued that one of these factors is the internal resistance against modern costing practices arising from common perception errors that even experienced managers suffer from in the handling of fixed costs. Secondly, overhead allocations have been found to be useful as a device for control and coordination within firms, and might thus lower the overall inefficiencies for internal costing. Most importantly, we will discuss the external effects of regulations for mandatory external costing procedures on internal costing behaviour. It will be argued that through the statutory use of cost allocations for external reporting, the firm's incentives to implement a dedicated and more sophisticated costing approach for internal reporting are lowered. Such an explanation might also contribute to an understanding of diverging international developments, where countries such as Finland and Germany see much lower usage rates of absorption techniques and costing practices are much closer to the economic "ideal" propagated by academic accountants.

The structure of the chapter is as follows. In order to give a sound foundation for discussing the phenomenon, a short overview of concepts in management accounting is given. This is contrasted with marginalist concepts of costs and put into perspective with empirical evidence on cost structures. Secondly, a typology of management accounting systems is presented and a short overview

of empirical evidence regarding costing and pricing practices is given. In order to understand the status quo of management accounting, I will then give an historical overview of costing practices and show how cost allocation techniques became institutionalized due to political, legal and organizational developments in the 19th and 20th centuries. I will then focus on the contemporary persistence of absorption costing and introduce a perspective on management accounting change that draws heavily on institutional economics. A possible explanation for the persistence phenomenon based on the concept of path dependence is then critically discussed. Last but not least, we will identify three "institutional stabilizers" that might play a role in the persistence of absorption costing in internal reporting systems. A short summary of the findings concludes.

## 2.2 An Overview on Contemporary Cost Accounting Practices

This overview is written from an economist's perspective and aims at providing a common foundation on which further discussions can be grounded. Internal cost reporting systems assist managers in a variety of situations, such as in altering the product portfolio, in make or buy and outsourcing decisions and in cost management. We will, for the most part, analyse costing practices with respect to the pricing decision.

### 2.2.1 Internal and External Accounting Systems

In general, we can distinguish between two branches of accounting, based on which users of accounting information they serve. *Financial accounting* is concerned with the provision of information to parties outside of the firm, and can thus be described as external reporting. Management accounting, in contrast, is concerned with the provision of information to people within the firm to control and manage the existing operations of the enterprise, and thus to produce cost information that is suitable as an aid for decision-making. The purpose of management accounting is thus internal reporting.

Following Drury (2008, pp. 7), several differences between financial and management accounting are worth mentioning. First, external financial reporting in the form of annual financial accounts is a statutory requirement for corporations. In contrast, the implementation of a management accounting system for internal reporting is entirely optional for the firm. Secondly, financial accounting statements have to be prepared according to legal requirements and their form must fulfill the national and international accounting standards formalized in general guidelines such as the Generally Accepted Accounting Principles (GAAP) in the US or the International Financial Reporting Standards (IFRS) in Europe and other countries. These standardizations ensure uniformity and consistency of the structure of financial statements and allow historical and inter-company comparisons. Thirdly, while cost data generated by financial accounting systems is typically highly aggregated to reflect, in retrospective, the whole of the business operation in a given time period (such as a quarter or a year), reports for internal purposes supplied by management accounting systems usually focus on small parts of the organization, such as the costs and profitability of products, divisions or departments and often report in higher frequency. In addition, cost data for internal purposes is usually future-orientated in order to be useful for decision-making, whereas financial accounting is characterized by a mostly historical perspective.

Due to these differences in objectives, firms are expected to have either two distinct costing systems for internal or external reporting, or one sophisticated costing system that can generate cost data for both purposes.

From the viewpoint of the economist who wants to study pricing behaviour, the internal costing system is, initially, the one of interest. In order to price correctly, especially in the short run, an internal costing system must be sophisticated enough to identify the decision-relevant marginal costs of each individual product. In the following discussion of management accounting practices, we want to investigate to what extent internal costing practices comply with this benchmark.

### 2.2.2 Accounting Cost Classifications

While economists distinguish costs mostly along the lines of variability with output, dividing costs into variable and fixed parts, cost accountants generally

employ other criteria for cost classification. The most prominent of these is the categorization into direct and indirect costs (e.g. Drury, 2008, p. 28). Although some surveys seem to use these terms interchangeably with "variable" and "fixed", the two classifications convey quite different notions. Costs that can be traced to a certain product are direct (such as sheet metal for a car), while costs that cannot immediately be traced are classified as indirect costs (such as a press shop in a factory that produces multiple types of cars). In contrast to the theoretically motivated classification into variable and fixed costs, the traceability criterion arose from the practitioner's point of view and poses a basic distinction between costs that is easily and cheaply applied in reality.

| *Cost item* | *Marginalist classification* |
|---|---|
| Direct materials | variable |
| + Direct labour | fixed |
| + Direct expenses | variable |
| **Total direct cost / prime cost** | |
| + Indirect materials | variable |
| + Indirect labour | fixed |
| + other indirect expenses | variable/fixed |
| **Total indirect cost / manufacturing overhead** | |
| **Total/full manufacturing unit cost** | |
| + Higher level sustaining costs | variable/fixed |
| **Total/full unit costs** | |

Table 2.1: Categories of Unit Costs in Mangement Accounting

In all likelihood, direct and variable costs - and hence fixed and indirect costs - are not identical. Table 2.1 shows why this is the case. Depicted are cost

categories as identified by common accounting systems and how they might be classified within the short-run marginalist framework. Usually, direct costs contain variable parts such as materials, but direct labour is most likely to be fixed in the short run (or quasi-fixed, as put forward by Oi, 1962) due to labour contracts. At the same time, indirect costs typically contain variable components, such as utilities or repair and maintenance costs.

Indirect costs can, by definition, not be directly attributed to products. In addition to the categorization of indirect costs presented in Table 2.1, they can also be split into *joint costs* and *common costs*, depending on the underlying production process. *Joint costs* can be defined as costs that are incurred when multiple products cannot be produced separately. In contrast, the term *common costs* describes costs that are shared between more than one cost object (Burrows, 1994, p. 51).

In general, the cost classification according to the traceability criterion might seem less useful for decision-making than a categorization along the lines of output variability.[2] As mentioned, the most apparent argument for the use of the traceability criterion by accountants is the ease of its application and the resulting low requirements in a situation where the firm has to dedicate resources for the creation of cost information. The most important implication of this - in the economist's point of view - is that as the firm relies on easily observable unit cost measures, i.e. direct costs, these costing bases will most likely be distorted away from the marginal costs that economists postulate to be necessary to price optimally.[3]

In the next section, we will discuss empirical findings on the cost structures that characterize the majority of modern corporations.

[2] It is also worth noticing that the classification into direct and indirect costs is arbitrary to some degree (Dorward, 1987, p. 44).

[3] At this point it is important to note that the accountant's definition of marginal costs is different from the economist's, and the use of the term in surveys can be somewhat confusing. Accountants usually define these as total direct costs plus variable overheads; therefore, they are likely to include (semi-)fixed cost positions such as direct labour. They are generally assumed to be constant and ignore several variable cost positions such as the increased wear and tear on machinery if output rises. Dorward (1987, p. 44) thus concludes that accountants' marginal costs will most likely underestimate economists' marginal costs. Furthermore, accountants often analyse costs ex post - leading to historical rather than future-oriented cost measures - and disregard opportunity costs (Coase, 1973, first published 1938). In the following, we will use the term "marginal cost" in the economist's or neoclassical sense to avoid confusion.

### 2.2.3 Some Stylized Facts on Cost Structures

Regarding the general cost structures of firms, Brierley et al. (2001) summarize findings from surveys of European manufacturing firms. They conclude that, in general, the majority of costs in manufacturing consist of materials and overheads, and that labour costs only play a minor role. In some cases, labour costs are reported to be so small that they are not listed separately but are included in overhead costs. These findings were also confirmed in case studies such as Anderson (1995), who closely examined the adoption of ABC by GM. Blinder et al. (1998, p. 105) found in a large US survey that firms were characterized by very high fixed costs, at an average of 40 per cent of total costs.

As discussed below, this is in stark contrast to the typical cost structure of manufacturing firms in the first half of the 20th century, when traditional product costing methods were developed (Johnson and Kaplan, 1987). Direct (labour) costs played a larger role and overheads did not pose as great a proportion of total costs as they do today. This increase in non-traceable costs can be attributed to the increased automation of production processes, increased product diversity and a stronger emphasis on marketing and distribution functions (Wraith, 1998, p. 32). The cost structure of firms in the service sector is characterised by an even higher proportion of overhead costs on overall costs, since important product components (such as direct materials and direct labour) cannot be traced (Kaplan and Cooper, 1998). In addition, most overhead costs in service organizations do not fluctuate with services provided in the short term, and can thus be considered fixed (Drury, 2008, p. 236).

### 2.2.4 A Typology of Management Accounting Systems

Ideally, a firm should maintain two separate costing systems - one for internal, and one for external purposes. One the one hand, cost data have to be prepared for external financial reporting and must comply with regulations regarding their calculation and composition. On the other hand, cost information that is used for internal reporting and decision-making is provided by a management accounting system that the firm "deliberately" decided to implement at one point. Decisions such as setting a price or managing the product portfolio require different (mostly incremental, future oriented) cost measurements than

those required for external financial reporting, which are usually historically determined.

In general, three categories of management costing systems for internal purposes can be defined, which are characterized by different levels of sophistication (Drury, 2008, p. 223): direct costing systems, traditional absorption costing systems and what I will call "modern" management accounting approaches, most prominently Activity-Based Costing, which will be explained in greater detail below. The firm usually has to decide on an internal reporting system that falls into one of these three categories. Note that our categorization of management accounting systems throughout this work might be too generalized and crude from the viewpoint of both the practitioner and the accounting scholar. In reality, the design, terminologies and complexities of cost accounting systems are much finer grained than presented here. Yet the aim of this contribution is to abstract from these complexities to a useful degree to analyse the basic features of management accounting systems and the considerations regarding their implementation. The following typology seems to be well suited for this purpose.

#### 2.2.4.1 Direct Costing

Direct costing systems only assign direct costs to cost objects, and do not trace indirect costs to cost objects. Identifying direct costs does not require any substantial investments by the firm and is the simplest and cheapest alternative (assuming for a moment that no costing system for external reporting is implemented). Since a part of the indirect costs is usually variable, without being easily attributable to an individual product, a part of variable costs is not included in cost measurement. At the same time, recognised direct costs might contain fixed costs.

Under a scenario where a firm barely invests in accounting information and uses easily identifiable direct costs as a basis for the pricing decision, the cost measure will in most cases underestimate the economist's definition of marginal costs. The reason for this is that such an accounting system disregards variable overhead costs, which, as argued above, play a large role in modern manufacturing corporations. A possible upward bias by the inclusion of fixed direct costs in the form of labour costs is likely to be overcompensated by this

effect, as direct labour costs are reported to play a rather minor role in the overall composition of costs. Note that this understanding of direct costing rules out that the firm is able to distinguish costs along the lines of output variability and identify marginal costs. As was argued above, this requires a much more sophisticated analysis and costing systems that contain such functionality are subsumed as modern management cost accounting systems.[4]

#### 2.2.4.2 Full/Absorption Costing

Traditional absorption (or full) costing systems are required for inventory valuation for external financial reporting in most countries (aligned to accounting standards such as GAAP in the US or IAS 2/IFRS in Europe), so every manufacturing firm is expected to have such a system in place. This costing approach relies on the technique of cost allocation. A cost allocation is defined as "the process of estimating the cost of resources consumed by products that involves the use of surrogate, rather than direct measures" (Drury, 2008, p. 23). The allocation of overheads as such can be seen as an attempt to "transform a fixed cost into a variable cost which is then applied to product as a constant addition per unit" (Dorward, 1986, p. 62). In a two-stage process, indirect costs are allocated to individual products. In the first stage, overhead costs are first assigned to cost centres (also called cost pools), which are usually departments or smaller segments. In the second stage, costs that are accumulated in cost centres are allocated to cost objects (products) using allocation bases (also called cost drivers).[5] The most commonly used cost drivers are direct labour hours or machine hours (Drury, 2008, p. 54).

[4] In other parts of this work, the term "direct costs" is used synonymously for variable costs, although, as just put forward, this is not the case. The previous identical use of the two terms stems from many surveys, where the terms "direct" and "variable" are used somewhat interchangeably. In other chapters of this work, when we refer to "variable costing", a situation is implied where the firm can correctly identify its marginal costs and bases its pricing decision on this cost measure. As argued here, this would be, if at all, the case only if the firm employed a sophisticated costing system. Yet the differences derived in the models in the other chapters of this work between variable and full costing stem from the smaller costing base in the former, which would be fulfilled both if variable or direct costs are compared to a full-cost measure.

[5] Consider the following example for one and two-staged overhead allocation, which follows Drury (2008, p. 51). A manufacturing firm produces three products A, B, and C with $20,000$ units each and incurs total manufacturing overheads of $\$900,000$. In the same period, a total of $60,000$ direct labour hours were recorded. Suppose the firm decides to use direct labour hours as a cost driver. The plant-wide overhead rate then is $\$900,000/60,000 = \$15$. If the

Financial accounting regulations usually require that inventories are valued at manufacturing costs.[6] Therefore, traditional costing systems allocate manufacturing overheads, while non-manufacturing overheads are not allocated and therefore not considered in decision-making - they are classified as "period costs". Surveys that report "full costs" as being the basis for cost-plus pricing calculations most probably refer to full manufacturing costs, excluding non-manufacturing costs that might vary with output. As explained in greater detail below, absorption costing systems originate from times where direct manufacturing costs posed a larger proportion of total costs and overhead costs were considerably smaller compared to today.

Due to their small degree of sophistication, absorption costing systems do not require significant investments for implementation and the gathering and processing of information. While there is some variation in the level of sophistication of absorption costing systems, they are in general less refined and thus less costly to implement than modern costing systems such as ABC (Drury, 2008, p. 50) and seldom provide variable cost measures (Cooper and Kaplan, 1988).

In a scenario of "perfect overhead allocation", each product would be charged the proportion of overhead costs it actually causes and output variability analysis would identify the variable parts of these overheads. In this way, marginal costs of products could be obtained and used for decision-making. Yet in most cases, traditional costing systems initially provide unit cost measures that are not equal to marginal costs. In their influential critique of the

firm does not, in a first step, allocate the overheads to the departements responsible for A, B and C, respectively, each product gets charged \$15 for each labour hour it consumes.

Now consider the traditional two-stage allocation process. Assume that the firm can further attribute manufacturing overheads and labour hours to the three departements (cost centres): manufacturing overheads for product A are $\$200,000$, for B $\$600,000$, and for product C $\$100,000$. Labour hours are $20,000$ each, so it takes one direct labour hour to produce either A, B or C. This gives rise for individual overhead rates: $\$200,000/20,000 = \$10$ for A, $\$600,000/20,000 = \$30$ for B, and $\$100,000/20,000 = \$5$ for C. As can be seen, the increase in attributability of overheads leads to higher accuracy in the costs assigned to individual products. As such, an increase in cost centres is likely to lead to better cost estimates. Yet it is not clear whether direct labour hours serve as a proportional indicator for the use of resources that give rise to indirect overheads.

[6] Regulations for external financial reporting also entail the obedience to other concepts in costing such as the first-in, first-out (FIFO) or average valuation methods. We will not discuss these in greater detail as they do not seem to be of direct relevance to the pricing decision.

use of traditional costing systems for internal decision-making, Johnson and Kaplan (1987, p. 1) describe cost information supplied by this approach as "too late, too aggregated and too distorted" to be relevant for managers' planning and control decisions. I will elaborate on the reasons for this claim in the following.

First, in order to allocate costs correctly, cost drivers have to reflect the proportionate use of the shared resource of each product. Cost drivers that are usually employed indiscriminately for all types of products in traditional costing systems, namely direct labour or machine hours, usually fail to comply with such a cause-and-effect requirement and thus lead to a distortion in the unit cost measures. Secondly, traditional costing systems usually make no efforts to abandon the historical costing perspective required for external financial reporting. Thirdly, due to an insufficient number of employed cost centres, cost allocations are not carried out in a sufficient level of disaggregation to identify true marginal costs (Drury and Tayles, 2005).

As discussed below, the aim of ABC systems is to address each of these three causes of cost distortion through a higher degree of sophistication in the allocation process. But, even if these three problematic aspects were absent, the exact identification of marginal costs by means of overhead allocation would still be highly unlikely. First of all, while allocation of common costs is unproblematic, identification of marginal costs under joint production processes is, regardless of the degree of sophistication of the costing system, impossible as, during the stage of joint production, products are technically inseparable.[7] Therefore, as Dorward (1987, p. 56) points out, "any attempt to allocate this marginal joint cost to individual products would be irrational and a denial of the essential jointness of the production process, as any such allocations could not be technically determined by the production function." Second, even absent joint production processes, the proportions of variable and fixed overhead costs in large modern corporations is usually quite large, which makes it a difficult task to capture all relevant costs that can depend on the production of a specific good. Third, as pointed out, the definition of marginal costs requires that future costs are regarded, not historical measures. The cost of previously acquired production factors must be determined by the current replacement

[7] Consider, for example, paraffin, petrol and lubricating oil that are only identifiable as individual products after the completion of the basic refining process (Dorward, 1987, p. 56).

value at the point of time when they are indeed used in the production process. Given uncertainties in the market and a limited information set of the firm, the acquisition of such cost data can be problematic, if at all attempted by the firm.

As a consequence of all these shortcomings and practical difficulties in cost estimation, unit cost measures supplied by a traditional absorption cost system are most likely to be significantly distorted when compared with marginalist incremental costs. We cannot generalize whether this leads to a general tendency for over or underestimation of marginal costs. This mainly depends on the amount of overhead that is allocated and the share of the overhead burden the product in question has to bear in a multiproduct environment.

As cost structures of corporations changed towards a higher share of overheads in the course of the 20th century, these distortions became more and more severe and led to the development of more sophisticated costing approaches in management accounting research, which we will discuss in the next section.

#### 2.2.4.3 Activity-Based Costing and Other Modern Management Accounting Systems

Activity-Based Costing, the most prominent of "modern" management accounting systems, emerged in the US in the 1980s when traditional costing systems came under wide criticism for reporting distorted product costs (e.g. Johnson and Kaplan, 1987), due to the aforementioned continuous relative rise in overhead costs that were crudely allocated by absorption cost systems. Similar to the traditional costing approach, ABC is based on a two-stage allocation process, but usually entails the use of more cost centres, and many different types of second-stage cost drivers that allow costs to be traced more accurately depending on the resource consumption ("activity") of each product.

An ABC system can, in general, help with identifying marginal costs given the restrictions above. The conditions under which a two-stage ABC system accurately identifies all incremental costs have been brought forward by Noreen (1991). For example, he found that all costs must be strictly proportional to their cost drivers, no fixed costs at the cost centre level may exist and joint production processes must be absent. Bromwich and Hong (1999) examined which

types of technologies and input prices fulfill these conditions and found them to be quite restrictive.[8]

Many other sophisticated costing approaches exist, such as *Life Cycle Cost Analysis, Target Costing, Throughput Accounting, Lean Accounting* or *Resource Consumption Accounting*. As will be discussed in a later section, developments in management accounting techniques have been quite heterogeneous among industrialized countries and country-specific approaches to management accounting have emerged in the second half of the 20th century. Examples are the German concept of *Grenzplankostenrechnung* (translatable as "Marginal Planned Cost Accounting") or the French *Tableau de Board.*

Given the practical difficulties that arise with marginal cost identification, a sophisticated costing system which aims at generating accurate cost estimates will require a substantial investment for the firm. Firms have to pay for licences of expensive software packages, the implementation of the system by professional staff in all subdivisions and training of the personnel to use the costing system correctly. Regarding these aspects, case studies such as Anderson (1995) give an impression of the vast amount of time and resources necessary to implement a sophisticated system for internal cost accounting.

### 2.2.5 Empirical Evidence on Costing and Pricing

Following the previous explanations of cost definitions and types of management accounting systems, we are led to ask which costing methods firms actually use in practice. Fortunately, there has been a relatively recent surge in the investigation of management accounting and product costing practices (see Brierley et al., 2001 for an overview). As discussed in the introductory chapter, most firms use full costs to determine their prices, as confirmed by surveys in the UK (Skinner, 1970; Atkin and Skinner, 1977; Mills, 1988; Drury et al., 1993; Friedman and Lyne, 1995), the US (Govindarajan and Anthony, 1983; Shim and Sudit, 1995) and some countries in Continental Europe (Bruggeman et al., 1996; Saez-Torrecilla et al., 1996). The exact costing base used for pricing varies between total manufacturing unit costs (most common) and total unit costs, with

[8] Necessary properties are, for example, that input mixes of a cost centre are fixed and invariant with output, and that inputs in a cost centre are independent of those in other cost centres.

a variety of partial overhead allocations also being encountered.[9] Empirical studies further suggest that these full costs are typically derived by the use of traditional absorption costing systems. In a UK study by Drury et al. (1993), 84 per cent of 303 surveyed manufacturing firms are found to employ an absorption costing system. A similar result was obtained by Saez-Torrecilla et al. (1996) for Spanish firms. Proportions of firms using absorption techniques in other European countries were examined by Israelsen et al. (1996) for Denmark (40 per cent)[10], Lukka and Granlund (1996) for Finland (31 per cent) and Ask et al. (1996) for Sweden (58 per cent).

As can be seen in Table 2.2, empirical studies suggest surprisingly low diffusion rates of ABC systems considering its heavy advertisement and availability for more than 20 years. Some firms have even started to implement ABC costing and then decided to stop. There is also no apparent trend for higher sophistication identifiable from survey results within the last 20 years. One of the few surveys that allow direct comparison is provided by Innes et al. (2000) who compare results of surveys undertook in the UK in 1994 and 1999, respectively. They find that the proportion of ABC users and those firms currently assessing its implementation has fallen over time, while the percentage of firms rejecting ABC has risen slightly.

These low diffusion rates seem especially surprising since ABC was specifically designed to remedy existing problems that traditional costing systems displayed when used for internal decision-making. In this context, Gosselin (1997, p. 105) termed this the "ABC paradox": if ABC has demonstrated benefits, why are more firms not actually employing it? In the course of this chapter, we seek to give an answer to the question along with the interconnected phenomenon of the persistence of traditional costing systems.

Of course, the table gives no information on the diffusion of other sophisticated management accounting systems, especially regarding country-specific approaches. In general, empirical evidence in this respect is limited. In Germany, Friedl et al. (2009) show that the aforementioned approach of *Grenzplankostenrechnung* (GPK) is popular among German firms and found that in

[9] In an early survey by Fog (1960) among Danish firms, managers reported repeatedly that "it is not unusual to allocate some fixed costs and not to allocate others" (p. 86).

[10] Yet as Israelsen et al. (1996, p. 44) state, about two thirds of the questioned firms expressed a need of change in their product cost calculation.

| *Study* | *Country* | *Share of ABC adoption (%)* |
|---|---|---|
| van Nguyen and Brooks (1997) | Australia | 13 |
| Bruggeman et al. (1996) | Belgium | 20 |
| Armitage and Nicholson (1993) | Canada | 14 |
| Lukka and Granlund (1996) | Finland | 6 |
| Malmi (1997) | Finland | 14 |
| Scherrer (1996) | Germany | 3 |
| Clarke (1992) | Ireland | 10 |
| Barbato et al. (1996) | Italy | 0 |
| Ask et al. (1996) | Sweden | 25 |
| Drury and Tayles, 2000 | UK | 23 |
| Friedman and Lyne (1995) | UK | 20 |
| Innes et al., 2000 | UK | 18 |
| Krumwiede (1998) | US | 25 |

Table 2.2: Diffusion Rates of Activity-Based Costing

a survey of the 250 largest corporations in Germany, 42 per cent employed a costing system that corresponds to the principles of GPK. Lebas (1996) also suggested that the majority of French firms used the country-specific concepts of the *méthode des sections homogènes* and the tool set *Tableau de Board*. We will discuss these country-specific developments in more detail below.

Contrary to the suggested operation of two costing systems for internal and external reporting requirements, most firms in the US and Great Britain seem to have only one product costing system in place which is used for both external reporting and internal decision-making. For example, Drury and Tayles (2000) surveyed 187 UK firms and found that only 9 per cent of firms reported maintaining two cost accounting systems, while the other 91 percent used only

one costing system both for decision-making and external financial reporting. Cooper and Kaplan (1988) argue that similar observations can be made for US corporations. This already hints at the importance of the financial accounting system for internal decision-making that we establish in the course of this chapter. In contrast, Friedl et al. (2009) find in their survey of large German enterprises that most firms in their survey use multiple costing systems. Again, this suggests some country-specific differences in costing practice, which we will analyse in more detail below.

## 2.3 The Historical Development of Cost Allocation Practices

In order to understand the persistence of absorption costing systems despite their apparent shortcomings, it is worthwhile to investigate the history of cost allocation practices. We will, in this analysis, focus primarily on the UK and the US, for several reasons. First, both countries have been studied intensively with regards to the historical developments of costing systems and the diffusion of ABC. Secondly, traditional absorption costing played an important role for internal decision-making of US and British firms in the 20th century, and arguably more so than in some parts of Continental Europe (Sharman and Vikas, 2004). Thirdly, ABC is a concept developed in the US with the aim of addressing the wide use of seemingly obsolete absorption costing techniques and has been most actively propagated by US scholars. Lastly, there emerged a considerable diversity in the development of costing methods after World War II among countries in Continental Europe, a detailed description of which is out of the scope of this chapter. We will, however, complement the analysis by referring to similarities in the developments in Continental Europe with those in the UK and the US.

### 2.3.1 Cost Accounting Before World War I

Accounting historians agree that cost allocation has been practiced by firms for a long time (Ahmed and Scapens, 2000, p. 159). Reports of cost allocation are found from as early as 1700. For example, business records of Welsh

companies, mainly in the metal work and iron manufacturing sector between 1700 and 1830, show evidence for the use of cost allocations for pricing, cost estimation and profit analysis (Jones, 1985). During the nineteenth century, as industries such as railways, mining, iron and steel, textiles, power and machinery manufacturing grew and flourished, the problem of dealing with overheads increased in relevance. As Ahmed and Scapens (2000, p. 160) report, textbooks in the late 19th and early 20th centuries commonly discussed cost allocation systems - as well as criticizing them.

According to Johnson and Kaplan (1987), intense competition and a wave of mergers in the US in the late 19th century and the first decade of the 20th century changed the internal structure of many firms; these became increasingly vertically integrated and active in multiple markets. Vertical integration offered opportunities for increased profits due to the circumvention of external markets and their replacement by more efficient internal processes (Coase, 1937). To manage these new organizations, firms needed new accounting techniques, leading to major developments in internal cost accounting. Among these was the definition of budgets to coordinate internal resource flows from raw material to final products and the allocation of the costs of resources that were shared across divisions. Indeed, Johnson and Kaplan (1987) argue that by 1925, all management accounting concepts that are in use today, first and foremost the simple cost allocations that characterize contemporary absorption methods, were developed and in operational use. The introduction of management accounting helped to reduce transaction costs of large vertically integrated firms and thus contributed to the success of the likes of GM and DuPont.[11]

### 2.3.2 Government Control and Cost Allocation During World War I and II

Governments also played a large role in the diffusion of cost allocation practices. During World War I, the British government expanded its operations and increased its own manufacturing capacity by building factories, as well as tak-

[11] This view is not shared among all in the profession. For example, Hopper and Armstrong (1991, p. 413) argue that "much of the gain in profitability from the early factory organization of production came, not from increases in the technical efficiency of the conversion process, but from the ability of owners/entrepreneurs to intensify labour through close disciplinary control and to extend the working day".

ing over existing private plants (Loft, 1986). Similar actions were taken, for example, in Germany, Denmark, France and the US (Scherrer, 1996; Israelsen et al., 1996; Lebas, 1996; Johnson and Kaplan, 1987). While the owners kept the properties and continued to run the businesses, the government controlled day-to-day operations in detail by requiring firms to report their operations in a standardized manner. Lacking a market that gave hints as to what price to pay for the manufactured goods, the government had difficulties with the determination of appropriate prices for goods it purchased (Wraith, 1998, p. 31). Furthermore, the war created an environment for exploitation and restrictive practices, and over-pricing and excessive profits were common phenomena (Loft, 1986). With its existing accounting routines and the impossibility of following a market-based approach to contract pricing, the government could do little to restrain such exploitation. The contractors controlled the information regarding their costs and had the pricing initiative. Reducing the wars financial burden, deterring profiteering and responding to public pressure became both an economic and political necessity.

In Great Britain, this resulted in legislation (e.g., the British Defence of the Realm Act of 1914 and the Munitions War Act of 1915, which stayed in effect until 1939) which introduced a formal approach to pricing contracts. The law required of contracting firms to follow prescribed accounting rules and to open their books to government accountants. The regulations implemented for contractors included a number of elements: detailed accounting rules and guidelines for cost estimation and pricing, a set of legal and legislative powers to provide legitimacy and enforcement and agencies to administer and monitor the implementation of measures prescribed in prevailing regulations. The government calculated prices using partial full manufacturing costs plus a profit margin. Through this process, the accounting profession became extensively involved in the government's wartime costing procedures.

A similar approach was taken by the government during World War II. Yet the growth of the electronics and aerospace industries added new complexity to the nature and structure of production cost, due largely to high overhead costs. In these industries, overhead rates of over 500 per cent of direct labour were not uncommon. Governmental regulations became even more rigorous. In July 1941, pricing controls in Great Britain were supplemented by the Price Control Act, which gave the government the power to fix a maximum price for

almost any manufactured article and to employ its own methods in determining the cost of production. Developments in Continental Europe were similar. For example, until the law of price control was abolished in 1952, Bruggeman et al. (1996, p. 32) report that the Danish Price Commission had decided which costs could be claimed to be included in a product's cost. Similarly, full costing became compulsory in all industrial firms in Finland from the beginning of the 1940s (Virtanen et al., 1996, p. 56).

In this situation of rigorous price controls, the only means for a firm to cover its costs - and to raise its price - was to convince the price-regulating authorities of the validity of methods of fixed cost allocation as a measure of the "true" cost of a product. In this way, firms effectively had an incentive to advance the establishment of cost allocation as a costing standard, even though there already existed some theoretical agreement among academics regarding the irrelevance of fixed costs in the determination of prices. In the course of tighter governmental controls, auditing firms became common to monitor whether firms priced conformingly to government regulations (Ahmed and Scapens, 2000, pp. 183-188).

### 2.3.3 The Dissemination and Institutionalization of Cost Allocation Practices

As Loft (1988) argues, many accountants and clerks leaving government factories and offices after the war to join private companies took their experiences, knowledge and techniques to their new workplaces. Thus, the knowledge which had become routinized in government-run factories was transmitted to and reproduced in the industry at large. Cost allocations, first put in place by the government to assess the "real" cost of products, became a widely recognised method of management accounting, even after price controls were lifted.

In Great Britain, other factors than the influence of (former) government controls contributed to the institutionalization of cost allocation practices. Several trades agreed on uniform methods of costing. For example, in 1913 the British Federation of Master Printers agreed on the implementation of the "Printer's Cost Finding System", which was a cost-plus pricing scheme, comprising cost allocation procedures and a profit formula. Within the following decades, similar uniform costing agreements were instituted among the members of many

industries, such as iron and steel, cotton weaving, plastics, hosiery, pottery, india-rubber manufacturers, laundries, cocoa and confectionery (Solomons, 1950; Ahmed and Scapens, 2000). Similar movements of standardization in recording systems and calculation principles on an industry-wide level had also taken place in other developed countries, for example Germany, Norway, Sweden and the United States (Bruggeman et al., 1996, p. 32).

Although the new control mechanisms limited the freedom and discretion of individual firms in choosing their own accounting systems, in many ways these enabled them to deal collectively with several issues such as pricing, profitability, trade abuses and market control. Economic efficiency was not a major issue in the debates surrounding the evolution of uniform costing systems. Predatory pricing, abusive trade practices and the formation of cartels posed a threat to many (especially small) firms and provided them with an incentive for cooperation (Ahmed and Scapens, 2000, p. 177). As such, cost allocation also became institutionalized through uniform costing. The collusive effect of such practices had also been recognised in early surveys such as Hall and Hitch (1939) and motivated the development of the kinked demand curve theory of pricing (see e.g. Stigler, 1947, p. 437).

Many of these collective agreements, including price-fixing arrangements, persisted after the war and sometimes mimicked former government regulations (Aldcroft, 1962, p. 682). Furthermore, firms in various industries were instructed by their trade associations to embrace and use a uniform costing system in order to be part of the industry's price policy (Lee, 1994). This was motivated by the belief of many trade associations that cost measurement and pricing rules modelled on government regulations enabled their members to do businesses with a predictability and stability they otherwise would not be able to achieve. Of course, an underlying motive was the creation of sustainable market power, and competition impeding practices were common in the 1940s and 1950s (Aldcroft, 1962). Government legislature reacted and passed laws that banned monopolistic behaviour and resale price maintenance (Ahmed and Scapens, 2000).

The effect of the institutionalization of absorption costing by governments and trade federations is still visible today. Accounting regulations for external reporting instituted by the government during the war were kept in place and are still in use. In addition to ensuring comparability, they help to reduce infor-

mation asymmetries between firms and investors and thus make it easier for firms to raise capital through financial markets (Lucas, 2000). Typically, these regulations contain mandatory costing methods that are based on allocation principles, such as the absorption costing approach for inventory valuation, as specified in the International Financial Reporting Standards (IFRS), which are mandatory for firms in the European Union since 2005, and the Generally Accepted Accounting Principles (GAAP) in the US.

### 2.3.4 Diverging Developments of Management Accounting in the 20th Century

The inclusion of overhead allocations in governmental regulations and trade association agreements was grounded in the understanding that this type of calculation was the one that provided the "real" costs of a product. The general notion was, at the time, that such a practice is necessary to secure the sustainable success of businesses, as described by Wraith (1998, p. 31):

> There was a general understanding that if some element of overhead escaped allocation to, and absorption by, units of production, the pricing mechanism would not cover it and ruin would surely follow. On the other hand if all costs were duly covered by absorption, profitability and success would surely follow.

In the course of the second half of the 20th century, this view became heavily disputed among accounting scholars. As production processes became increasingly complex and diversified, and the role of overheads in the composition of overall costs increased, absorption costing systems became, in the view of their critics, more and more problematic.

As discussed in the empirical section above, traditional cost accounting did not lose its importance for internal decision-making in Great Britain and the US (and many other countries) during the 20th century, much to the dismay of accounting academics. They argued that, while traditional costing systems emerged in the first decades of the 20th century as a "rational" response to new information and control requirements due to the changed structure of organizations, they are inadequate for serving this purpose today. Indeed, Johnson and Kaplan (1987) argue that the development of these techniques was paramount

to the success of US corporations in the war and early postwar periods. Yet in their view, the following decades up to the 1980s were a period of decline, stagnation and obsolescence for management accounting techniques as the discipline failed to meet the informational requirements of modern production technologies and global competition. They identify two reasons for this failure. The first is that regulators failed to adjust financial reporting rules to account for the changes in cost structure that occurred in the second half of the 20th century. Secondly, they argue that accounting educators also endorsed financial accounting procedures for decision-making after World War II. Johnson and Kaplan (1987) propose remedies to management accounting's post-war problems. These center on broadening the scope of management accounting and improving its information base by stepping outside the boundaries dictated by financial accounting systems. Their suggestions include reducing product throughput time, lengthening the time horizon of control reports, value-chain analysis, developing long-term efficiency and quality measures of performance and Activity-Based Costing.

Controversies of this sort, which took place in Great Britain, the US and in Continental European countries, probably peaked with the publication of the aforementioned book "Relevance Lost: The Rise and Fall of Management Accounting" by Johnson and Kaplan in 1987. Yet developments of management accounting after the considerable easing of price controls in the beginning of the 1950s followed different paths in Continental Europe and led to the emergence of country-specific approaches to cost accounting.

For example, after the war, Finland and Denmark saw a surge of academic and practical interest in methods that were inspired by similar movements in the US. These related to the ideas of contribution margins and variable costing and stood opposed to arbitrary overhead allocations that characterized full costing. These approaches were, although supported rather unanimously in the academic realm, met with skepticism from senior managers of enterprises. As Virtanen et al. (1996, p. 59) state:

> The possibly inherent fallacy in setting prices according to variable costs, and especially the risk of "forgetting" fixed costs, were emphasized. Among accounting professions, heated discussions on

> the advantages and weaknesses of both variable and full costing took place [..].

In the case of Finland, variable costing gradually became accepted in Finnish practice in the late 1950s and the 1960s, in contrast to British, US and Continental European legislation. Interestingly, Finnish legislation changed to requiring a variable costing approach for external financial accounting in the late 1960s and early 1970s. As Virtanen et al. (1996) suggest, this hints at a strong relation between externally required costing systems and the decision which costing approach is adapted for internal decision-making (this will be discussed in more detail below). Also in contrast to most other developed countries, where income statements require manufacturing costs being lumped together as a part of the total costs of goods sold, Finish legislation requires the separation of variable and fixed costs, thereby "steering companies toward the contribution approach and variable costing perspective" (Virtanen et al., 1996, p. 60). Perhaps as a consequence, variable costing is used extensively by Finnish companies and absorption costing plays only a minor role, as surveys by Virtanen et al. (1996) and Lukka and Granlund (1996) suggest.[12]

In contrast, the French economy only emerged from an environment of regulated "market" prices about 20 years ago. Since World War II, management accounting served the main purpose of determining the full cost of products, upon which the price negotiation with the supervisory governmental authority was based. Full costing was institutionalized as a standard set by a federation of businesses as early as 1937, in the form of an approach that consists of two concepts that are still used by most French firms today. These are the *méthode des sections homogènes* and the toolset *Tableau de Board,* which is rather geared towards supplying information for decision-making. Full costing had also been strongly challenged by concepts of variable and direct costing in the late 1960s, but the current management mentality still strongly favours full costing (Lebas, 1996, p. 77).

In Germany, as Sharman and Vikas (2004) argue, financial reporting plays a much less important role for management accounting methods used for internal purposes than, for example, in the UK and the US. In Germany, the predom-

[12] Lukka and Granlund (1996) conducted a survey of 130 Finnish manufacturing firms where they found that 42 per cent calculated product costs using a direct/variable approach, while 31 per cent employed full costing and 27 per cent used both methods.

inant management accounting system *Grenzplankostenrechnung* was developed after World War II by Hans-Georg Plaut and Wolfgang Kilge. This system has a focus on accurate operational modelling through a focus on costs that vary with output. An allocation of fixed costs to products is generally not employed. The system is applicable in both manufacturing and service industries. Nowadays, it is implemented in software packages such as SAP and includes the use of many cost centres and methods to separate fixed costs from variable costs at the cost centre level in order to achieve a high degree of cost control and accuracy.

To summarize, the allocation of overhead costs - although already practiced in the 19th century and perhaps even earlier - became firmly established in the 20th century due to a variety of socioeconomic factors. A rise in the importance of allocation practices due to increased vertical integration was amplified by an institutionalization of these rules and routines during and after the two World Wars. This institutionalization took place in several dimensions: wartime policy and subsequent increased government control led to an influx of cost allocation principles into regulations on external financial reporting that have, by and large, remained unchanged until today, while trade unions facilitated agreements on uniform costing that were based on absorption principles. In addition, knowledge transfer from government factories and agencies into the private sector through accounting and auditing professionals fostered the use of allocation techniques for internal decision-making. As has been pointed out, these traditional costing practices became subject to increasing criticism in the course of the second half of the 20th century, as cost structures of corporations became more and more dominated by indirect overheads. This criticism led to the emergence of new costing approaches specifically geared towards the needs of internal decision-making. While in the US, such an alternative system in the form of ABC was only introduced at the end of the 1980s still finds low acceptance among practitioners, country-specific approaches such as GPK in Germany emerged early after World War II and are now used by a large share of domestic corporations.

## 2.4 The Persistence of Absorption Costing in Management Accounting

The historical perspective on cost accounting offered in the previous section allows insights into the factors that lead to the embedding of absorption techniques in legal regulations, trade federation agreements and the internal costing systems of firms. The question remains, however, why, especially in Great Britain and the US but also in parts of Continental Europe, absorption costing remains so persistently used as a management costing system, when approaches that are much more sophisticated and accurate such as ABC are widely available and heavily advertised by accounting academics. We will now analyse some of the underlying aspects that govern management accounting change. For this purpose, an institutional framework of management accounting change is first discussed and then applied to shed light on the phenomenon.

A preliminary word of caution seems in order at this point: an analysis of internal cost accounting along the lines of a theoretical framework of institutional economics could, in the author's opinion, easily fill a whole book. Due to the limited space of this chapter, many important concepts and ideas that relate to the analysis will only be sketched. At the same time, the discussion of the institutional aspects of management accounting change will be by no means exhaustive, as only a limited number of facets can be covered.

### 2.4.1 An Institutional Framework of Management Accounting Change

As has become apparent, the choice of a management costing system is not merely influenced by economic, but also by political, legal and organizational factors within and outside the firm. The recognition of the relevance of these factors outside the neoclassical framework on management accounting was recognized in the literature only quite recently. In order to incorporate this idea into a consistent framework, some authors (Scapens, 1994; Ahmed and Scapens, 2000; Burns and Scapens, 2000; Scapens and Jazayeri, 2003) embrace a view of management accounting in the line of old institutional economics in the spirit of Veblen, Commons and Ayres. This approach states that the

choice of a management accounting system has to be considered within its broader context, such as legal constraints, the market environment and structures internal to the firm, such as culture and the conflicting interests of parties within the organization. Management accounting as an institution is, in this approach, understood as "a way of thought or action of some prevalence and permanence, which is embedded in the habits of a group or the customs of a people" (Scapens, 1994, p. 306). This view rejects the treatment of firms as economically rational individuals and entails the notion of a non-market clearing, non-equilibrium perspective which is, as such, opposed to neoclassical economics and, for the most part, new institutional economics. It is, as Ahmed and Scapens (2000, p. 166) put it, "concerned with the cumulative unfolding processes through which economic activities evolve [..and..] makes the 'institution' the unit of economic analysis". Accounting practices are thus understood as institutionalized rules and routines that emerge due to complexity and uncertainty, as shaping and being shaped by individuals embedded in their organizational and cultural context. Burns and Scapens (2000) also infer from this framework properties of institutional change. They stress that in general, institutionalized routines such as accounting procedures take time to change and are subject to inertial forces. Their understanding of change permits the distinction between random (or informal) and systematic (or formal) mechanisms, where an example for the latter would be the conscious implementation of a superior costing system. Furthermore, they distinguish between revolutionary and evolutionary institutional change. Whereas the former involves "a fundamental disruption to existing routines and institutions" (Burns and Scapens, 2000, p. 20), evolutionary change is incremental and poses only minor disturbances to existing routines and institutions. While management accounting as an institution may have been subject to evolutionary change in the form of an increase in the sophistication of cost allocation procedures within the traditional costing framework (such as a continuing increase in the number of cost centres), revolutionary change in the form of a paradigm shift regarding the architecture of internal costing systems, as demanded by Johnson and Kaplan (1987) and others, has not been encountered on a large scale in the course of the 20th century.

Scapens (1994, p. 308) contrasts the holistic approach of old institutional economics to the atomistic stance of new institutional economics in the spirit of

Williamson, Coase, North and others, which can be seen as an extension of neoclassical economics and thus conveys the idea of optimality. New institutionalism is what mostly underlies the arguments of Johnson and Kaplan (1987): management accounting, in its contemporary form, emerged as an optimal response to a changed environment around the late 19th and early 20th century to decrease transaction costs, but has become obsolete in the past decades due to changes in the organizational structure and the production processes of firms.

In the following discussion, we will not commit to a strict obedience to either the old or the new school of institutional economics, but rather borrow various concepts from both camps to find satisfactory explanations of the persistence of internal overhead allocation practices.

#### 2.4.1.1 Path Dependence

The historical analysis above suggests an explanation for the persistence of absorption costing systems for internal purposes along the lines of path dependence: the described institutionalization of allocation practices in the late 19th and early 20th century could explain its prevalence as a method used for internal costing today. The inertia or even deterrence in the process of changing from overhead allocation systems to more appropriate internal costing solutions could then be explained by referring to the concept of an institutional lock-in, conveying the notion that firmly established routines are difficult to overthrow and to replace by fundamentally new concepts. The institutionalization in the course of historic events might, in this sense, have led to a persistent lock-in of a seemingly inefficient costing custom.

Yet it may be argued that such an explanation lacks an underlying reason for such a path dependence. Typically, path dependence and resulting institutional lock-in arise due to critical mass effects or network externalities, technical interrelatedness or increasing returns to the use of an established standard. Typical examples for such institutional lock-ins due to critical mass effects or economies of scale are, for example, the QWERTY keyboard layout (David, 1985; Liebowitz and Margolis, 1990), railway track gauges (Puffert, 2000) or the technical design of nuclear power reactors (Cowan, 1990).

For example, it has been argued that the QWERTY keyboard layout was initially not designed with ergonomic efficiency in mind but may have become a

standard due to critical mass effects (for a detailed discussion, see Schlicht 1998, pp. 65-67). The case of railway gauges exemplifies how in some countries, inefficient standards became locked in due to technological interrelatedness and economies of scale that make a switch to a more efficient system not worthwhile (Puffert, 2000). Technological lock-in is also discussed by Cowan (1990) for the case of nuclear power, where he argues that the established "light-water" design of civilian power reactors, which was initially used for power reactors of submarines and is, among engineers, considered a suboptimal choice for power plants, emerged due to a hurried attempt to demonstrate peaceful applications of nuclear technology during the cold war; it is still dominant due to learning effects in the construction of civil nuclear plants. Many more examples for technological path dependence and the lock-in of (supposedly inferior) technologies could be cited here but exceed the scope of this section.[13] Note, though, that institutional lock-ins do not necessarily imply economic inefficiency, as pointed out by Schlicht (1998, pp. 65).

In general, an argument of path dependence can, as argued by Puffert (2004) and demonstrated by Schlicht's discussion of custom, be transferred from examples of technology to institutions, as both depend on the value of adopting a common set of techniques that becomes costly to change. Indeed, parallels to some of the explanations of technological lock-ins could be drawn to the case of internal costing practices. In this sense, there could exist network effects or economies of scale that decrease the incentive to switch to a more sophisticated costing system and may thus keep inefficient costing practices in place.

For example, network externalities could be present that make the use of a specific internal costing approach more valuable to a firm the more this system is used by other firms. One such effect could arise from accounting professionals probably being most proficient with established standards of costing. Firms might have few possibilities to find qualified personnel for the implementation and operation of more sophisticated costing approaches that are used by only a small number of firms. Indeed, Sharman and Vikas (2004, p. 29) argue that in the US, the number of practicing management accountants is one-tenth the number in the UK, Canada and Germany and as a consequence, US firms are

[13] For a comprehensive overview on the topic of path dependence and many more examples, see Puffert (2008).

hindered in the application of modern internal costing methods.[14] Yet it can be argued that this small supply of management accountants able to implement and operate sophisticated costing systems is an effect, rather than a cause of the prevalence of simple costing techniques. Also, the education of management accountants is, even in the US, heavily geared towards modern accounting techniques and is highly critical of traditional absorption techniques (see, for example, Drury 2008, pp. 224). Furthermore, a transfer of technological innovations to the US was demonstrated earlier, for example by the success of the concepts of *Lean Manufacturing*, which originated in Japan.

Another cause for network externalities in the choice of internal costing systems could lie in the possibility of collusion. As mentioned earlier, uniform costing helped industries to achieve stability in turbulent times and might foster collusion. Consistency of costing practices among firms might thus be preferable, and given that most firms use a full-cost method to calculate their prices, it might be a rational response for the individual firm to do so as well.[15] The historically established cost accounting standard might thus be held in place. We will pick up this aspect in the discussion of the economic virtues of overhead allocations.

At the same time, a parallel to technical interrelatedness may be drawn. In the case of railway gauges, if parts of either the railway track or wheels of rolling stock have to be replaced, they have to be changed in a way that they are still operable with the existing technology, thus reinforcing the persistence of the standard. It could be argued that internal costing systems, and the methods they include, show some contingencies within the firm that might have a similar affirming effect to existing costing methods. If a subdivision of the enterprise wants to change its cost calculations for the purpose of obtaining better managerial cost information, comparability with other divisions, which might be necessary for product portfolio or other managerial decisions, would be compromised. Similarly, new costing methods that are to be implemented

[14] Sharman and Vikas argue that one cause of this underrepresentation of management accountants is that the accountancy certification of CPA (Certified Public Accountant) is regarded as the preferable accounting qualification by the public, in comparison to the CMA (Certified Management Accountant).

[15] Of course, one could argue that such a firm would then have an incentive to increase costing efficiency and outperform its competitors. Standard arguments that relate to the stabilizing effect of punishment threats under tacit collusion can be held against such an argument.

by a firm have to ensure compatibility with the existing system, deterring incremental innovations.

An institutional lock-in could be stable even if new firms emerge that design their costing system from scratch. It could be argued that in a situation where existing firms lack incentives to initiate a fundamental change of their internal costing practices, innovation impulses could arise from newly founded firms. As they do not have a predisposition towards a costing method, they could, one could argue, be a source for management accounting change. Yet the ability to implement a highly sophisticated internal cost reporting system might be contingent on having previous experiences with costing methods. Development of more refined methods of cost estimation might only be possible in a stepwise manner, incrementally undergoing a necessary evolution of techniques. This idea of "work continuity", developed by List (1841, pp. 161), might thus prohibit innovative impulses from firms entering the market and designing a costing system from scratch. Existing costing routines might thereby be stabilized.

Through these channels, established overhead allocation methods might persist because they generate comparatively small transaction costs for firms and switching costs for implementing a novel costing approach are prohibitively high.

#### 2.4.1.2 Limitations of the Path Dependence Argument

It was argued in the previous section that the persistence of overhead allocations as an inefficient internal costing method may be due to path dependence that reflects the importance of historical developments for today's situation due to critical mass and network effects. In this view, as a result of the multi-dimensional institutionalization of overhead allocations in the course of the late 19th and early 20th century, this method of costing has become so established that competing costing approaches are deterred from finding broad support from practitioners. Yet some arguments could be held against this explanaition.

One argument is that the developments of management accounting in Finland serve as a counter-example to the path dependence explanation. As explained earlier, Finland saw a surge of variable costing from the 1950s and on-

wards and is characterized today with low proportions of full-costing firms, despite its historical developments with respect to former government regulations based on cost allocation principles during and after the World Wars. If path dependence, and the underlying mechanisms of network or critical mass effects play a major role in the persistence of cost allocation methods, it would have to be argued why these mechanisms did not lead to a domination of allocation methods in Finland.

Another more general argument relates to the nature of accounting systems as institutionalized rules and routines. As Schlicht (1998, pp. 52) argues, established customs - or, for that matter, institutions in general - may display fuzziness and ambiguity in their application and might thus be vulnerable to erosion even in a situation of critical mass effects which lead to phenomena of path dependence. The idea of fuzziness or ambiguity as a property of institutionalized rules and routines emerges through their inherent vagueness. The scope, level and compliance of a set of rules and routines are never fully defined for each individual case. In the case of management accounting, we would expect a great deal of fuzziness: rules and routines are likely not to be defined well enough to allow the handling of each individual case and are thus open to individual interpretation - especially in a competitive and dynamic environment. For example, the accountant could be hesitant to strictly apply a traditional absorption costing approach on a newly introduced product that is manufactured using a new technology, since he or she is unsure if existing accounting routines can be applied to such a case. This leaves room for an individual reinterpretation of the problem. The accountant might use the chance to reassess the problem outside the imposed framework and might, eventually, come up with a better solution that leads to a more accurate estimation of product costs but deviates from the prevailing custom. As such inventions could spread inside and outside the firm, the custom of using overhead allocations for the derivation of internal cost measures could eventually erode and make room for better costing methods. So, through this vagueness of accounting routines, the traditional use of inefficient and unprofitable accounting methods would then, over time, be interrupted and eventually be expected to erode for the sake of better systems even if critical mass effects are at work.

#### 2.4.1.3 Convergence to Optimality

Given the limitations of an explanation of the phenomenon along the lines of path dependence through critical mass and network effects, we are led to ask: if there is some adaptability displayed by firms regarding their internal costing methods towards increased efficiency, to what degree should we expect observed costing practices to be optimal?

In the old institutional view, accounting change must not necessarily lead to the contextually optimal solution. Scapens (1994) in fact refers to the field of evolutionary economics, in particular Nelson and Winter (1982), to argue that accounting as a "highly structured set of routines"(Nelson and Winter, 1982, pp. 410-411) is subject to constant change but that the term "evolutionary" does not necessarily refer to a survival of the optimal solution:

> It simply recognizes that processes of change are shaped by a combination of random, systematic and inertial forces, which together create the context out of which new practices emerge. In other words, the process of management accounting change is much more complex than the rational selection of so-called 'optimal' procedures and techniques, and it is inherently path-dependent. (Burns and Scapens, 2000, p. 13)

As a consequence, in the view of Scapens, concepts of neoclassical (and, as such, new institutional) rationality are not suited for the analysis of management accounting change. He thus pleads for management accountants not to "mind the gap" between the academic treatment of cost accounting, which is heavily influenced by neoclassical ideas, and the empirical evidence that draws a very different picture. He thus asks accounting scholars not to compare observed costing practice with "theoretical ideals" (Scapens, 1994, p. 301), but instead to concentrate on the examination of accounting practice as it is encountered in reality.

Yet although this old institutional view on accounting change is highly insightful, it does lack an explanation for the persistence of seemingly obsolete traditional costing systems for such a long time. Certainly, as has been argued above, the change of institutions both internal (the rules and routines subsumed under the term management accounting systems) and external (laws and regulations) to the firm may be subject to inertia and do not have to result

in an optimal equilibrium state as described by textbook theories of costing and pricing. But given the huge economic deficiencies attributed to simplistic costing procedures - Johnson and Kaplan (1987) in fact argue that they are a main reason for the lack of global competitiveness that US firms suffered from in the 1970s and 1980s - and the fact that these institutions have been successfully adapted to new circumstances in the US and in Europe in the late 19th and early 20th centuries, when cost allocation practices became a standard, the persistence of traditional costing does seem puzzling even in the light of the ideas of old institutional economics.

The question that begs itself is thus not if and how firms follow an optimal costing approach, but why a suppposedly gravely suboptimal system such as absorption costing is used by the majority of firms for such a long period of time after having been deemed obsolete and unfit for the purposes of supplying decision-relevant cost data.

### 2.4.2 Institutional Stabilizers of Cost Allocation Methods

Schlicht (1998) showed in his analysis of custom in the economy that institutions which are individually costly (such as, in this case, inefficient costing practices that lead to suboptimal profits) will eventually erode in a setting of adaptive institutions. Properties such as the fuzziness of institutions can foster erosion even in a situation of path dependence induced by network externalities or critical mass effects. Even if adaptive processes would not lead to a situation where most firms apply highly sophisticated, "textbook" techniques to estimate their product's cost, we would, for example, expect the majority of US firms not to apply the same costing measures that have been deemed obsolete 20 or more years ago. It is the view of this author that neither an analysis along the lines of old institutional economics, nor a basic new institutional approach based on path dependencies offer a satisfactory answer to such grave inefficiencies, particulary if we consider that there is no apparent trend towards higher average costing sophistication, especially in Great Britain and the US.

In the following, I thus seek to discuss several aspects that could serve as "institutional stabilizers" in the sense that they contribute to the persistence of cost allocation practices for internal decision-making despite apparent economic shortcomings arising from inaccurate cost measures that this approach

entails. The first two aspects, i.e. cognitive biases and positive economic effects of overhead allocations, mostly refer to the influences on management accounting change inside of the firm, while the last aspect highlights the interplay between regulations for external financial accounting and the choice of an internal management accounting system.

#### 2.4.2.1 Psychological Fallacies

If a custom is fully malleable, then, as Schlicht (1998) argues, remaining inefficiencies could be a result of taste or persistent cognitive effects in the perception of individuals. We will focus on cognitive aspects, since it seems hard to argue that firms could have a taste for forgone profits due to the use of suboptimal costing methods.

Discussing customary behaviour of individuals, Schlicht argues that customs that are individually costly are not eroded because of a web of reinforcement that emerges through the interaction of habitual, emotional and cognitive aspects and stabilizes the custom from erosive pressures. In the case of accounting rules and routines, this framework might not be fully suitable, since firms, as decision entities, should not experience effects of subjective perception. As management accounting systems are designed and implemented by accounting professionals who, in general, aim for solutions that are as "rational" and "economic" as possible, the role of cognitive biases such as a mistreatment of sunk costs in decision-making should not be relevant. Against this view, Scapens (1994, p. 15) quotes an accounting manager of a big multinational corporation who, in the course of a case study, explained how common inconsistencies in the internal accounting system are:

> Well it is, you see, how things evolve. I suppose in the academic world, it's all clear cut; but it isn't really you know. When you come down here, it's a hell of a big mish-mash, all inter-related influences. It's not clear cut and logical. It looks completely illogical, but that's how it happens. And I'm sure we're no different from any other outfit. And you'll go back and say "what a load of idiots". But that's how it happens.

Management accounting systems might thus be initially designed and implemented with economic efficiency in mind, but due to fuzziness that arises

through the ambiguous nature of formalized rules in a constantly changing business environment, the routines that emerge in everyday practice might be heavily influenced by individuals within the organization, and thus by their cognitive dispositions.

Indeed, evidence that the human handling of sunk costs is often erroneous is plentiful, even in the case of business professionals. Coming back to the history of cost allocations described above, we can note that the inclusion of overhead allocation in government regulation and trade association agreements was grounded in the understanding that this type of calculation was the one that provided the "real" costs of a product. When it comes to relevant costs for decision-making, this reasoning is flawed. The inclusion of fixed costs in the costs used for the pricing decision might lead to a price that is too high. Thus, fewer units can be sold than expected, and fixed costs may not be recovered.

Experimental economists have repeatedly shown that decision-making of subjects is influenced by previous, essentially irrelevant decisions. For example, Buchheit (2004) reported results of a duopoly experiment with subjects that had an average of over six years of work experience, where sunk costs had a significant influence on the level of prices. Similar results have been obtained by Offerman and Potters (2006). In addition, there is much anecdotal evidence supporting such sunk cost fallacies.[16]

But, can we infer from this evidence that psychological biases are the cause for the persistence of cost allocations in internal cost accounting? The main argument against such an assertion is that it is questionable whether rules and routines that are shaped by these cognitive biases can and will be maintained in a competitive environment. Indeed, Waller et al. (1999) found in an experimental study that a fixed cost pricing bias did not persist in competitive markets. A negative correlation between the degree of competition and the use of cost-plus pricing has also been reported in a large survey of European firms by Fabiani et al. (2007).

[16] Al-Najjar et al. (2008, p. 215) give a vivid example for a sunk cost fallacy. They cite Edgar Bronfman, former owner of Universal Studios, who criticized the movie industry's pricing model because ticket prices do not reflect differences in the sunk production costs of different movies: "He [...] observed that consumers paid the same amounts to see a movie that costs $2 million to make as they do for films that cost $200 million to produce. 'This is a pricing model that makes no sense, and I believe the entire industry should and must revisit it.' " (Wall Street Journal, April 1, 1998).

This might lead to the conclusion that these costing inefficiencies are kept in place because competition is not strong enough to "cleanse" firms of the cognitive biases of their decision-makers. At least two arguments can be held against this view. First, while modern firms usually have some sovereignty over their selling prices, their market power is usually limited as antitrust authorities aim to curb market domination and promote competition. Also, economic theory suggests that one competitor can be enough to exert significant competitive pressure (Bertrand, 1883). Secondly, pressures towards profit maximization must not only occur from outside the firm. The firm might be under considerable pressure to satisfy shareholders and perform well in order to attract capital through financial markets. Inside pressures may arise through competition for executive positions which control the pricing policies of the firm in a situation where the evaluation of job performance through achieved profits gives an incentive to optimize pricing policies.

Of course, the effect of competition portrayed here assumes no collusion due to uniform costing or similar network effects described above which might dampen competitive pressures and support cost allocation practices among the firms in an industry. This positive effect of uniform costing will, along with other beneficial effects of cost allocation, be further discussed in the next section.

It is also questionable whether a cognitive bias that "justifies" the inclusion of fixed costs in managerial decisions against economic rationality would persist if the management overcame this bias. If it decided to implement a fundamentally different costing approach which generally rules out any overhead allocation, it might, as a consequence, steer individuals within the firm towards a more rational handling of sunk costs.

#### 2.4.2.2 Auxiliary Functions of Cost Allocations

One could argue that a management accounting system based on overhead allocation is, in fact, not economically inefficient: although the distorting effect on cost measures is hard to deny, perhaps such a system has other economic virtues that make it the best choice for a majority of firms.

In fact, many economic explanations for the rationality of full-cost pricing have been identified by economists and accounting academics, usually through

an extension of the standard neoclassical framework. Some of these mechanisms might not even be cited by firms as a (main) reason for using traditional costing systems - in fact, many practitioners might not even be aware of these beneficial effects of traditional costing. Yet the technique of overhead allocation may be more economically rational than recognised in many instances, and these virtues could outweigh the negative effects of cost measures being "too slow, too aggregated and too distorted" (Johnson and Kaplan, 1987, p. 1) for managerial decision-making.

One economic effect, apparent also in the above discussion of the history of cost accounting, is the collusive aspect of uniform costing. Underlying is the idea that full-costing practices can lead to higher prices which are, through a similar method of calculation, arrived at by several competitors simultaneously and thus can constitute a stable price point, leading to higher profits for all participating firms. This form of tacit collusion has been discussed in theoretic models such as the kinked demand curve (Hall and Hitch, 1939; Sweezy, 1939), but also in more recent approaches that use game theoretic concepts (Grant and Quiggin, 1994; Al-Najjar et al., 2008). In contrast to more sophisticated costing systems, or direct costing which relies on an arbitrarily defined costing base, pricing on the basis of full costs is easy to replicate. It is likely that firms in the same industry with comparable cost structures might thus find a stable common pricing point above more competitive equilibria.

Another economic advantage of traditional costing approaches is the motivational and controlling effect on managers that cost allocations can exert within firms. Zimmerman (1979) showed how the allocation of overheads can deter managers from the over-consumption of perquisites or serve as a tool for rationing internal services. Behavioural aspects of cost allocations were also found in surveys by Baumes (1963), Mautz and Skousen (1968) and Fremgen and Liao (1981). According to these surveys, cost allocations are used in practice to remind divisional managers of the existence of overhead costs, to encourage the use of central services, or to serve as a check for divisional expenses and central services.[17] The usefulness of absorption costing to reduce moral hazard in principal-agent settings was furthermore demonstrated by Thépot and Netzer (2008) in a theoretical model.

[17] For a discussion of these behavioural aspects, see Ahmed and Scapens (1991, p. 57).

Furthermore, beneficial effects of full-cost pricing have been brought forward in the context of capacity planning (Balakrishnan and Sivaramakrishnan, 2002), inter-temporal profit shifting under seasonal demand (Drury, 2008, p. 146), inventory sales (Langlois, 1989) and its increased robustness in the presence of demand uncertainty and pricing heuristics (see Chapter 3 of this work).

Also, the management and executives of the firm might prefer their internal costing systems to be consistent with external reporting since the firm is evaluated by financial markets through this cost data. For example, Hopper et al. (1992) show in a case study of six firms that senior managers are primarily interested in external financial accounting data because it is believed to have a strong influence on shareholder value. Additionally, performance-based compensation often depends on measures of external accounting, which may also strengthen management's interests in external financial accounting and its compatibility with internal cost reporting.

Overhead allocation might thus be more than just a method for determination of unit cost measures for external and internal purposes. The aspects described here stress its function as a device of internal and external coordination. Of course, other costing systems might display similar or further virtues in addition to their function of supplying cost data. Yet we do not argue here that overhead allocation is, in these aspects, necessarily superior to other costing systems. Rather, these auxiliary functions might explain why overhead allocation practices, being institutionalized a long time ago, are not replaced by firms for the sake of more sophisticated costing systems.

#### 2.4.2.3 The External Effect of Financial Accounting Regulations

While the stabilizing effects of both psychological biases and auxiliary functions may play a role in the persistence of absorption costing in internal reporting, these explanations do not account for the divergence in the development of internal costing methods between the US, UK and several other European countries on the one hand, where absorption costing is predominant, and countries such as Finland and Germany on the other hand, where firms use internal costing methods that are much closer to the economic "ideal". In order to shed light on these country-specific differences, we turn our attention to the

influence of external reporting regulations on the choice of internal reporting methods.

So far, an obvious virtue of using traditional costing systems to generate cost measures for internal decisions has not been mentioned, namely its ease of use and low costs of implementation and operation. Yet according to the arguments brought forward by Johnson and Kaplan (1987) and other critics of absorption costing, this lack of sophistication comes at the supposedly much greater cost of having to rely on distorted cost measures that render decision-makers unable to manage business operations in the most profitable way.[18] While no estimates of either the costs nor the gains of management accounting systems with different degrees of sophistication exist, we can make some general predictions when comparing the costs and benefits of choosing an approach for internal cost accounting.

### Cost and Benefit Considerations

Let us reassess the decision firms have to make when choosing an internal cost reporting system. Regarding the benefits of the different costing approaches, we can draw on the work of Dickhaut and Lere (1983), who demonstrated that the losses incurred due to the use of imperfect accounting data are positively related to the severity of the cost distortion away from the incremental unit cost measure. This leads to the very intuitive notion that the higher the cost distortions of a costing system currently in use, the larger the gross benefits in terms of obtainable additional profits if a more sophisticated costing system is implemented.

As we have discussed above, firms are confronted with three basic options to choose from: a simple direct costing approach based on the traceability of costs to individual products without any allocated overheads and no identification of variable costs, a sophisticated costing system like ABC, or a traditional absorption costing system discussed at length in the previous sections.

[18] Theoretical models that investigate the effect of distorted costs reported by accounting systems on profits were developed by Dickhaut and Lere (1983), Lere (1986) and Al-Najjar et al. (2008). Lere's model created some testable predictions regarding which accounting system would be preferred by decision-makers given the cost structures of the firm and the nature of distortion. These predictions were partially confirmed in experimental studies by Hilton et al. (1988) and Turner and Hilton (1989).

The first option - direct costing - is, as established earlier, likely to lead to a grave distortion of marginal costs due to the large positions of variable and initially unattributable overheads that characterize modern corporations. It is thus likely that in many cases, the costs in the form of forgone profits arising from having unsuitable cost data for decision-making exceed the savings in implementation costs for a dedicated internal reporting system if a direct costing system is employed.

The second option is the implementation of a modern management accounting system such as ABC. Such a costing framework is specifically designed the estimation of decision-relevant costs. As argued before, these costing systems probably allow for a better estimate of decision-relevant costs than either direct or absorption costing, but are characterised by high implementation costs for consulting services, software licences, implementation, and training of in-house staff in addition to higher maintenance costs. Initially, it is not clear if the gain through better managerial decisions due to more accurate cost measures offsets these expenses.

The third option - a traditional costing system - might, under some circumstances, generate cost data that is more useful than data obtained by direct costing due to the (partial) inclusion of variable overheads. Yet as fixed elements are also usually included, allocations could easily lead to an "overshooting" of cost measures when compared to marginal costs. In comparison to modern accounting systems, the cost accuracy provided by absorption costing techniques is surely inferior.

### Mandatory Cost Allocation Practices

But what general statements can we make regarding are the implementation costs of traditional costing systems? As argued before, regulations for external financial reporting require, as formalized in obligatory guidelines such as US-GAAP and IFRS, methods of overhead allocation for the determination of products, for example for the purpose of inventory valuation. This obligation makes the operation of a financial costing system based on overhead allocation mandatory for many firms. As a consequence, a large number of organizations already have a traditional costing system in place in order to be able to meet financial reporting standards and, as a consequence, the choice among the three

alternatives outlined above becomes altered: since the use of the existing external reporting system for internal purposes creates no additional implementation costs, its utilization becomes more viable.

### International Divergence and Financial Accounting Regulations

Under this light, we can examine the empirical evidence and the historical developments of cost allocation practice, along with its ongoing persistence, from an inter-country perspective. If the effect of financial reporting regulations on the choice of internal costing systems is considered, we expect firms only to deviate from using their financial accounting system for internal decision-making if the additional gains in accuracy outweigh the costs associated with the introduction of a more sophisticated management accounting system. These gains depend, of course, on how suitable the costing data generated by the traditional costing system required for external reporting is for internal decision-making.

In the US, regulations for external reporting are strongly oriented toward the interests of equity investors, and costing measures calculated based on these guidelines might be more suitable for decision-making than, for example, cost data required for financial reporting in Germany, where the focus of valuation rules is on the protection of creditors (Friedl et al., 2009, p. 39). While German regulations underlie the *Vorsichtsprinzip* ("prudence principle"), the general philosophy embedded in the US-GAAP is the principle of "fair presentation" which aims at a realistic representation of the economic situation of the firm. This may, in part, explain the divergent development paths of internal costing standards in the two countries: after markets became deregulated in the period after World War II, German firms found the cost measures generated for external reporting generally unsuitable for managerial decision-making. As the use of the financial accounting system for internal decision-making was generally not a fall-back option, the role of external financial accounting for internal purposes became much less significant in Germany than in the US (Sharman and Vikas, 2004). This made the development of internal costing solutions specifically geared towards managerial needs worthwhile, and concepts such as GPK emerged and found high acceptance rates among practitioners. In contrast, firms in the US (and, in that respect, in Great Britain) had successfully

made use of allocation practices in the first half of the 20th century and found the same basic costing methods and principles to be required for external reporting. In contrast to developments in Germany, there was less need for a distinction between costing procedures for internal and external purposes. As a consequence, financial reporting standards keep playing a substantial role for internal costing, especially in the US.

Finland serves as another interesting example of a diverging development due to financial reporting legislation. After regulations required a variable costing approach for financial reporting, Finnish firms did not see the need for a separate costing system for internal reporting, as cost data generated for external reporting showed comparatively little distortion from economically relevant costs. The low adoption rates of ABC methods in Finland also fits into this rationale: for Finnish firms, the additional gains in costing accuracy do not offset the high implementation costs, as mandatory external reporting regulations already require cost measures that are relatively well-suited for internal decision-making.

### Financial Accounting Regulations and Institutional Change

In the framework of institutional change outlined above, legal regulations for financial reporting can influence the choice of internal costing systems. By altering the firm's incentives regarding internal costing systems, standards for external reporting can inhibit institutional change that would possibly be, other things equal, advantageous to the firm. The reason is that through the mandatory operation of an allocation system, the potential gains from implementing a dedicated and complex management accounting system are diminished by the use of the external costing system as a low-cost surrogate for internal purposes.[19]

[19]Note that one could argue that only listed manufacturing firms may be affected by the favourability of allocation practices due to external reporting regulations, as both service and unlisted firms do not have to comply to these parts of financial accounting regulations. Yet it can be argued that a significant share of listed manufacturing firms that use allocation procedures due to the effects discussed here suffices to stabilize this internal costing approach as a standard. This would then give rise to critical mass and networks effects described above. In addition, there is usually a significant minority of firms that deviates from standard costing routines.

This impact of legal directives on the choice of internal management systems can be seen as a classical case of a (positive) economic externality. Such an understanding of the effect can also explain the prevailing persistence of traditional costing in a framework of institutional change: in the discussion of malleability of institutions, we concluded that inefficient institutions will erode eventually if not stabilized by preferences or persistent cognitive effects. Of course, such an adaptation of institutions would not only apply to the rules and routines inside the firm, but also to the institutions outside of the firm, such as the legal framework and regulations issued by standard-setting boards for external financial reporting. If these regulations create inefficient outcomes, they also would be subject to pressure for adaptation.

Yet it can be argued that the measure of efficiency of an institution relates, first and foremost, to the purpose it is designed for. In the case of financial reporting standards, the objective target is to ensure comparability of financial performance figures on an historical and inter-firm basis, and to reduce possible principle-agency problems between insiders and outsiders of the firm. Including a full-cost approach for the valuation of the firms products does not conflict with such an aim. Possibly inhibiting effects on the evolution of internal costing systems are not recognised in the objectives of these regulations.

The fact that inefficiencies in practices of management accounting are usually not attributed to financial accounting regulations can be taken as an indicator for the lack of pressure for change that is exerted on external reporting standards due to possible distortions in the incentives of internal costing practices. In fact, regulations for external financial accounting fulfill their purpose well: they constitute a common basis for the evaluation and comparison of the assets, liabilities, income, and expenses of firms. As a consequence, we can expect no momentum of institutional change towards a reduction of the deterrence of improvement of management accounting techniques by financial reporting standards.

### Information Inductance

Another channel of influence that is exerted from external to internal reporting has been identified by Prakash and Rappaport (1977). They assert that the behaviour of an individual is affected by the information he or she is required

to send, and term this effect "information inductance". For example, as pointed out before, as the firms performance is evaluated by the information it provides through external financial reporting, managers might be influenced to orient decisions towards a maximization of said performance measures. A change in the data required for external reporting would thus induce a change in the behaviour of the decision-maker.

Similarly, managers might be influenced by cost definitions imposed by external reporting. As has been pointed out above, an exact identification of "true" unit costs is, in a situation of complex production processes, hardly feasible. As a consequence, estimates of cost measures are, to some extent, subjective and are contingent on the specific processes that were used to derive the cost measure. As firms may be unsure - or internally discordant - about finding a valid way to calculate unit costs, statutory cost calculations defined by regulating bodies might serve as a point of reference in the search for a valid costing method for internal reporting. Psychological fallacies in the context of handling fixed costs could reinforce the belief in cost allocations being able to identify the "true" costs of a product. So, even if internal and external reporting serve different purposes and thus require fundamentally different costing approaches, decision-makers might be influenced by having to prepare cost measures for financial accounting.

### 2.4.3 Summary and Outlook

In the analysis above, three aspects were discussed that may provide some explanation for the lack of erosion of overhead allocation practices in internal costing systems. By and large, these aspects supply explanations for the persistence of full-costing methods even if other effects of path dependence are disregarded. We have discussed these aspects in the context of the premise that initially, the firm faces foregone profits due to distorted cost measures generated by overhead allocation systems. Previous works on the topic, most prominently Johnson and Kaplan (1987), suggest the validity of this hypothesis. With more accurate costing systems available, we have identified a simple condition under which we should expect broad management accounting change, i.e. if the costs of implementing such a sophisticated costing system are exceeded by the gain of additional profits through more costing accuracy. All

three discussed aspects that might support the persistence of allocation practices in management accounting relate to this condition in a different way.

Firstly, the existence of psychological biases in the handling of fixed costs may deter the introduction of a novel costing approach or raise the effective implementation costs, as resistance within the firm has to be overcome. Also, due to the general vagueness and ambiguity of costing rules, operators within the firm could negatively influence costing practice due to their biases and thus decrease the possible gains from a more sophisticated cost system.

Secondly, possible auxiliary functions of overhead allocations can decrease the relative inefficiency of cost allocation methods, by exerting a positive effect on profits through other channels, such as fostering collusion, better internal control or increased robustness in the face of uncertainty. As a result, the potential gain from switching to a more sophisticated costing system is diminished.

Lastly, the effect of mandatory cost allocation methods for financial reporting can inhibit institutional change of management accounting practices in several ways. On the one hand, it establishes cost estimation by overhead allocation as a seemingly correct manner for the calculation of "true" product costs. Firms may thus be "steered towards" using overhead allocation methods for the derivation of decision-relevant cost measures. On the other hand, the full-cost approach required for external reporting decreases the relative implementation costs of absorption costing as a management accounting system, in turn decreasing the relative gains that can be expected from a more sophisticated costing system. By providing an almost costless option for a crude but practicable internal costing solution, traditional costing methods might thus be far from undesirable from the firm's point of view.

It is questionable whether the stabilizing functions of psychological aspects and the auxiliary functions of overhead allocation alone suffice to hold inefficient allocation practices in place in the face of pressures towards change in management accounting methods. The examples of Finland and Germany discussed above may be taken as underlining this argument. Both stabilizing factors should have been present in both countries after the end of World War II and did not hinder the development of more decision-relevant costing methods. The effect of external reporting regulations, in contrast, might play a much more decisive role in the persistence of traditional costing techniques

employed for internal purposes and the slow diffusion of more sophisticated management accounting approaches.

## 2.5 Conclusion

In the course of this chapter, it has been established that using a costing approach that relies on a crude allocation of overheads generates cost estimates that are unsuitable as a basis for taking decisions on the product level, such as pricing, reengineering or discontinuation of product lines. Instead, firms should operate separate internal costing systems to generate such costing information. In contrast to these theoretical considerations, it is clear from empirical evidence that in most countries, firms use costing data that is required for external financial reporting for internal purposes and thus rely heavily on full costing for managerial decision-making. The two most common alternatives for internal costing, namely a simplistic direct costing system which allocates no overheads and identifies unit costs by the traceability of costs, and more sophisticated costing approaches such as Activity-Based Costing, which allows for more accuracy in the estimation of relevant unit costs, are disregarded and not adopted by the majority of firms.

By analyzing the historical evolution of internal costing practices in the 19th and 20th century, alongside with organizational, political and legal developments, we found how traditional cost allocation practices were firmly established for external and internal cost accounting purposes. Under the institutional framework introduced thereafter, we sketched a possible solution to the paradox of the ongoing persistence of traditional costing methods in management accounting. As overhead allocations became institutionalized under circumstances in the past, where it may have posed an efficient costing system for the purposes at hand, it did not lose its popularity after these external conditions changed. Rather, it was already established as a standard, and as such "locked in" by critical mass and network effects. It was argued here that this explanation along the lines of path dependence is unsatisfactory by itself and that, given the significant economic opportunity costs attributed to these inefficient costing systems, they would have eroded and been replaced a long time ago.

Given these considerations, we identified three aspects that may play a role in the stabilization of allocation methods in internal reporting against tendencies of institutional change towards more sophisticated costing methods. Most importantly, we stressed the role of regulations on external financial reporting for the internal costing behaviour of firms. As cost allocation practices are required for financial accounting, firms are obliged to use a costing system capable of generating such cost data. As a consequence, allocation methods are a free alternative to the implementation of a sophisticated internal costing system. As the benefit of such a more complex costing framework might not outweigh its high implementation and operating costs, firms may have an incentive to stick to using their traditional costing system for both internal and external reporting. In addition, change in the structure of management accounting might be hindered by psychological biases in the handling of sunk costs, which might create the impression that an inclusion of fixed costs is necessary in order to obtain "true" product costs. Also, several auxiliary functions were discussed that may play a positive role in the efficiency considerations of allocation practices. Collusion that is stabilized by easily established uniform costing within an industry, as well as making use of cost allocations as a tool for control and coordination in a firm might be important aspects that justify the continuing use of allocation practices for internal decision-making.

Accounting scholars such as Johnson and Kaplan (1987) have often argued that the prevalence of simplistic cost allocation methods in internal costing systems is a source of grave economic inefficiencies. Our analysis suggests that this is only partially true. While it is fairly certain that more accurate costing measures than the ones obtained by traditional costing systems could enable firms to manage their business more efficiently, it is not clear if the high costs that they incur from the implementation of sophisticated costing methods are outweighed by these gains. At the same time, as was established in this chapter, external costing regulations might exert a positive external effect on the firm in its choice of the degree of sophistication it is willing to implement for internal costing procedures, and thus might leave firms with costing systems that are less accurate than optimal. Trends regarding the regulation of external costing methods suggest that this is unlikely to change in the near future. The reporting standard IFRS, which entails cost allocation methods, has become obligatory for listed corporations in the European Union in 2005 and is in a

process of convergence with US-GAAP, due to the Norwalk Agreement which allows US firms to present their financial statements in accordance to IFRS. It thus follows from our analysis that the full cost approach is unlikely to lose its relevance for internal reporting in the near future.

From this analysis it has become clear that more research on costing and pricing is needed. In the following two chapters, we will thus explore the economic properties of full-cost pricing in greater detail. Using a theoretical model of pricing under uncertainty, we can demonstrate how full costing can be a favourable strategy for the firm. In the last chapter, this model is used to show that such pricing behaviour gives rise to empirically observed phenomena such as the increase of price dispersion with the rate of inflation.

# 3 Cost-Plus Pricing and Uncertainty

## 3.1 Introduction

The wide use of cost-plus pricing, and full-cost pricing in particular, remains an explanandum in economics. While in the field of management cost accounting, the importance of the choice of which costing and pricing system to implement is long recognised and its effect on the firm's profitability in a dynamic market environment is acknowledged, the specifics of pricing and costing methods is usually not part of the economics research agenda. In the same vein, cost accountants, much more than economists, recognise the "reality gap" between observed practice and the assumed pricing behaviour within the neoclassical framework (Lucas, 1999). This chapter tries to build a bridge between cost accounting and economics, by examining the implications of different cost-plus methods and their effect on profitability in an uncertain environment both in a neoclassical and in a behavioural framework.

The motivation of this chapter is threefold. The first is to give an explanation complementary to previous theories on the wide use of full-cost pricing strategies in favour of variable costing, linking the choice of pricing method to uncertainty about the market environment. This is done within a framework that deliberately deviates from strict neoclassical principles, e.g. by assuming firms that use rules of thumb for the determination of the profit mark-up instead of being standard profit maximizers. To contrast the findings under this alternative approach with those under a strict neoclassical analysis will be the second aim of this contribution. Thirdly, from a rather methodological perspective, I want to show how the treatment of demand uncertainty under the neoclassical framework fails to reflect the effects of the use of different cost-

ing systems on profitability, which is widely discussed in the field of management cost accounting. This identical treatment of variable and full costing in the neoclassical framework is, as I will argue, one of the factors that favoured the absorption of full-cost pricing by the marginalist framework, following the marginalist controversy in the 1950s and the subsequent neglect of the empirical regularities concerning pricing methods in mainstream economics. Yet, as will be shown, in other realistic settings of pricing behaviour, the specifics of the cost-plus decision do indeed matter, and economists should not rely on the postulates of the neoclassical framework when they seek to understand what governs the pricing decision.

The paper is organized as follows. First, an introduction to cost-plus pricing and its discussion within economics and management accounting is given. Next, literature on pricing under demand uncertainty is surveyed. In the following treatment of the neoclassical approach to demand uncertainty, the irrelevance of distinguishing between variable and full costing is shown for the monopoly case. Subsequently, the "behavioural approach" to pricing methods will be introduced. This approach does not assume that firms maximize their profits but instead rely on a rule of thumb for the determination of the profit mark-up that evolved or was adaptively improved to be optimal on average, but is subject to a distortion since the rule of thumb fails to exactly identify the optimal profit mark-up in each individual case. It is then shown that under these conditions, full costing outperforms variable costing and can thus be, given the imposed restrictions, the best pricing strategy for the firm. Both the neoclassical and the behavioural models are then extended to the case of imperfect competition. A summary and discussion of the findings concludes the chapter.

### 3.1.1 Cost-Plus Pricing in Economics and Management Accounting Research

It is widely agreed upon within the economics profession that the well-known calculus of equating marginal costs with marginal revenues, in order to find the point of maximum profits, is more a theoretical tool of the economist than a realistic description of the price-setting process of the majority of firms. The actual method by which most firms arrive at their price is that of cost-plus

(or mark-up) pricing. Generally speaking, this refers to a method where the selling price is derived by adding a mark-up on a unit cost base. Not only the procedure itself, but also the nature of the cost base used, especially the inclusion of fixed costs, gave rise to a large debate within the profession of economics. Initiated by the seminal paper by Hall and Hitch (1939), the debate on the so-called full-cost principle became part of the marginalist controversy, and proponents of the full-cost principle questioned the validity of marginalist theory as a description of real world phenomena.[1] The debate died down during the 1950s, after supporters of the marginalistic approach, such as Machlup (1946), Alchian (1950), Heflebower (1955) and also Friedman (1953) argued that observed firm behaviour such as cost-plus pricing would not stand in contradiction with marginalist theory. This is because the theory aims not to describe firm behaviour, but rather the observable market phenomena that are arrived at by the interaction of economic agents under market forces. Cost-plus pricing is thus understood as a means of price setting which eventually leads to the state as it is described by marginalist theory. Mostly, this state is arrived at as a consequence of competitive pressure, leading to refinement of methods employed by the firm and/or the weeding out of firms that employ suboptimal routines, up until the point where only firms that use a pricing method that ensures optimal profits remain in the market. As such, neoclassical theory fully endorses and accepts the use of heuristics in the price setting process, postulating their optimality as a consequence of adaptive and selective processes. In this vein, as was argued, cost-plus pricing behaviour in general does not stand in contradiction with neoclassical theory of pricing. This line of argumentation ultimately led to the absorption of the full-cost principle into neoclassical economics. A detailed discussion of the controversy and the premature absorption of cost-plus pricing into the marginalist framework is given in the introductory chapter of this work.

Since the proponents of marginalism managed to integrate cost-plus pricing in the neoclassical framework, the economist's interest in cost-plus pricing has been comparatively small. Yet, especially the widely observed phenomenon of including fixed costs into the pricing decision, runs up - at first glance - against economic reasoning, and is hard to reconcile with the aforementioned

[1] In addition to the introductory chapter of this work, see for a comprehensive overview of the full-cost controversy Mongin (1990) and Lee (1984).

postulate of optimality that we should encounter according to the neoclassical framework. As e.g. Dorward (1987, p. 21) states, only costs that accrue in the future and that are incremental, i.e. that vary with output, are economically relevant for the determination of the selling price. Clearly, fixed costs, which are sunk by definition and allocated to individual units when a full-cost pricing method is used, do not satisfy these criteria.

One of the aims of this chapter is to reestablish the importance of inner-firm processes for the pricing decision. In particular, the mainstream of the economics profession has neglected the role of accounting systems and the decision-relevant data they provide for pricing behaviour. Ronald Coase acknowledges this when he writes:

> The theory of the accounting system is part of the theory of the firm. It is not my belief that the secret to the determination of the institutional structure of production will alone be found in the accounting system, but it certainly contains part of the secret. (Coase, 1990, p. 12).

This general recognition of the central role of accounting systems for the operation of the firm is one of the central points of this chapter and the other chapters contained in the work at hand.

To incorporate the relevance of accounting in the theory of pricing, the model presented below will distinguish between the two most prominent cost accounting approaches, variable and full costing. It will be shown that in the neoclassical framework, in line with the aforementioned postulate of optimality, the two methods of price setting differ only in the means of calculation, since they lead to identical prices if no uncertainties concerning the mark-ups and costs exist. Yet there is a fundamental difference in the understanding of relevant costs between the two approaches in the management accounting and older economics literature. Under variable costing, a comparatively large profit mark-up is multiplied with the small variable cost base. Management accountants also refer to this approach as "contribution costing": the revenue generated by each individual product, less its marginal cost, contributes towards the overall recovery of higher-level overhead costs and eventually to a profit if total revenues exceed total costs. In contrast, full costing takes a different approach: a relatively small profit mark-up is multiplied with a costing base that includes

total costs of the product, which can be split into the product's marginal costs and its share of fixed costs. This approach is also labeled "absorption costing", since each individual product absorps all the costs that were generated in the course of its production once it is sold at a price that is larger or equal to the cost base. In contrast to variable costing, the profit mark-up under absorption costing is "pure" in the sense that it does not have to contribute towards the covering of higher-level costs and can directly enter the books as generated surplus. While research in management accounting and economics has debated the virtues of the two approaches to a considerable extent (see, e.g. Burrows, 1994, for comprehensive overview), the second half of the 20th century saw most academics arguing in favour of a contribution/variable approach to costing - largely due to the inclusion of irrelevant fixed costs and the arbitrary nature of cost allocations that the absorption/full costing approach entails. In Chapter 2, the details of these two management accounting approaches, their use in practice and some of the controversies surrounding them are discussed.

Survey evidence such as Fog (1960), Drury et al. (1993) and Fabiani et al. (2007) continue to support Hall and Hitch's initial supposition that cost-plus pricing is the most common form of price setting behaviour. Additionally, the nature of the cost base onto which the mark-up is applied has also been subject to business surveys. In a study among 141 U.S. firms, Shim and Sudit (1995) found that about 60 per cent used full manufacturing costs or even all costs as the base for their mark-up calculation. Only 12 per cent reported using a variable costing approach, and about 18 per cent reported other methods, mostly market-based pricing. In a study by Govindarajan and Anthony (1983), 82 per cent of 505 U.S. firms reported using some sort of full-cost measure as their pricing base, as opposed to 17 per cent that followed a variable costing approach. In contrast to the earlier understanding of the full-cost principle, which saw the mark-up as unresponsive to changes in demand, empirical evidence points toward a strong orientation to demand factors even when employing full-cost methods (Dorward, 1987, p. 116).

While the "reality gap" (Lucas, 2003) between the observed prevalence of full-cost pricing practices and the neoclassical assumptions on pricing was largely neglected by mainstream economics, a considerable body of literature in the field of management accounting (and in rather heterodox branches of economics) exists on the use of cost-plus pricing, which offers several explana-

tions for the preferred use of full costing in favour of a variable costing system. A very early idea, already put forward by Hall and Hitch (1939), is that full costing might help to facilitate and stabilize implicit collusion by providing a more or less commonly known focal point for pricing above variable costs. Another explanation for the inclusion of full costs was given by, among others, Balakrishnan and Sivaramakrishnan (2002). These authors who survey several models which connect capacity planning and pricing decisions to show that full-cost pricing can be the most profitable strategy if capacity constraints apply, and if the firm is unable to adjust its price after production has taken place. Furthermore, Drury et al. (1993) argue, as we have discussed in Chapter 2, that the procedures used for internal cost accounting are strongly aligned with external financial reporting. This includes absorption costing and an emphasis on historical costs. A reason for this might be that managers prefer the same information for internal uses as what is communicated to the the firm's peers. As external financial reporting requires a full-costing approach in most countries, this might play a role in the decision on the costing system.[2] Furthermore, Drury (2008) describes the differences in profits over more than one period that occur under the two costing regimes when the firm uses inventories. For example, the absorption approach may have an intertemporal smoothing effect on profits if demand volatility is high, because fixed production costs do not enter profit calculations before the produced units are sold. Of course, this line of argument can also be reversed in favour of variable costing, depending on demand factors. But a full-costing strategy might also entail other disadvantages. Despite the inclusion of a variable into the decision process that is irrelevant, full costing might hinder the firm from achieving optimal profits in a multi-product environment due to additional constraints in the price setting problem (Burgstahler and Noreen, 1997). Additionally, the larger cost base under full costing might prevent the firm from achieving the optimal price with a cost-plus pricing method (assuming a non-negative profit mark-up), which may lie below total costs.

[2]This aspect is discussed in more detail in Chapter 2 of this work.

### 3.1.2 Uncertainty, Pricing and Cost-Plus Methods

The pricing decision under demand uncertainty has been the subject of a variety of analyses in economic literature. In the studies discussed here, the firm is assumed to set a price as a quantity taker that is not capacity constrained. Being the standard reference, Leland (1972, p. 285) writes:

> [..] the introduction of uncertainty does not affect the price decision of the price-setting, risk-neutral firm with constant marginal cost.[..]
>
> [..] when marginal costs are not constant [..] Jensen's inequality may be used to show that if marginal cost is rising at a non-decreasing rate, the optimal price set by risk-neutral firms will be higher under uncertainty than under certainty; the opposite holds if marginal cost is decreasing at a non-increasing rate.

These findings were extended by Aiginger (1987), who made a distinction between additive and multiplicative uncertainty.[3] He also finds that in both cases, the optimal price depends on the cost function. If marginal costs are falling (constant, rising), then the optimal price is lower (equal, higher) than under certainty (Aiginger, 1987, p. 54).[4] In the case of a convex cost function, a higher price is chosen to reduce the danger of high marginal costs if demand should turn out to be high.

Only few works focused on the connection between demand uncertainty and cost-plus pricing. Most noteably, Fraser (1985) analyses a monopolist who uses a cost-plus pricing approach on constant variable costs in a situation of additive demand uncertainty. He first shows that, consistent with my findings, the risk neutral firm attains maximum profits with the same price under both certainty

[3] In his formulation, Aiginger defines additive demand uncertainty as $q = f(p) + u$, where $q$ is the realized quantity, $f(p)$ is the demand function and $u$ is an error term with $E(u) = 0$. As for multiplicative uncertainty, he refers to $q = f(p) \cdot u$ with $E(u) = 1$ and $p = g(p) \cdot u$, with $E(u) = 1$ and $q = g^{-1}\left(\frac{p}{u}\right)$. We will only cover the first variant. The firm maximizes expected profits and is risk neutral.

[4] Under the special form of multiplicative uncertainty where $p = g(p) \cdot u$, with $E(u) = 1$ and $q = g^{-1}\left(\frac{p}{u}\right)$ the optimal price depends on the curvature of the marginal cost and the marginal revenue functions. Aiginger finds that if marginal revenue is concave in $u$ and marginal cost is convex in $u$, the optimal price will be reduced, while it will increase in the opposite case. If both are concave or convex, the result is indefinite. (Aiginger, 1987, p. 56)

and additive demand uncertainty. If the firm is risk averse, however, he shows that the profit mark-up will be lower than under certainty, a result that also appears in Leland (1972). Interestingly, under risk aversion, the profit mark-up is not solely dependent on the elasticity of demand, but a range of other factors, among them variable and fixed costs and the expected level of demand. Despite these insights, Fraser does not distinguish between different forms of cost-plus pricing, namely the variable and the full-cost approach.

Another noteworthy contribution on using heuristics for the price-setting decision in a situation of uncertainty is by Pasche (1997). He compares marginalistic maximization with a non-maximizing mark-up heuristic on variable costs in a situation where the agent does not know the true demand function (which is subject to an additive error) and has to solve a signal extraction problem based on his price-quantity observations. In this setting, Pasche shows that it can be preferable for the agent to use the mark-up heuristic in contrast to a maximization over a stochastic profit function.

This chapter aims to pick up several aspects of these aforementioned contributions. Following Fraser (1985) and Aiginger (1987), I will extend the neoclassical literature on pricing and demand uncertainty by comparing variable and full-costing systems. Furthermore, more in line with Pasche (1997), I will use an alternative model influenced by the behavioural theory of the firm. This approach assumes non-maximizing firms that follow a mark-up heuristic, which in turn leads to optimum profits on average. On the other hand, it returns profit mark-ups that are distorted at each implementation, reflecting the rigidity and defectiveness of heuristics. It will shown that under these assumptions, full-cost pricing is the best strategy for the firm under both a monopoly setting and an imperfectly competitive market.

## 3.2 The Choice of Cost-Plus Pricing Methods in Monopoly

In the basic model, we assume a monopolist that sets prices in a one period setting and is not capacity constrained, i.e. it can satisfy any demand level that

is realized. For the sake of simplicity, we assume that the firm only produces one good, for which the following demand function is given:

$$q(p) = m - ap, \quad m, a > 0$$

We further assume that $m > ac$, where $c$ denotes marginal cost, to insure that positive profits are attainable. The firm operates with the cost function

$$C(q) = cq + F, \quad c \geq 1, F > 0$$

Before posting its offer, the firm has to decide which costing approach it implements to calculate its selling price. It can choose between a variable (contribution) costing system and a full-cost (absorption) costing approach. Under variable costing, the price is calculated as

$$p_{vc} = (1 + \alpha) c$$

where $\alpha$ denotes the profit mark-up under variable costing. In contrast, the price under full costing is arrived at by

$$p_{fc} = (1 + \lambda)(c + f)$$

where $\lambda$ is the profit mark-up under full costing. The allocated fixed cost $f$ is defined as $f = \frac{F}{q_e}$, where $q_e > 0$ is the quantity the firm expects to sell.[5] Again for the sake of simplicity, we will not further specify the process by which the firm estimates $q_e$, but rather will take the estimation as exogenous. Throughout, we will denote profits of the variable costing firm as $\pi$, and profits of the full costing firm as $\omega$. All parameters are assumed to be reals.

### 3.2.1 The Neoclassical Approach to Demand Uncertainty

In this section, the setting satisfies all criteria of the neoclassical framework. The firm seeks to maximize its (expected) profits and has full knowledge of the

[5] Note that this allocation, namely the proportionate distribution of fixed expenses to individual units, is apparent for the single-good case, but much less so when the firm produces multiple products; here, an allocation base such as labour hours is necessary to achieve a sensible fixed cost allocation. We discuss the influence of internal costing systems necessary for a correct allocation of overhead costs in Chapter 2.

demand and cost functions, as well as on the distribution of the error term that will be introduced later.

#### 3.2.1.1 Certainty

As a benchmark case, we will analyse profits of the monopolist under certainty, where the firm has to decide on which costing system to implement. Profits under certainty will be denoted as $\pi^{cert}$ and $\omega^{cert}$.

##### Variable Costing

Under a variable costing regime, profits under certainty are[6]

$$\begin{aligned}\pi^{cert} &= p_{vc}q\left(p_{vc}\right) - cq\left(p_{vc}\right) - F \\ &= -c(m - ac(1+\alpha)) + c(1+\alpha)(m - ac(1+\alpha)) - F \\ &= c\alpha(m - ac(1+\alpha)) - F \end{aligned} \tag{3.1}$$

Differentiating with respect to $\alpha$ and setting equal to zero yields

$$\alpha^{cert\,*} = \frac{m - ac}{2ac} \tag{3.2}$$

The second order condition is also satisfied. Maximum profits are

$$\pi^{cert\,*} = \frac{a^2c^2 - 4aF - 2acm + m^2}{4a} \tag{3.3}$$

##### Full Costing

In the case of full costing, profits are

$$\begin{aligned}\omega^{cert} &= p_{fc}q\left(p_{fc}\right) - cq\left(p_{fc}\right) - F \\ &= -c(m - a(c+f)(1+\lambda)) + (c+f)(1+\lambda) \\ &\quad \cdot (m - a(c+f)(1+\lambda)) - F \\ &= -(f + (c+f)\lambda)(-m + a(c+f)(1+\lambda)) - F \end{aligned} \tag{3.4}$$

[6]The model was analysed with Mathematica 7.0.0. The source code is available upon request from the author. Most numbered expressions are labeled accordingly in the Mathematica source code for the readers convenience.

Differentiation with respect to $\lambda$, setting equal to zero and plugging in $f = \frac{F}{q_e}$ gives the optimal mark-up

$$\lambda^{cert*} = \frac{mq_e - 2aF - acq_e}{2aF + 2acq_e} \tag{3.5}$$

which also fulfills the second order condition. Inserting into $\omega^{cert}$ gives maximum profits under full costing of:

$$\omega^{cert*} = \frac{a^2c^2 - 4aF - 2acm + m^2}{4a} \tag{3.6}$$

### Comparison

Comparing results under the optimal mark-ups in both cases, we see that

$$p_{vc}^{cert*} = p_{fc}^{cert*} = \frac{ac + m}{2a} \tag{3.7}$$

and accordingly

$$\pi^{cert*} = \omega^{cert*}$$

This shows that the firm is indifferent between variable and full costing and can achieve maximum profits under both costing systems. Note that $\lambda^{cert*}$ becomes negative if $c + f > p^* \geq c$, while $\alpha$ never turns negative since this would result in $p < c$. Comparison of the mark-up gives the intuitive result

$$\alpha^* > \lambda^* \tag{3.8}$$

since under variable costing, the mark-up $\alpha^{cert*}$ is applied to a comparatively small cost base $c$, while under full costing the smaller mark-up $\lambda^*$ is multiplied with the larger cost base $c + f$.

The optimal profit mark-up under full costing $\lambda^{cert*}$ increases with expected quantity $q_e$:

$$\frac{\partial \lambda^{cert*}}{\partial q_e} = \frac{F(ac + m)}{2a(F + cq_e)^2} > 0 \tag{3.9}$$

As the full costing firm expects to sell more units, the allocated fixed cost per unit $f$ decreases and thus lowers the cost base, which in turn makes a higher

mark-up necessary to set the optimal price. Note that an error-ridden calculation of the expected sold quantity might prevent the firm from deriving the optimal mark-up.

#### 3.2.1.2 Additive Demand Uncertainty

We now introduce a demand shock that the firm cannot observe before it fixes the selling price. We assume that the firm knows the distribution of the error parameter. Concerning the dichotomization by Knight (1933), who defines "uncertainty" as a situation where agents have no knowledge about the probability function over the random variable, and "risk" as the situation where they do, we will follow Aiginger (1987) by referring to the latter.

We define $u$ as a shock which is characterized by a symmetric Beta distribution within the domain delimited by the minimum $v$ and the maximum $w$. For reasons of simplicity, we assume the distribution of $u$ to be symmetrical around its mean. The according probability density function of $u$ is then given as[7]

$$f(u;\beta) = \frac{(u-v)^{\beta-1}(w-u)^{\beta-1}(w-v)^{1-2\beta}}{\mathrm{B}(\beta,\beta)} \tag{3.11}$$

where $\beta$ is a shape parameter and $\mathrm{B}(\beta,\beta)$ is the Euler Beta function. We delimit the probability density function by $v = -1$ and $w = 1$. The expected value and the variance of $u$ are then given as:

$$E(u) = 0 \tag{3.12}$$

$$Var(u) = \frac{1}{1+2\beta} \tag{3.13}$$

Figure 3.1 depicts the probability density function of $u$ for different values of the shape parameter $\beta$. It can be seen that this distribution incorporates a variety of possible characteristics regarding the dispersion of $u$.

[7] The general form of the Beta probability density function is given as

$$f(z;\gamma,\beta,v,w) = \frac{1}{\mathrm{B}(\gamma,\beta)} \frac{(z-v)^{\gamma-1}(w-z)^{\beta-1}}{(w-v)^{\gamma+\beta-1}} \tag{3.10}$$

where $\gamma$ and $\beta$ are the shape parameters of the distribution. The symmetric version is obtained by assuming $\gamma = \beta$.

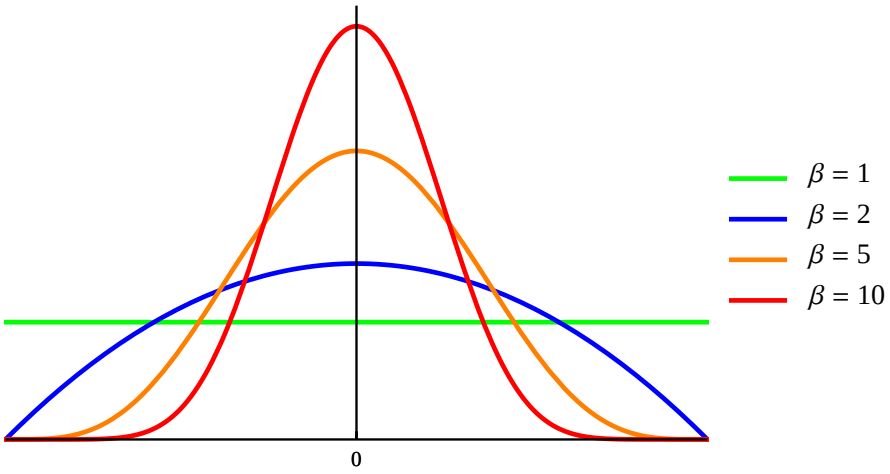



Figure 3.1: The Probability Density Function of $u$ for Different Values of $\beta$

We will, again following Aiginger (1987), distinguish between additive and multiplicative demand shocks. To keep the main mechanism of the model in focus, we will assume that profits are evaluated through a linear utility function $U(x) = x$. Firms are hence risk neutral and, in the neoclassical approach, maximize expected utility. For the sake of clarity, we will omit the notation of the utility function.[8] In the following, variables for additive uncertainty in the neoclassical model will be denoted with the superscript *auc*, while in the case of multiplicative uncertainty (introduced below), the superscript *muc* will be used.

Under additive demand uncertainty, the demand function is given as

$$q^{auc}(p) = m - ap + u$$

### Variable costing

Knowing the distribution of the error, the firm faces the following expected utility of profits in the case of variable costing:

$$\begin{aligned} E\left(\pi^{auc}\right) &= \int_{v}^{w} (c(1+\alpha)(m+u-ac(1+\alpha)) \\ &\quad - c(m+u-ac(1+\alpha)) - F)\, f\left(u\right) du \end{aligned}$$

[8] This also applies to the model discussed in the next chapter.

$$
\begin{aligned}
&= \int_v^w (c\alpha\,(m+u-ac\,(1+\alpha))-F)\,f\,(u)\,du \\
&= \int_v^w uf(u)du + (c\alpha\,(m-ac\,(1+\alpha))-F) \\
&= c\alpha(m-ac(1+\alpha))-F
\end{aligned} \tag{3.14}
$$

Maximizing and solving for $\alpha$ yields again

$$\alpha^{auc\,*} = \frac{m-ac}{2ac} \tag{3.15}$$

which is equal to the optimal mark-up under certainty, $\alpha^{cert\,*}$. Facing additive demand uncertainty, the variable costing firm does not alter its strategy compared to the certainty case. Hence, expected utility of profits under additive uncertainty are the same as profits under certainty:

$$E\,(\pi^{auc\,*}) = \frac{a^2c^2-4aF-2acm+m^2}{4a} = \pi^{cert\,*} \tag{3.16}$$

### Full costing

Expected profits under full costing are

$$
\begin{aligned}
E\,(\omega^{auc}) &= \int_v^w ((c+f)(1+\lambda)(m+u-a(c+f)(1+\lambda))-c\,(m+u \\
&\quad -a(c+f)(1+\lambda))-F)\,f\,(u)\,du \\
&= \int_v^w (-(f+(c+f)\lambda)(a(c+f)(1+\lambda)-m-u)-F)\,f\,(u)\,du \\
&= \int_v^w uf\,(u)\,du + (-(f+(c+f)\lambda)(a(c+f)(1+\lambda)-m)-F) \\
&= -\,(f+(c+f)\lambda)(a(c+f)(1+\lambda)-m)-F
\end{aligned} \tag{3.17}
$$

Differentiating with respect to $\lambda$, setting equal to zero, using $f = \frac{F}{q_e}$ and solving for $\lambda$ gives

$$\lambda^{auc*} = \frac{mq_e - 2aF - acq_e}{2aF + 2acq_e} = \lambda^{cert*} \tag{3.18}$$

Of course, since mark-ups and price are equal to the values in the case of certainty, expected profits under uncertainty are identical:

$$E\left(\omega^{auc*}\right) = \frac{a^2c^2 - 4aF - 2acm + m^2}{4a} = \omega^{cert*} \tag{3.19}$$

As we can see, the presence of an additive demand shock with a zero mean has no effect on the firm's behaviour under either costing system.

#### 3.2.1.3 Multiplicative Demand Uncertainty

Under multiplicative demand uncertainty, the demand function is given as

$$q^{muc}(p) = u\left(m - ap\right)$$

where we assume $E\left(u\right) = 1$. This is obtained by changing the limits of the distribution given in (3.11) to $v = 0$ and $w = 2$.

Again, we will consider the effects of this form of demand shock under both costing regimes.

##### Variable costing

Expected profits under variable costing and multiplicative uncertainty are

$$\begin{aligned} E\left(\pi^{muc}\right) &= \int_v^w (cu(1+\alpha)(m - ac(1+\alpha)) \\ &\quad - cu(m - ac(1+\alpha)) - F) f\left(u\right) du \\ &= \int_v^w \left(cu\alpha(m - ac(1+\alpha)) - F\right) f\left(u\right) du \\ &= c\alpha(m - ac(1+\alpha)) - F \end{aligned} \tag{3.20}$$

which is again identical to the profit function under certainty, $\pi^{cert}$. Thus, the optimal mark-up is again given as

$$\alpha^{muc*} = \frac{m - ac}{2ac} = \alpha^{cert*} \tag{3.21}$$

and expected profits are equal to the profits under certainty, $E(\pi^{muc*}) = \pi^{cert*}$.

#### Full costing

If the firm employs a full costing method and demand is subject to a multiplicative shock, expected profits are

$$\begin{aligned} E(\omega^{muc}) &= \int_v^w ((c+f)u(1+\lambda)(m - a(c+f)(1+\lambda)) - cu(m \\ &\quad - a(c+f)(1+\lambda)) - F) f(u)\, du \\ &= \int_v^w (-u(f + (c+f)\lambda)(-m + a(c+f)(1+\lambda)) - F) f(u)\, du \\ &= -(f + (c+f)\lambda)(-m + a(c+f)(1+\lambda)) - F \end{aligned} \tag{3.22}$$

Again, maximization gives

$$\lambda^{muc*} = \frac{mq_e - 2aF - acq_e}{2a(F + cq_e)} = \lambda^{cert*} \tag{3.23}$$

The full costing firm thus also faces the same expected profits as under certainty, $E(\omega^{muc*}) = \omega^{cert*}$.

#### 3.2.1.4 Summary of the Results of the Neoclassical Approach in Monopoly

As we can see, the optimal mark-ups do not change under additive or multiplicative demand uncertainty as long as the firm is risk neutral.[9] As a consequence, the firm suffers no disadvantages by using the - from a neoclassical

[9] Analysis of the case of a risk seeking/averse firm is omitted here for the sake of brevity, but there is no reason to suspect that the optimal solution could not be attainable for full-cost pricing under these circumstances.

standpoint - economically counter-intuitive full-cost approach, which includes sunk costs in the pricing decision. It anticipates the higher cost base in the mark-up calculation when maximizing the expected profit function and arrives at the optimal price just like under variable costing.

If profit mark-ups are assumed to be non-negative, the optimal price will not be attainable under full-cost pricing if it lies between variable and average unit costs. However, there are several empirical studies that suggest that prices exceed marginal cost and - under common assumptions regarding the cost structure - also average costs in almost all sectors (Baba (1997), Hall (1988), Martins et al. (1996)). Therefore, and because of the obvious possibility of negative profit mark-ups, we have reason to suspect that this limitation of the full-costing approach does not play a large role for the pricing behaviour of firms. It can thus be seen that the neoclassical model fails to explain the wide use of full-cost pricing. In the same vein, this example shows that full-cost pricing does not stand in contrast to neoclassical ideas, but can be easily incorporated into its general framework without leading to different implications or making marginalist methods in theoretical research on pricing obsolete. It is thus not very surprising that the recognition of the widespread use of full-cost pricing failed to induce a persistent dent in the popularity of neoclassical economics.

### 3.2.2 A Behavioural Approach to Pricing and Uncertainty

> The economics of uncertainty must abandon its preoccupation with optimal rules of behavior and concentrate instead on reasonable rules of thumb. (Hey, 1983, p. 139)

In the previous section, we assumed the firm to determine its profit mark-up in an optimal way, as presumed by standard economic theory. The firm is assumed to be able to correctly estimate its individual demand function and use the obtained information to calculate the most profitable mark-up.

However, empirical evidence on the information set used in price reviews suggests that this assumption is often violated in the real world. Fabiani et al. (2007) report of six national surveys within the Euro area that investigate the information basis firms use when setting their prices. If firms would price according to standard economic theory, we would expect them to use a wide array of information, especially expectations about future economic conditions.

However, the surveys find that as many as one third of firms only take historical data into account.[10] For those studies that included an answer "pricing by rule-of-thumb", such as fixed percentage adaptation or indexation based on a price index, roughly one third of firms were found to follow such a pricing strategy (Fabiani et al., 2007, p. 37). Although these results suggest that firms deviate in their behaviour from the neoclassical postulate, these and similar studies fail to give a clear picture of the decision processes firms actually go through when fixing their price, while most of them stress the importance of product costs in the pricing decision.

In this section, we seek to suggest and investigate one of many possible scenarios for the price setting process. We will, for this purpose, adopt an approach that is closer to the behavioural theory of the firm than to the neoclassical framework. Cyert and March (1963) define the behavioural theory of the firm as taking "an explicit emphasis on the actual process of organizational decision making" (Cyert and March, 1963, p. 19). We try to follow this notion, without losing too much generality that would otherwise make our findings only applicable to a special case.

For such a theory, it seems to be of central importance to recognize the differences between variable and full costing from the viewpoint of the decision-maker - even though, as shown above, neoclassical theory treats both approaches as equivalent. Quotes from managers, who were surveyed on their pricing practices by Fog (1960) hint at the reasons for the favourability of full costing over variable costing[11]:

> One of the chief reasons why allocation costing predominates is that it is felt that the price calculations rests on fairly safe ground whereas price setting on the basis of direct costing is too uncertain. [..] A business man will often be in doubt as to what is the best price. (Fog, 1960, p. 76-77)

He continues by stating that

> Direct costing makes greater demands on the person setting the price because it requires him to survey all aspects of the situation

[10] For an analysis of the implications of this historical pricing behaviour, see the next chapter.
[11] In his book, Fog refers to "direct costing", but uses the term "variable costing" interchangeably for the same costing approach.

> and to find the correct price, whereas allocation costing is built up in easy stages each of which does not appear to be alarmingly great. The business man usually feels safer to use allocation costing as the basis for price setting. (Fog, 1960, p. 77-78)

Of course, the suggested sense of a larger amount of useful information being available to the manager under full/allocation costing is misleading: the share of fixed costs that an individual product is to cover contains no information about demand conditions, and thus does not constitute a useful guideline for the determination of the profit-maximizing price. Yet these quotes provide inspiration for a different idea: given that decision-makers have limited information about their market environment and are unsure what profit mark-up to choose for a given product, the costing base might have an additional function of serving as an anchor that limits the effect of pricing errors.

To incorporate this idea, we suggest a model where firms do not know the demand functions (and make no direct attempts to estimate them), but rather decide on a profit mark-up by using a rule of thumb. This rule of thumb is not specified in detail; we assume that it has developed in an adaptive process that eventually led to a heuristic which is successful in providing satisfactory profits to the firm. This evolution of the price setting heuristic can - but does not necessarily have to - be consciously induced by the firm. The idea that heuristics may lead to near-optimal results is, for example, discussed in detail by Gigerenzer and Todd (1999). The methodologically related concept of near-rationality has been developed by Akerlof and Yellen (1985) and applied in a situation of wage and price setting by Akerlof et al. (2000).

Yet, although optimal in an average or long-run perspective, we assume that the rule of thumb used to determine the profit mark-up will not lead to a very exact estimate of the optimal profit mark-up in every case. It lies in the concept of a heuristic that it is fast and easily employed, but at the cost of (over)simplification. In order not to impose too specific a case on our model, we will assume that this heuristic leads, because of iterative refinements and/or market selection, to optimal decisions on average. This means that in terms of expected value, the rule of thumb is already sufficiently developed to lead the firm to the optimal profit mark-up. Nevertheless, due to its crudeness as a simplifying procedure, it is prone to an error that disturbs the mark-up from its

optimal value. The distortion of the mark-up is multiplicative in nature, which can be interpreted as a situation in which the errors the firm makes when determining the profit mark-up scale with the size of the profit mark-up. Thus, the multiplicative error leads to a distortion that is equal in relative terms but unequal in absolute terms under the two costing regimes.

This distortion away from the optimal profit mark-up offers several interpretations. For example, the error could arise as a consequence of limited rationality by the firm. Even with all necessary information available, the firm is unable to exactly identify (or internally agree on) the optimal profit mark-up. Indeed, it ends up with a crude estimate of the truly optimal mark-up. At the same time, the distortion allows for an interpretation of a fully rational firm that suffers from informational constraints and thus has to estimate the optimal profit mark-up on the basis of incomplete or perhaps biased data. Of course, these distortions are not equivalent to demand uncertainty in the sense covered by the neoclassical model, where uncertainty exists because demand fluctuates. In the behavioural approach, uncertainty exists due to computational and/or informational constraints by the firm that prevail even if the market is stable. Yet both ideas seem related and are thus covered here jointly. In order not to confuse the two concepts, I will refer to the error term applied to the mark-up as "distortion", in contrast to "(demand) uncertainty" in the neoclassical model.

If the firms are employing a rule of thumb in this setting then, as shown below, the choice of which cost base to employ for the cost-plus pricing method becomes relevant. In line with the rationales given by the managers quoted above, we show that in the behavioural model, full-cost pricing may indeed lead to a more robust profit performance than variable costing if the profit mark-up is distorted from its optimal value. A full-cost price thus may rest "on fairly safe ground".

Technically, we will model the use of a nearly-rational pricing heuristic by introducing an error term $z$ that is randomly determined and multiplied with the optimal profit mark-up.[12] It is important to note that the firm does not know

[12]The case of an additive distortion term was also analysed. It was found that in this case, variable costing is more robust than full-cost pricing in the sense explained below. This formulation of the model seems to run against intuition, as the same absolute value of the distortion is applied to both the variable and the full costing profit mark-ups. Yet, we would expect an error of comparable magnitude in both cases to scale with the profit mark-up. For example, if the variable costing mark-up is 30 per cent, and the full costing mark-up 10 per

the demand function, nor the optimal profit mark-up nor the realization of $z$. Attempts to estimate the structural form of either of these measures may be assumed to be too cognitively demanding or too costly to be worthwhile. The firm can thus only observe the realized value of the profit mark-up determined by the heuristic, as well as its prices, quantities, costs and profits.

The error term $z$, which is multiplied with the optimal mark-up to simulate the distortive nature of the employed heuristic, is, like the demand shock $u$ introduced above, characterized by a Beta distribution. The probability density function of $z$ is:

$$f(z;\beta) = \frac{(z-v)^{\beta-1}\,(w-z)^{\beta-1}\,(w-v)^{1-2\beta}}{\mathrm{B}\,(\beta,\beta)} \tag{3.24}$$

Since the distortion is applied multiplicatively to the profit mark-up, we will define the distribution in a way that $E\,(z) = 1$, so $v = 0$ and $w = 2$. The variance of $z$ is thus again given as $Var(z) = \frac{1}{1+2\beta}$. In the following, we will study the implications of the use of a nearly-rational heuristic separately for the two costing approaches.

#### 3.2.2.1 Variable Costing

The multiplicative error is applied in the following way under variable costing:

$$p_{vc}^{mdist} = (1 + z \cdot \alpha^{mdist})c$$

where $\alpha^{mdist}$ is the optimal mark-up given a distortive error term. Again, note that the firm does not know the structure of $z \cdot \alpha^{mdist}$ at each realization of the heuristic, but can only observe its value. After the use of the heuristic resulted in a mark-up $z \cdot \alpha^{mdist}$, the firm can thus not distinguish between the optimal mark-up and the error term. That the firm makes no attempt to disentangle these two components could be, for example, due to high information processing costs or a continuously changing market environment that makes such an effort too costly to be worthwhile.

cent, the multiplicative formulation of the distortion may lead to a positive distortion of 10 per cent in both cases, leading to mark-ups of 33 and 11 per cent. In the case of an additive mark-up, both mark-ups would rise by the same absolute value. This leads to a larger relative increase in the full costing case, which seems not to be justified.

In the following, we will take the position of a fully informed observer that can - in contrast to the decision-maker - analyse the underlying structure of the model. All considerations regarding the optimality of the pricing decision are not conscious to the firm, but are the economist's view on the structures that form the basis of the observable phenomena.

The optimal mark-up $\alpha^{mdist}$ must not necessarily be identical to the optimal mark-up under certainty, $\alpha^{cert*}$. We thus derive $\alpha^{mdist}$ as being the mark-up that maximizes expected profits in a situation of a distorted profit mark-up. Expected profits under variable costing, using a price $p_{vc}^{mdist}$, are

$$\begin{aligned} E(\pi^{mdist}) &= \int_v^w (cz\alpha(m - a(c + cz\alpha)) - F)\, f(z)dz \\ &= -\frac{F + 2F\beta + c\alpha(-m(1+2\beta) + ac(1 + 2\alpha + 2(1+\alpha)\beta))}{1+2\beta} \end{aligned} \tag{3.25}$$

Differentiation with respect to $\alpha$ yields the first order condition

$$\begin{aligned} \frac{\partial E(\pi^{mdist})}{\partial \alpha} &= -\frac{1}{1+2\beta}\Big(ac^2\alpha(2+2\beta) + c(-m(1+2\beta) \\ &\quad + ac(1 + 2\alpha + 2(1+\alpha)\beta))\Big) \end{aligned} \tag{3.26}$$

Note again that neither this maximization of expected profits, nor the structure of the profit and demand functions are known to the firm in this setting. Rather, the model analysed here is quite detached from the firm's considerations and describes the properties and consequences of the price-setting procedure if a well-proven rule of thumb is used to determine the profit mark-up.

Setting equal to zero and solving for $\alpha$ yields the optimal mark-up under distortion, $\alpha^{mdist*}$

$$\alpha^{mdist*} = \frac{(m - ac)(1+2\beta)}{4ac(1+\beta)} \tag{3.27}$$

This gives us price $p_{vc}^{mdist}$, which the firm will arrive at by using the heuristic and which is subject to the distortion $z$ at each use of the rule of thumb

$$p_{vc}^{mdist} = \left(1 + \frac{z(m - ac)(1+2\beta)}{4ac(1+\beta)}\right) c \tag{3.28}$$

Expected prices and quantities are given as

$$E\left(p_{vc}^{mdist}\right) = \frac{3ac + m + 2ac\beta + 2m\beta}{4a + 4a\beta} \tag{3.29}$$

$$E\left(q_{vc}^{mdist}\right) = \frac{(m - ac)(3 + 2\beta)}{4(1 + \beta)} \tag{3.30}$$

Inserting into $p_{vc}^{mdist}$ the expected profit function gives

$$\begin{aligned} E(\pi^{mdist}) = \frac{1}{8a(1+\beta)} \Big(a^2c^2(1+2\beta) + m^2(1+2\beta) \\ - 2a(4F(1+\beta) + cm(1+2\beta))\Big) \end{aligned} \tag{3.31}$$

#### 3.2.2.2 Full Costing

The result of a distortion in the profit mark-up under full costing can be derived in a similar way. The price is, in this case, given as

$$p_{fc}^{mdist} = \left(1 + z \cdot \lambda^{mdist}\right)(c + f)$$

In order to derive the optimal mark-up under the distortive heuristic, we write down expected profits in the full costing case:

$$\begin{aligned} E(\omega^{mdist}) = \frac{1}{q_e^2} \Bigg( a\left(F + cq_e\right) \left( \left(-cq_e - 2F\right)\lambda - \frac{2\left(F + cq_e\right)(1+\beta)\lambda^2}{1+2\beta} - F \right) \\ + q_e\left(cmq_e\lambda + F\left(m - q_e + m\lambda\right)\right) \Bigg) \end{aligned} \tag{3.32}$$

Differentiation with respect to $\lambda$ and setting equal to zero yields

$$\lambda^{mdist\,*} = -\frac{\left(2aF + acq_e - mq_e\right)(1 + 2\beta)}{4a\left(F + cq_e\right)(1 + \beta)} \tag{3.33}$$

The price set by the full-costing firm under a distorted profit mark-up is then

$$p_{fc}^{mdist} = \left(1 - \frac{\left(2aF + acq_e - mq_e\right)z(1 + 2\beta)}{4a\left(F + cq_e\right)(1 + \beta)}\right)\left(c + \frac{F}{q_e}\right) \tag{3.34}$$

In terms of expected values, prices and quantities under full costing are then given as

$$E\left(p_{fc}^{mdist}\right) = \frac{2aF + 3acq_e + mq_e + 2acq_e\beta + 2mq_e\beta}{4aq_e + 4aq_e\beta} \tag{3.35}$$

$$E\left(q_{fc}^{mdist}\right) = \frac{mq_e(3+2\beta) - a\left(2F + cq_e(3+2\beta)\right)}{4q_e(1+\beta)} \tag{3.36}$$

Expected profits under full costing, given that the profit mark-up heuristic leads to an average mark-up $\lambda^{mdist\,*}$, can be written as

$$\begin{aligned} E(\omega^{mdist}) = \frac{1}{8aq_e^2(1+\beta)} \Big( & m^2q_e^2(1+2\beta) + a^2(c^2q_e^2(1+2\beta) - 4F^2 \\ & - 4cFq_e) - 2aq_e\left(cmq_e(1+2\beta) + F\left(4q_e(1+\beta) - 2m\right)\right) \Big) \end{aligned} \tag{3.37}$$

#### 3.2.2.3 Comparison

Comparing the two prices $p_{vc}^{mdist}$ and $p_{fc}^{mdist}$, we can see that there is a distortion

$$z' = \frac{2(1+\beta)}{1+2\beta} \tag{3.38}$$

for which both prices are equal. At $z'$, the resulting mark-up (after the distortion caused by the heuristic is realized) corresponds to the optimal mark-up in the case of certainty, $z' \cdot \alpha^{mdist\,*} = \alpha^{cert\,*}$ and $z' \cdot \lambda^{mdist\,*} = \lambda^{cert\,*}$. If the realization of $z$ is higher or lower than $z'$, we can make the following statement:

$$p_{fc}^{mdist} \lessgtr p_{vc}^{mdist},\ z \gtrless \frac{2(1+\beta)}{1+2\beta}$$

Under mark-up distortion, a value of $z > z'$ leads to a smaller price under full costing than under variable costing. The opposite is true for a value of $z$ that is smaller than $z'$. Figure 3.2 depicts this relationship.[13] Thus, the full-cost price becomes less disturbed by the error when compared with the price under variable costing: if $z$ leads to a profit mark-up that is higher than optimal, the full costing price reacts to this deviation in a lesser extend than the price

[13] The numerical values used to generate the example depicted in the following figures are: $\gamma = 2$; $\beta = 2$; $m = 21$; $F = 10$; $c = 1$; $a = 4$; $q_e = 10$.

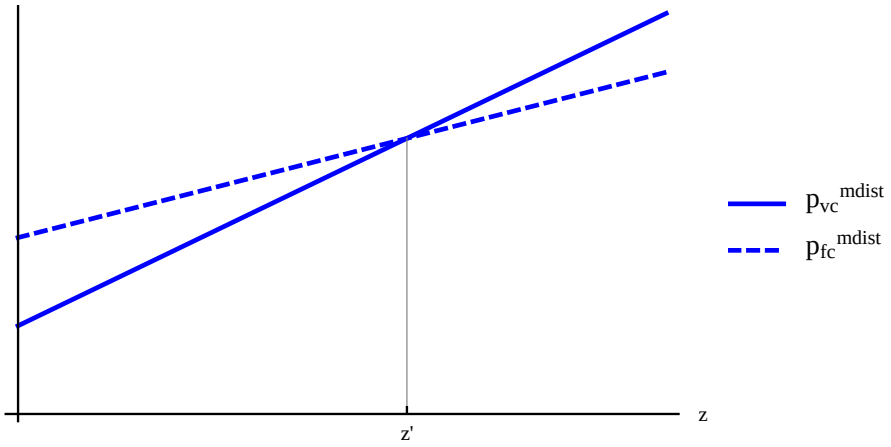



Figure 3.2: Prices and Distortions $z$

under variable costing. The reason is that the error term $z$ is multiplied by the comparatively large mark-up in the variable costing case and thus has a greater influence on the overall price than in the full costing case.

Optimal mark-ups are lower if profit mark-ups are distorted due to an inaccurate heuristic, so long as all mark-ups are positive:

$$\alpha^{mdist*} < \alpha^{cert*} \tag{3.39}$$

$$\lambda^{mdist*} < \lambda^{cert*} \tag{3.40}$$

Note also that under mark-up distortion, the expected prices under both costing regimes are smaller than the prices under certainty

$$E\left(p_{vc}^{mdist}\right) < p_{vc}^{cert*} \tag{3.41}$$

$$E\left(p_{fc}^{mdist}\right) < p_{fc}^{cert*} \tag{3.42}$$

if we assume profit mark-ups in all cases to be positive. Furthermore, we find that $E\left(p_{vc}^{mdist}\right) < E\left(p_{fc}^{mdist}\right)$.

Due to the amplified distortion in the variable costing case, profits are less robust to distortions than under full costing. Comparing expected profits, we see that

$$E(\omega^{mdist}) > E(\pi^{mdist}) \tag{3.43}$$

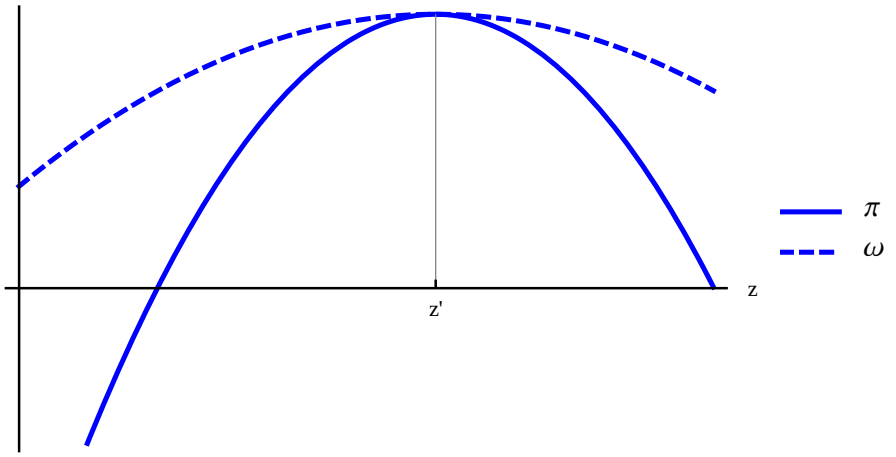



Figure 3.3: Profits and Distortions $z$

which is fulfilled if mark-ups are positive. Graphically, the increased robustness of full cost pricing becomes evident when profits are plotted against $z$, as shown in Figure 3.3 on page 139.

The difference in expected profits between the two costing regimes is

$$\Psi^{mdist} = E(\omega^{mdist}) - E(\pi^{mdist}) = \frac{F\left(mq_e - a\left(F + cq_e\right)\right)}{2q_e^2(1+\beta)} \tag{3.44}$$

This leads to $\Psi^{mdist} > 0$ and thus higher expected profits under full costing if

$$\begin{aligned} mq_e &> a\left(F + cq_e\right) \\ m &> a(f + c) \end{aligned}$$

This in turn states that as long as demand is positive under a price that is equal to full costs, the full cost strategy is favourable when the firm evaluates the costing regimes in terms of expected profits.

Figure 3.4 shows how expected profits under full costing are higher than expected profits under variable costing for all values of the shape parameter $\beta$, which characterizes the distribution of the distortion term $z$. As is also evident from expression (3.44), the difference in expected profits decreases if $\beta$ is increasing (which corresponds to a decreasing variance of $z$).

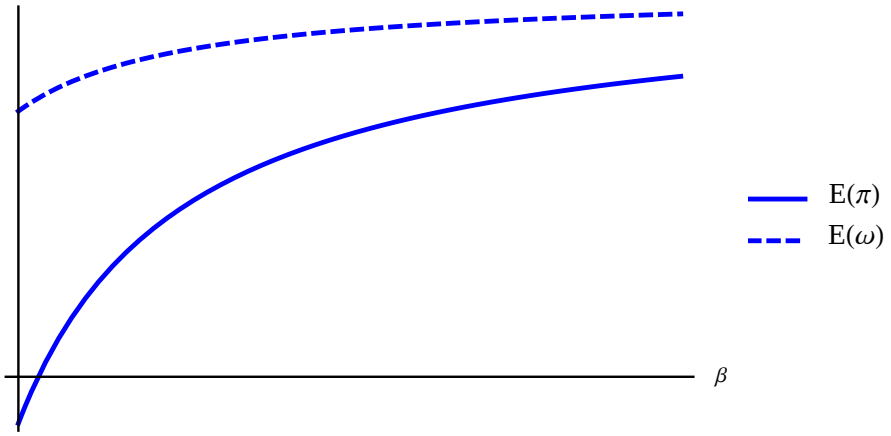



Figure 3.4: Expected Profits and $\beta$

## 3.3 Choice of Costing Systems under Uncertainty and Competition

In order to extend and generalize the analysis, we will now examine both the neoclassical and the behavioural model under a setting of imperfect competition. We now assume that there are $n$ firms in the market that produce differentiated goods. This notion of imperfect competition allows the firms to have some sovereignty over the prices they set. As we pursue a short run analysis, no tendencies for market entry exist. We further assume that $n-1$ firms have already decided which cost system to implement. Let $\eta \in ]0;1[$ denote the share of firms using a variable costing approach, so that $\eta n$ is the number of variable costing firms, while $(1-\eta)n$ gives the number of firms applying a full costing system. Let us further denote the price of a variable costing firm $j$ as $p_j^{vc}$, and the price of a full costing firm $k$ as $p_k^{fc}$. Apart from that, we will keep the notation of the monopoly case but denote variables under imperfect competition with a tilde.

For the demand function, we follow a formulation by Shubik and Levitan (1980), which leads to an individual demand function of firm $i$ given as

$$q_i = \frac{1}{n}\left(m-(1+\mu)p_i+\frac{\mu}{n}\left(\sum_{j=1}^{\eta n} p_j^{vc}+\sum_{k=1}^{(1-\eta)n} p_k^{fc}\right)\right) \quad j,k \neq i$$

$$
\begin{aligned}
&= \frac{1}{n}\left(m-(1+\mu)p_i+\frac{\mu}{n}\left(\eta n p_j^{vc}+(1-\eta)np_k^{fc}\right)\right)\\
&= \frac{1}{n}\left(m-(1+\mu)p_i+\mu\left(\eta(1+\alpha_j)c+(1-\eta)(1+\lambda_k)(f+c)\right)\right)
\end{aligned}
$$

Equality of prices within the groups of firms that apply the same costing systems allow the substitution of the sum over individual prices with the product of prices. The parameter $\mu \in [0,\infty)$ represents the degree of substitutability between the number of products $n$ that are produced by the firms. With this formulation, total demand is given as

$$
\begin{aligned}
Q &= \sum_{i=1}^{n} q_i = m-\frac{1}{n}\left(\sum_{j=1}^{\eta n} p_j^{vc}+\sum_{k=1}^{(1-\eta)n} p_k^{fc}\right)\\
&= m-\left(\eta p_j^{vc}+(1-\eta)p_k^{fc}\right)
\end{aligned}
$$

This choice of a demand function ensures that aggregated demand is independent of the degree of substitutability parameter $\mu$, and, in the case of symmetry, the number of firms $n$ in the market. Again, we will distinguish the cases of certain and uncertain demand in the neoclassical model and the behavioural model separately.

## 3.3.1 The Neoclassical Approach to Demand Uncertainty under Competition

### 3.3.1.1 Certainty

First, we consider the case of demand certainty in the case that the firm is a maximizer of expected profits. The firm now faces the choice of which costing system to implement, given the share of variable and full-costing firms in the market $\eta$ and the total number of firms $n$. We will now compare both costing systems and then derive results in market equilibrium.

If the firm decides to resort to variable costing, we can write the profit function of firm $i$ as

$$
\begin{aligned}
\tilde{\pi}_i^{cert} &= -\frac{1}{nq_e}\left(Fnq_e+cF\alpha(\eta-1)\left(1+\lambda_k\right)\mu+cq_e\alpha(c(1+\alpha\right. \qquad (3.45)\\
&+ \left.\left(\alpha-\alpha_j\eta+(\eta-1)\lambda_k)\mu\right)-m\right)\right)
\end{aligned}
$$

where $\alpha_j$ and $\lambda_k$ are the profit mark-ups applied by the other variable or full-costing firms, respectively. Differentiating with respect to firm $i$'s mark-up under variable costing, $\alpha_i$, and setting equal to zero gives the optimal mark-up as a function of the mark-ups of the other firms, $\alpha_j$ and $\lambda_k$:

$$\tilde{\alpha}_i^{cert\,*}(\alpha_j, \lambda_k) = \frac{mq_e - F(\eta-1)\left(1+\lambda_k\right)\mu + cq_e\left(\left(\alpha_j\eta + \lambda_k - \eta\lambda_k\right)\mu - 1\right)}{2cq_e(1+\mu)} \tag{3.46}$$

This reaction function is increasing in $\alpha_j$ and $\lambda_k$ for $0 < \eta < 1$ . Also note that the optimal profit mark-up is independent of the number of firms in the market, since an increase in $n$ only lowers the firm's share of total profits but has no influence on the marginal properties of the profit maximum.

Similarly, if firm $i$ would pursue a full costing strategy, its profits would be given as

$$\begin{aligned}\tilde{\omega}_i^{cert} \;=\; & \frac{-1}{nq_e^2}\Big(F^2(1+\lambda)\left(1+\lambda+(\eta+\lambda+(\eta-1)\lambda_k)\,\mu\right) \\ & + cq_e^2\lambda\left(c\left(1+\lambda+\left(\lambda-\alpha_j\eta+(\eta-1)\lambda_k\right)\mu\right)-m\right) \\ & + Fq_e\Big(nq_e - m(1+\lambda) + c\Big(1+3\lambda\ +2\lambda^2+\Big(-\alpha_j\eta(1+\lambda) \\ & +\ \lambda(1+\eta+2\lambda)+(\eta-1)(1+2\lambda)\lambda_k\Big)\,\mu\Big)\Big)\Big)\end{aligned} \tag{3.47}$$

Again, optimization with respect to $\lambda_i$ yields

$$\begin{aligned}\tilde{\lambda}_i^{cert\,*}(\alpha_j, \lambda_k) \;=\; & \frac{1}{2\left(F+cq_e\right)\left(1+\mu\right)}\left(-F\left(2+(1+\eta\right.\right. \\ & \left.\left.+\ (\eta-1)\lambda_k\right)\mu\right) + q_e\left(m + c\left(\left(\alpha_j\eta+\lambda_k-\eta\lambda_k\right)\mu-1\right)\right)\end{aligned} \tag{3.48}$$

This represents the reaction function of the full-costing firm $i$, which is also increasing in $\alpha_j$ and $\lambda_k$ for $\eta > 0$ and $\eta < 1$, respectively.

#### 3.3.1.2 Properties of Equilibrium

In a market equilibrium, we can follow from the symmetry assumption that all firms with the same costing system will charge the same price and thus choose

the same profit mark-up. As this also applies to firm $i$, the following conditions are satisfied in equilibrium:

$$\begin{aligned} \tilde{\alpha}_i^{cert} &= \alpha_j \\ \tilde{\lambda}_i^{cert} &= \lambda_k \end{aligned}$$

We can use this condition, together with (3.46) and (3.48), to derive the equilibrium profit mark-ups for both costing approaches:

$$\tilde{\alpha}^{cert\,*} = \frac{m-c}{c(2+\mu)} \tag{3.49}$$

$$\tilde{\lambda}^{cert\,*} = \frac{(m-c)q_e - F(2+\mu)}{(F+cq_e)\,(2+\mu)} \tag{3.50}$$

Intuitively, both optimal mark-ups decrease in $\mu$, $\frac{\partial \alpha^{cert\,*}}{\partial \mu} < 0$, $\frac{\partial \lambda^{cert\,*}}{\partial \mu} < 0$. If substitutability between the offered products decreases, the firms are subject to higher competitive pressure and have to lower their prices. Prices in equilibrium are equal for both variable and full costing firms and are given as

$$\tilde{p}_{vc}^{cert\,*} = \tilde{p}_{fc}^{cert\,*} = \frac{c+m+c\mu}{2+\mu} \tag{3.51}$$

Eventually, if $\mu$ becomes infinitely large, we have

$$\begin{aligned} \lim_{\mu\to\infty} \tilde{p}_{vc}^{cert\,*} &= c \\ \lim_{\mu\to\infty} \tilde{p}_{fc}^{cert\,*} &= (1-\frac{f}{c+f})(c+f) = c \end{aligned}$$

As the produced goods become more and more homogeneous, in other words as the situation approaches the state of perfect competition, prices approach marginal costs.

Firm $i$ is now in a position to compare profits under both costing regimes. Inserting $\tilde{\alpha}^{cert\,*}$ and $\tilde{\lambda}^{cert\,*}$ into firm $i$'s profit function under both costing scenarios and simplifying the results, we can see that profits are equal under variable and full costing:

$$\tilde{\pi}_i^{cert\,*} = \tilde{\omega}_i^{cert\,*} = \frac{c^2(1+\mu) - 2cm(1+\mu) + m^2(1+\mu) - Fn(2+\mu)^2}{n(2+\mu)^2} \tag{3.52}$$

Firm $i$ is thus indifferent on which costing system to implement in the case of certainty. Note that its choice also does not affect the other firms' profits, as the share of variable costing firms $\eta$ does not enter either profits nor equilibrium profit mark-ups.

#### 3.3.1.3 Additive Demand Uncertainty

In this section, we will analyse the implications of additive and multiplicative demand uncertainty under competition. Specifically, we would like to test whether optimal strategies under competition are altered if demand uncertainty in the neoclassical formulation is introduced. For additive uncertainty, we will again assume a distribution of the demand shock according to the Beta probability density function defined in (3.11) and the delimiters $v = -1$ and $w = 1$. The demand shock is then characterized by a symmetric distribution around $E(u) = 0$.

When subject to an additive shock, the individual demand function of firm $i$ becomes, with $j, k \neq i$:

$$\tilde{q}_i^{auc} = \frac{1}{n}\left(m + u - (1+\mu)p_i + \mu\left(\eta(1+\alpha_j)c + (1-\eta)(1+\lambda_k)(f+c)\right)\right)$$

#### Variable Costing

The variable costing firm has the following expected profit function

$$\begin{aligned} E(\tilde{\pi}_i^{auc}) &= \int_v^w \tilde{\pi}_i^{auc} f(u)du \qquad (3.53) \\ &= -\frac{1}{nq_e}\left(Fnq_e + cF\alpha(\eta-1)\left(1+\lambda_k\right)\mu\right. \\ &\quad \left. + cq_e\alpha\left(c\left(1+\alpha\left(\alpha-\alpha_j\eta+(\eta-1)\lambda_k\right)\mu\right)-m\right)\right) \end{aligned}$$

As we can see, this is equivalent to (3.45), the profit function of the variable costing firm under certainty. As a consequence, the reaction function is unchanged to the case of demand certainty, (3.46):

$$\tilde{\alpha}_i^{auc\,*}(\alpha_j, \lambda_k) = \frac{mq_e - F(\eta-1)\,(1+\lambda_k)\,\mu + cq_e\left(\left(\alpha_j\eta + \lambda_k - \eta\lambda_k\right)\mu - 1\right)}{2cq_e(1+\mu)} \tag{3.54}$$

### Full Costing

Profits of the full costing firm under additive demand uncertainty are, given the profit mark-ups $\alpha_j$ and $\lambda_j$ of the competing firms:

$$\begin{aligned} E(\tilde{\omega}_i^{auc}) &= \int_v^w \tilde{\omega}_i^{auc} f(u)du \qquad (3.55)\\ &= \frac{-1}{nq_e^2}\Big(F^2(1+\lambda)\,(1+\lambda+(\eta+\lambda+(\eta-1)\lambda_k)\,\mu)\\ &\quad + cq_e^2\lambda\left(c\left(1+\lambda+\left(\lambda-\alpha_j\eta+(\eta-1)\lambda_k\right)\mu\right)-m\right)\\ &\quad + Fq_e\Big(nq_e - m(1+\lambda) + c\Big(1+3\lambda\ +2\lambda^2+\Big(-\alpha_j\eta(1+\lambda)\\ &\quad +\ \lambda(1+\eta+2\lambda)+(\eta-1)(1+2\lambda)\lambda_k\Big)\mu\Big)\Big)\Big) \end{aligned}$$

This in turn is equivalent to (3.47) and leads to the identical reaction function as under certainty:

$$\begin{aligned} \tilde{\lambda}_i^{auc\,*}(\alpha_j, \lambda_k) &= \frac{1}{2\,(F+cq_e)\,(1+\mu)}\,(-F\,(2+(1+\eta+(\eta-1)\lambda_k)\,\mu)\\ &\quad + q_e\,\left(m + c\left(\left(\alpha_j\eta+\lambda_k-\eta\lambda_k\right)\mu-1\right)\right)) \qquad (3.56) \end{aligned}$$

### Equilibrium with Additive Demand Uncertainty

As both types of firms have the same reaction functions as under demand certainty, it is clear that equilibrium is characterized by the same results as described under section 3.3.1.2.

#### 3.3.1.4 Multiplicative Demand Uncertainty

Now consider the case of a multiplicative demand shock, similar to the situation previously analysed for the monopoly case. Again, the error term $u$ is assumed to be characterized by the Beta distribution function described in (3.11) and the density function is delimited by $v = 0$ and $w = 2$, so $E(u) = 1$. In the case of multiplicative demand uncertainty, individual firm demand of firm $i$ becomes, with $j, k \neq i$:

$$\tilde{q}_i^{muc} = \frac{1}{n}\left(m \cdot u - (1+\mu)p_i + \mu\left(v(1+\alpha_j)c + (1-v)(1+\lambda_k)(f+c)\right)\right)$$

#### Variable Costing

Expected profits in this case can be written as

$$\begin{aligned} E(\tilde{\pi}_i^{muc}) &= \int_v^w \tilde{\pi}_i^{muc} f(u)du \\ &= -\frac{1}{nq_e}\Big(Fnq_e + cF\alpha(\eta-1)\left(1+\lambda_k\right)\mu + cq_e\alpha\Big(c\Big(1+\alpha \\ &+ \left(\alpha - \alpha_j\eta + (\eta-1)\lambda_k\right)\mu\Big) - m\Big)\Big) \end{aligned} \tag{3.57}$$

Again, we can see that the expected profit function is the same as (3.45) and (3.53). Accordingly, the reaction function remains unchanged:

$$\begin{aligned} \tilde{\alpha}_i^{muc\,*}(\alpha_j, \lambda_k) &= \frac{1}{2cq_e(1+\mu)}\left(mq_e - F\left(\eta-1\right)\left(1+\lambda_k\right)\mu\right. \\ &\left. + cq_e\left(\left(\alpha_j\eta + \lambda_k - \eta\lambda_k\right)\mu - 1\right)\right) \end{aligned} \tag{3.58}$$

#### Full Costing

The full costing firm faces the following expected profit function:

$$\begin{aligned} E(\tilde{\omega}_i^{muc}) &= \int_v^w \tilde{\omega}_i^{muc} f(u)du \\ &= \frac{-1}{nq_e^2}\Big(F^2(1+\lambda)\left(1+\lambda+\left(\eta+\lambda+(\eta-1)\lambda_k\right)\mu\right) \\ &+ cq_e^2\lambda\left(c\left(1+\lambda+\left(\lambda-\alpha_j\eta+(\eta-1)\lambda_k\right)\mu\right) - m\right) \end{aligned} \tag{3.59}$$

$$+ Fq_e \Big( nq_e - m(1+\lambda) + c \Big( 1 + 3\lambda + 2\lambda^2 + \Big( - \alpha_j \eta (1+\lambda) + \lambda(1+\eta+2\lambda) + (\eta-1)(1+2\lambda)\lambda_k \Big) \mu \Big) \Big) \Big)$$

which again corresponds to (3.47) and (3.55). Hence the reaction function of the full-costing firm is given as

$$\begin{aligned} \tilde{\lambda}_i^{muc*}(\alpha_j, \lambda_k) &= \frac{1}{2(F+cq_e)(1+\mu)} \left( -F\left(2 + (1+\eta+(\eta-1)\lambda_k)\mu\right) \right. \\ &\quad \left. + q_e \left( m + c\left( \left( \alpha_j \eta + \lambda_k - \eta\lambda_k \right) \mu - 1 \right) \right) \right) \end{aligned} \tag{3.60}$$

#### Equilibrium with Multiplicative Demand Uncertainty

Again, the given reaction functions are the same under multiplicative and additive demand uncertainty and, for that matter, under demand certainty. Hence, the equilibrium under multiplicative demand uncertainty shows the very same characteristics as under 3.3.1.2.

#### 3.3.1.5 Summary of the Results of the Neoclassical Approach and Competition

It was shown that the results obtained under the neoclassical approach in the monopoly case also hold in the case of imperfect competition.

In both scenarios, the optimal pricing strategy of the risk neutral firm under certainty is unaltered if additive or multiplicative demand uncertainty is introduced. As a consequence, the choice of the costing system has no influence on expected profits. Thus, the neoclassical approach offers no explanation for the predominant use of full costing practices that is suggested by empirical evidence. At the same time, this equivalence made it possible for proponents of the neoclassical framework to argue that the prevalence of full-cost pricing should not be taken as evidence against the neoclassical theory of the firm.

### 3.3.2 The Behavioural Approach to Pricing and Uncertainty under Competition

Turning to the behavioural model, we will now analyse the effects of a distortion of the profit mark-up under both costing regimes in the case of imperfect

competition. Again, we will use $z$ to denote the distortion term, which is characterized by the probability density function given in (3.24). The distribution is delimited by $v = 0$ and $w = 2$, and the expected value of $z$ is given as $E(z) = 1$.

In the analysis of the monopoly case above, we assumed that the heuristic leads to the contextually optimal solution: given that the profit mark-up is subject to a distortion, the rule of thumb generates an optimal baseline value for $\alpha$ or $\lambda$, respectively, which maximize expected profits. As shown above, these optimal values of $\alpha$ and $\lambda$ are not equal to the optimal mark-up levels under certainty. Unfortunately, given the increased complexity in the model of imperfect competition, a model designed along these lines is not analytically evaluable. Therefore we will, as an approximation, use the optimal mark-up levels derived for the model of imperfect competition in the cases of certainty (and additive and multiplicative uncertainty, respectively). Numerical simulations suggest that this approximation does not alter the qualitative results established here.[14]

Under these assumptions, firm $i$'s profit mark-ups are, for the variable and full costing cases, respectively, given as

$$\begin{aligned} \tilde{\alpha}_i^{mdist} &= \tilde{\alpha}^{cert*} \cdot z_i = \frac{z_i\,(m-c)}{c(2+\mu)} \\ \tilde{\lambda}_i^{mdist} &= \tilde{\lambda}^{cert*} \cdot z_i = \frac{z_i\,(m-c-f(2+\mu))}{(c+f)(2+\mu)} \end{aligned}$$

where $E(z_i) = 1$. Note that every firm $i$ is subject to a distortion $z_i$, where all $z_i,\ i = 1, 2, .., n$ are iid.

#### 3.3.2.1 Variable Costing

Demand for firm $i$ is certain and given as

$$\tilde{q}_i^{mdist} = \frac{1}{n}\left(m - (1+\mu)p_i + \frac{\mu}{n}\left(\sum_{j=1}^{\eta n} p_j^{vc} + \sum_{k=1}^{(1-\eta)n} p_k^{fc}\right)\right) \quad j,k \neq i$$

[14] The analytical evaluation of the case of optimal mark-ups was attempted in Mathematica 7.0.0 but had to be aborted. Yet numerical simulations for different parameter values fulfilling our basic assumptions were run and analysed using Mathematica 7.0.0 and led to the same qualitative conclusions, which we will present in the following. The source code of the model is available from the author upon request.

$$= \frac{1}{n}\left(m-(1+\mu)(1+\alpha_i z_i)c+\frac{\mu}{n}\left(\sum_{j=1}^{\eta n}(1+\alpha_j z_j)c + \sum_{k=1}^{(1-\eta)n}(1+\lambda_k z_k)(c+f)\right)\right)$$

Again, firm $i$'s mark-up distortion $z_i$ is independent of the distortions $z_k$ and $z_j,\ j,k=1,...,n,\quad j,k\neq i, k\neq j$ and vice versa. Using the symmetry of firms, and the fact that we can write:

$$\begin{aligned}\sum_{j=1}^{\eta n}\int_v^w (1+\alpha_j z_j)cf(z_j)dz_j &= \eta n(1+\alpha_j)c\\ \sum_{k=1}^{(1-\eta)n}\int_v^w (1+\lambda_k z_k)(c+f)f(z_k)dz_k &= (1-\eta)n(1+\lambda_k)(c+f)\end{aligned}$$

we can state the expected profit function of the variable costing firm as

$$\begin{aligned}E(\tilde{\pi}_i^{mdist}) &= \int_v^w \tilde{\pi}_i^{mdist} f(z_i)dz_i\\ &= -\frac{1}{nq_e}\left(Fnq_e + cF\alpha(\eta-1)(1+\lambda_k)\mu + \frac{2c^2q_e\alpha^2(1+\beta)(1+\mu)}{1+2\beta}\right.\\ &\left. - cq_e\alpha\left(m+c\left(\left(\alpha_j\eta+\lambda_k-\eta\lambda_k\right)\mu-1\right)\right)\right) \qquad (3.61)\end{aligned}$$

Assuming that the heuristics applied by the firms will be approximately optimal on average, we can plug in:

$$\alpha_i=\alpha_j=\frac{m-c}{c(2+\mu)}$$

and

$$\lambda_k=\frac{m-c-f(2+\mu)}{(c+f)(2+\mu)}$$

to obtain expected profits of variable costing firm $i$ in equilibrium:

$$E(\tilde{\pi}_i^{mdist}) = \frac{2(c-m)^2\beta(1+\mu)-Fn(1+2\beta)(2+\mu)^2}{(n+2n\beta)(2+\mu)^2} \qquad (3.62)$$

#### 3.3.2.2 Full Costing

We now consider the case of a multiplicative distortion in the mark-up with firm $i$ as using a full costing system. The individual demand function of firm $i$ is then

$$\begin{aligned}\tilde{q}_i^{mdist} &= \frac{1}{n}\left(m-(1+\mu)(1+\lambda_i z_i)(c+f)+\frac{\mu}{n}\left(\sum_{j=1}^{\eta n}(1+\alpha_j z_j)c\right.\right.\\ &\left.\left.+\sum_{k=1}^{(1-\eta)n}(1+\lambda_k z_k)(c+f)\right)\right) \quad j,k\neq i\end{aligned}$$

With the same transformations as in the variable costing case above, we obtain the expected profit function of the full costing firm:

$$E(\tilde{\omega}_i^{mdist}) = \int_v^w \tilde{\omega}_i^{mdist} f(z_i)dz_i$$

Assuming the average optimality of the rules of thumb that are implied by the firm, we can use the optimal profit mark-ups $\alpha_j = \frac{m-c}{c(2+\mu)}$ and $\lambda_i = \lambda_k = \frac{m-c-f(2+\mu)}{(c+f)(2+\mu)}$ to obtain:

$$\begin{aligned}E(\tilde{\omega}_i^{mdist}) &= -\frac{1}{q_e^2(n+2n\beta)(2+\mu)^2}\left(-2(c-m)^2q_e^2\beta(1+\mu)\right.\\ &+F^2(1+\mu)(2+\mu)^2+Fq_e(2+\mu)(2c(1+\mu)\\ &\left.-2m(1+\mu)+nq_e(1+2\beta)(2+\mu))\right)\end{aligned} \tag{3.63}$$

#### 3.3.2.3 Comparison and Comparative Statics

Similarly to the case of mark-up distortion under monopoly discussed in above, we have found that[15]

$$\tilde{p}_{fc}^{mdist} \lessgtr \tilde{p}_{vc}^{mdist},\ z \gtrless 1$$

[15]Note that in contrast to the analysis above, we now have $z' = 1$, independently of the shape parameter $\beta$. The reason lies in the approximation we used with respect to the profit mark-ups under competition.

which means that the full-costing price shows less reaction to the distortion term $z$ than the variable costing price and is thus on average closer to the optimal price. Again, the reason is that the error is multiplied with a larger profit mark-up under the variable costing system, which amplifies its impact in comparison to the full-cost system, where the effect of the error term is smaller since it is multiplied with a smaller profit mark-up. In terms of expected profits, comparison of (3.62) and (3.63) makes apparent that

$$E(\tilde{\omega}_i^{mdist}) > E(\tilde{\pi}_i^{mdist})$$

as long as

$$m > c + \frac{f(2+\mu)}{2} \tag{3.64}$$

Again, as under monopoly, full-cost pricing is more profitable in terms of expected profits if (3.64) is fulfilled. This condition states that market size has to be sufficiently large in comparison to marginal and allocated fixed costs. We can see that the condition is less likely to be fulfilled the higher the degree of substitutability is between the produced goods.

The difference in expected profits between variable and full costing is given as

$$\begin{aligned} \tilde{\Psi}^{mdist} &= E\left(\tilde{\omega}_i^{mdist}\right) - E\left(\tilde{\pi}_i^{mdist}\right) \\ &= \frac{F(1+\mu)\left(-2(c-m)q_e - F(2+\mu)\right)}{nq_e^2(1+2\beta)(2+\mu)} \end{aligned} \tag{3.65}$$

which is greater than zero if (3.64) is true. We can see immediately that the absolute value of the profit difference increases with the variance of the error term, which corresponds to a decrease in the shape parameter $\beta$. If (3.64) is satisfied, full-cost pricing becomes more profitable compared to variable costing, the more volatile the distortion term $z$ becomes, or, in other words, the more inaccurate the rule of thumb that the firm uses to set its price.

We have thus reestablished our result which was already derived in the monopoly case for a market that is characterized by imperfect competition. If the profit mark-up is determined by the firm using a rule of thumb which is, by definition, fast but frugal and thus subject to inaccuracies, full-cost pricing is,

under quite general assumptions, the more robust alternative when compared to using a variable cost base.

## 3.4 Summary and Conclusion

The importance of the choice of costing and pricing systems is long recognized by cost accountants, but has not been on the research agenda of most economists that take interest in the theory of the firm. In our neoclassical interpretation of cost-plus pricing, we have derived an explanation for this phenomenon. It was shown that both under monopoly and imperfect competition, the neoclassical model fails to replicate a difference between variable and full costing and thus cannot explain the wide use of the latter, which is characterized by the economically counter-intuitive concept of including fixed costs into the pricing decision. It is thus not surprising that mainstream economics has shown little interest in the specifics of different methods of cost-plus pricing.

In order to contribute to the existing literature on full-cost pricing and pricing under uncertainty, we developed an alternative approach which is more aligned to the behavioural theory of the firm. The firm was assumed not to consciously maximize expected profits, but to use a well-proven heuristic for mark-up determination, which gives optimal results on average, but is subject to a distortion at each individual application. The heuristic is not specified in greater detail so as to allow for a greater degree of generality of our findings. We found that under this setting, the choice of costing systems becomes an important determinant of the profitability of the firm. Specifically, it was derived that the full-costing approach returns higher expected profits and is thus preferred by the firm. In an extension of the model, we showed that these findings also hold in a setting of imperfect competition.

These findings are relevant for several reasons. First, we contribute to the historical and methodological analysis of the marginalist controversy and the full-cost principle that took place between the late 1930s and the 1950s by illustrating the "emptiness" of the full-cost principle in the neoclassical formulation. Secondly, we offer an alternative reason for the favourability of a full costing approach in our behavioural model, by showing that the larger cost base may form a "safer ground" for pricing decisions in a situation of computational or informational limitations for the firm. The model thus offers

an explanation for the wide use of full-cost pricing heuristics and establishes the method as an optimal choice given the constraints that firms face. Findings of this kind contribute to a better understanding of the decisions involving the price-setting process by firms, which in turn is essential for macroeconomic analysis. Thirdly, we suggest an alternative for modelling firm behaviour within a consistent framework that is easy to handle, by introducing the concept of heuristics that are optimal on average but prone to a distortion at each use.

Several extensions and modifications of the discussed models come to mind. For example, we focused solely on cases of constant marginal costs and risk-neutrality. Judging by previous works on pricing and uncertainty, the relaxation of these assumptions should lead to interesting results within our framework, as Aiginger (1987) showed in his analysis that the optimal pricing decision depends on the risk attitude of the decision-maker. Furthermore, our analysis focused on a heuristic that returns a distorted profit mark-up but supplies the optimal value on average. Certainly, other characteristics are imaginable, such as a lagged adjustment in a dynamic market environment or a permanent bias in the estimation of the profit mark-up. Lastly, imperfect knowledge of the market environment is not the only uncertainty that the firm is exposed to - the introduction of cost or production uncertainty may also deliver interesting findings on cost-plus pricing behaviour. Chapter 2 of this work investigates some of the implications of imperfect costing systems in the context of the pricing decision.

After having established the result that using imperfect heuristics, full-cost pricing may be preferable, the idea of studying further implications of this type of pricing behaviour presents itself. In the next chapter, we will thus apply the model demonstrated here and show how this - compared to marginalistic analysis - more realistic approach can serve to explain other pricing phenomena that are of importance for micro and macroeconomic research. Taking the relationship between the dispersion of prices and the rate of inflation as an example subject-matter, it will be shown that such an approach can explain phenomena that are not resolved by existing theories in a satisfactory manner. This thus allows us to deepen our understanding of the nature and the implications of real-world pricing behaviour.

# 4 Price Dispersion, Inflation and Cost-Plus Pricing Heuristics

## 4.1 Introduction

The focus of the previous chapter was to show how full-cost pricing can result in a stable market phenomenon. In contrast to common economic intuition, it was demonstrated that if firms resort to frugal and inaccurate heuristics in the price setting process, their best strategy, both in monopoly and imperfect competition, can be to include allocated fixed costs in the cost-plus pricing calculation.

This chapter discusses further implications for market dynamics that this price setting behaviour is likely to exhibit. This analysis serves two purposes: First, having established a theoretical explanation for the prevalence of full-cost pricing, we can now examine additional economic characteristics of this most commonly used type of price setting behaviour. The second purpose is related to methodological aspects of microeconomic price theory. The approach pursued here deviates from mainstream price theory in several aspects, most importantly in the assumption that firms are using non-marginalist cost information, and may be subject to cognitive or informational constraints and are, at best, only "imperfect" or "indirect" profit maximizers. In comparison to neoclassical price theory, we thus restrict generality by partly abandoning the common instrumentalist as-if approach and drawing a sharper picture of the way firms may behave. The point that this contribution wishes to make is that such an endeavour, i.e. the loss of generality for the sake of more realistic assumptions, can allow economic research to deliver new insights into phenomena that are still incompletely explained by prevailing theoretical concepts.

Concretely, we will study the effect of inflation on the dispersion of prices, a link that is very important for our understanding of economic systems. Since a positive relationship is likely to have an influence of the welfare costs of inflation, the phenomenon is also linked to the question on whether money is neutral. Substantial research efforts, both theoretical and empirical, have already been expended on the subject. While the empirical literature agrees almost in unison on a positive relationship between the rate of inflation and the dispersion of prices, the most prominent theoretical explanations, namely menu cost theories and models of costly consumer search, find only mixed support in the data.

By taking into account known characteristics of the pricing methodology of firms, we can develop two explanations of the phenomenon of price dispersion. Both prevail even in the absence of price rigidities or costly consumer search, and they are not mutually exclusive. First, it will be shown that if we incorporate the fact that firms base their prices on historical costs of previously bought inputs, rather than marginalist costs arrived at by estimating market replacement values, price dispersion emerges as soon as marginal costs change and not all firms restock on inputs at the same time. Secondly, it will be shown that even if firms use marginalist cost measures, possible errors in the pricing process become amplified under full costing as inflation increases, and thus lead to a higher expected variation in the prices. In a model of imperfect competition, it is then shown that this variance leads to an increase in the dispersion of relative prices within the market.

The structure of the chapter is as follows. I will first survey the empirical literature, which is followed by a presentation of existing theories on the link between inflation and price dispersion, and a brief discussion of their support by empirical evidence. A simple monopoly model of cost-plus pricing under inflation is then developed, and the connection betweeen price dispersion and inflation that emerges under historical costing is explained. We then return to the model presented in the previous chapter, which incorporates assumptions derived from survey evidence on pricing behaviour and features the main dynamics that lead to a positive relationship between inflation and price dispersion, even if firms consider marginalist cost measures for the pricing decision. After discussing these findings, I extend the model to a setting of imperfect

competition and show that these results reoccur at a market level. A short summary of the findings concludes.

## 4.2 Previous Research on Inflation and Price Dispersion

Economic research on the link between inflation and price dispersion and variability has been extensive. In this section, both empirical and theoretical work will be surveyed.

### 4.2.1 Empirical Evidence

Empirical literature on the influence of the rate of inflation on individual prices has mostly focused on the relationship between the aggregate rate of inflation and the inflation of prices of different product groups. In these studies, the measure of interest is *intermarket price variability*. In some empirical investigations, depending on the data set used, the measure of interest is *intramarket price variability,* i.e. the variability of relative prices of a given product across different sellers. In contrast, studies that examine the phenomenon of *intramarket price dispersion* study the variations of the level of prices for the same goods offered by different sellers.[1]

Many empirical studies find a positive relationship between the rate of inflation and price variability, usually measured as the difference in the rates of change of individual prices or average prices of product groups. Research efforts towards this phenomenon are by no means confined to recent times - Mills (1927) is an early example. Elwertowski and Vining (1976), often cited as among the first in the modern era to investigate the phenomenon, use US data to run different forms of regressions, with a measure of cross sectional variability in sector-specific inflation rates on the left and the rate of inflation of aggregate prices on the right hand side. They find that cross-sector price variability, i.e. intermarket price variability, is positively related to inflation. Similar results were obtained by Parks (1978) and Fischer et al. (1981). A posi-

[1] This terminology follows the one used in Lach and Tsiddon (1992) and Fengler and Winter (2007). Evidently, the concept of *intermarket price dispersion* is meaningless in the sense that it compares apples with oranges and thus does not appear in the literature.

tive relationship between intramarket price variability and inflation was found by van Hoomissen (1988) with Israeli data from 1971-1984. Using price data of food stuffs in Israel during the high inflation period of 1978 to 1984, Lach and Tsiddon (1992) also obtain a positive relationship between intramarket price variability and the aggregate rate of price change. Their results were replicated by Konieczny and Skrzypacz (2005) for Poland using data recorded during the transition period between 1990 and 1996. In addition, both studies found expected inflation to have a much stronger influence on price variability than unexpected inflation. Grier and Perry (1996) disentangle the effects of higher trend inflation and higher inflation uncertainty on price variability and show, using a bivariate GARCH-M model of inflation, that inflation uncertainty, as measured by the conditional variance, dominates trend inflation as a predictor of relative price dispersion.

Some confusion exists in the empirical literature about terminology. Some authors, for example Elwertowski and Vining (1976), van Hoomissen (1988) and Grier and Perry (1996) refer to price dispersion, although they in fact examine price variability. This confusion is not only of linguistic nature. In fact, as Reinsdorf (1994, pp. 727 ) points out, variation in the rates of price change were often used as a proxy for a measure of price dispersion (the variation of intramarket prices around their mean) - the validity of which is highly questionable.

Although - as I will argue below - price dispersion may be more relevant than price variability, from a theoretical point of view, a comparatively small number of empirical studies investigate the relationship between the rate of inflation and intramarket price dispersion. One reason for this might be the high degree of disaggregation in price data that is needed to examine this relationship.

Tommasi (1993) studies the effects of inflation on price dispersion using weekly grocery prices from Argentina in 1990. He obtains a weak correlation between inflation and the coefficient of price variation as a measure for intra-product price dispersion. Price variability, both on the intra and inter good levels, is increasing with inflation. In addition, he finds that squared inflation has a negative influence on dispersion and variability which might hint at a tendency towards unification of prices at high inflation levels. Using US data from 1975-1992, Parsley (1996) studies both price dispersion and price variability. Higher inflation (measured either at the product level or at the city level)

is associated with greater cross-sectional dispersion of relative prices and of relative rates of inflation, both across cities and across products. In addition, using vector autoregressions, he finds that the effect of inflation on prices is not long run, i.e. the two time series are not cointegrated and thus he concludes that the welfare implications of inflation are relatively minor. Fengler and Winter (2007) use highly disaggregated data from a period of low inflation in Germany (1995), using data from the Consumer Panel by the *Gesellschaft für Konsumforschung*. They find a positive correlation between the rates of price change and price dispersion, both at the level of individual products and product groups. Yet they do not find evidence for a correlation between the rates of price change and intermarket price variability. Referring to previous research, they conclude that if inflation is small, only price dispersion is correlated with the rate of price change. As the rate of inflation rises, both price variability and and dispersion become affected. Another interesting result was obtained by Reinsdorf (1994), who uses U.S. Consumer Price Index data from 1980-1981, a period of disinflation (often referred to as the Volcker disinflation), and finds a negative correlation between inflation and price dispersion.

To summarize, a positive relationship between the rate of aggregate price change and price variability (both intra and intermarket) has been confirmed by many empirical studies. The positive effect of inflation on intramarket price dispersion has been studied less intensely, probably due to the lack of highly disaggregated price data, but is also mostly supported by the empirical evidence.

### 4.2.2 Theoretical Explanations

Both phenomena - the variability and the dispersion of relative prices - have been analysed with regard to welfare considerations. If a negative effect on welfare is accompanied by either price variability or price dispersion, and inflation increases these measures, then from this fact alone it follows that money is not neutral in the sense that the rate of inflation matters: a low inflation rate would then be favoured by a policy maker. Indeed, modern macroeconomic theory emphasizes this distorting effect of inflation on relative prices. For example, standard new Keynesian dynamic general equilibrium models with staggered price setting entail price stability as an outcome of optimal monetary policy

because inflation increases relative price dispersion (e.g. Woodford, 2003). As Friedman (1977) argued in his Nobel lecture, inflation can, through relative price dispersion, induce a misallocation of resources which reduces welfare. In his view, an important function of relative prices, and the price system as a whole, is to efficiently communicate information to economic actors in order to achieve an efficient allocation of resources. If inflation distorts the information contained in relative prices, this previously efficient allocation might become disturbed. This reasoning is challenged by Fischer (1986), who argues that price dispersion can in fact be welfare improving, as substitution towards goods whose prices are relatively low increases welfare. Yet, as has been proven by Tommasi (1994), if the assumption of perfect information is lifted and information becomes costly, it follows that welfare is decreasing if intramarket price dispersion increases.[2]

Explaining the existence of intramarket price dispersion as an equilibrium phenomenon per se has posed a puzzle to economists for a considerable amount of time (Rothschild, 1973). The most prominent explanations see price dispersion as a consequence of insufficiently informed consumers (Salop and Stiglitz, 1977; Varian, 1980). A similar mechanism is used to explain the link between price dispersion and inflation. There are also two other explanations, namely signal extraction and menu cost models. We will cover each of these three explanations in the following.

The first category of explanations for the inflation/price dispersion relationship stems from models of costly consumer search as just described (Benabou, 1988). Stigler and Kindahl (1970) argue that changes in the price level cause price information that consumers hold to become obsolete, which in turn prevents the search process from reducing price dispersion. Similarly, van Hoomissen (1988) argues that for repeatedly purchased products, this information obsolescence, induced by inflation, reduces the optimal stock of price information that consumers will hold, also leading to an increase in price dispersion.

[2] In his model, real price dispersion depreciates the information about future prices contained in current ones. This lowers the incentive of repeat-purchase customers to acquire price information. The fact that consumers are less well informed permits firms to increase their markups and allows inefficient producers to increase their sales, leading to a reallocation of production toward higher-cost firms.

A second strand of research that offers an explanation for the phenomenon stems from Barro's (1976) signal extraction model (based on work by Lucas, 1972). In this model, firms do not know whether a price change in their market is caused by a change in aggregate demand or a change in relative product demand. As a consequence, firms adjust output less and prices must move more to equate quantity demanded, from which follows an increase in price dispersion.

The third group of models that link inflation to price dispersion - which are most commonly referred to in this context - assume that there exist costs associated with price changes (also referred to as menu costs). Sheshinski and Weiss (1977) assume a fixed cost of price change and show that in this situation, firms will follow a one-sided (S,s) pricing rule if faced with inflation.[3] The nominal price of a firm is held constant until its real price hits the lower boundary s. Then, the nominal price is raised so that the new real price is set at the upper boundary S. If menu costs differ across firms, or if firm-specific shocks exist, this pricing policy can lead to staggered price changes which may imply positive price dispersion.[4] Yet this finding might not be very robust. As Bertola and Caballero (1990) point out, a two-sided menu cost model (where sellers may want to change prices downward and upward) may also lead to a negative relation between inflation and price dispersion.

Empirical support for these three lines of explanation is mixed. In general, many studies are unable to identify which mechanism establishes the link between the rate of inflation and price dispersion - especially if the data set used consists of aggregated price information. Some authors were able to find support for theories by differentiating between the influence of expected and unexpected inflation on price dispersion. For example, Grier and Perry (1996) argue that menu cost models fail to explain the relationship since unexpected inflation dominates expected inflation as a predictor of price dispersion. Thus, they argue that their results support signal extraction models, as they link price dispersion to unexpected inflation. Fengler and Winter (2007) argue that price dispersion is caused by frictions in the price setting behaviour, whereas price

[3] Another common variant of the menu cost model is that adjustment costs depend on the size of the price change, and usually are assumed to be convex (Rotemberg, 1982).

[4] Such price stickiness on an individual market level does not necessarily lead to rigidities in the aggregate level if timing of price change is endogenous, as shown by Caplin and Spulber (1987).

variability is related to costly search and information dynamics. Furthermore, related to the argument of Bertola and Caballero (1990), a particular difficulty in finding support for the menu cost hypothesis by using price variability as a measure has been pointed out by Danziger (1987): as price variability is measured through observations in time that are usually not synchronized with the price changes, a fixed cost of adjustment may lead to a positive, negative or zero correlation between (expected) inflation and the price dispersion proxy. Thus, evidence of this type usually does not permit judgment on the importance of menu cost explanations. In addition, findings of an extensive interview survey conducted by Blinder et al. (1998, p. 251) suggest that adjustment costs only play a role for a minority of firms.

In the light of this existing literature, it seems clear that the relationship between the rate of price change and the dispersion of relative prices is not yet fully understood. In this contribution, I thus try to add aspects to the theoretical discussion of the phenomenon that have not been previously brought forward. While substantial research efforts were spent on including costly search and information on the side of the consumer, such an approach is seldom applied to the supply side of the market. While I discuss the possible reasons for this neglect in the introductory chapter of this work, I want to stress that economists usually disregard important aspects of the pricing behaviour of firms and hold on to an as-if approach which imposes - rather than derives - pricing behaviour without a coherent justification grounded on observed behaviour. Exemplifying that a deviation from the prevailing "abstract" approach towards more realism in economic theorizing can lead to useful insights, I want to add an explanation for the link between inflation and price dispersion. From a methodological viewpoint, the aim is to demonstrate that with a model of pricing behaviour which is more restrictive in its (empirically justified) assumptions, new findings emerge that give the opportunity for empirical verification and thus allow progress to be made on understanding actual observed pricing behaviour. Further, the theory proposed here may be seen as complementary to existing explanations.

By using assumptions that are derived from empirical evidence about firm's pricing behaviour, such as cost-plus pricing and the use of heuristics or the use of historical cost measures, I find a positive relationship between inflation and the dispersion of relative prices even if prices are fully flexible, the firm can

correctly identify the rate of aggregate price change and consumers are fully informed and incur no search costs. In this sense, the mechanisms described here do not rule out previous explanations of the problem, but should rather be seen as a complementary contribution towards a deeper understanding of the phenomenon of price dispersion.

## 4.3 A Monopoly Model of Cost-Plus Pricing with Inflation

In order to establish a connection between price dispersion and cost-plus pricing, we first set up a simple monopoly model with inflation which will serve as a departure point to demonstrate the two mechanisms through which the cost-plus pricing behaviour of firms can lead to price dispersion.

### 4.3.1 Model Setup

We assume a price-setting monopolist that posts a price and will produce and supply any quantity demanded, and is thus not capacity constrained. We assume two periods, $t = 0$ and $t = 1$, between which costs (corresponding to prices of the firm's suppliers and wages of its workers) increase due to inflation.[5]

The firm faces a linear demand function in period $t$ which is given as

$$q_t(p_t) = m - a_t p_t, \quad m, a_t > 0$$

We assume that the firm does not know this demand function and makes no attempts to estimate it (efforts to do so might prove too costly to be worthwhile). Denoting marginal costs as $c_t$ (invariant in output), we assume that $m > a_t c_t$ so that positive profits are attainable. The cost function is fully known to the firm and is given as

[5] This formulation also allows us to incorporate the scenario of several periods of inflation before the price is readjusted, to reflect the empirical phenomenon of price stickiness. The inflation rate $i$ is then simply the overall growth rate between the initial period $t = 0$ and the end period $t = 1$.

$$C_t(q_t) = c_t q_t + F, \quad c_t, F > 0$$

To include the notion of an increase in the general price level, we assume that $c_t$ is subject to inflation. With $t = 0$ being the starting period, and $t = 1$ the period after the inflationary adjustment took place, $c_1$ is then defined as

$$c_1 = (1 + i)\, c_0$$

where $i$ is the rate of inflation per period. Also assume that $c_0 \geq 1$, $i > 0$. We will run an analysis by comparative statics, i.e. we examine and compare the change in prices, quantities etc. between $t = 0$ and $t = 1$ for different levels of inflation. As we generally pursue a short-run analysis, we assume that fixed costs $F$ occur in both periods and remain constant. $F$ could thus, for example, represent depreciation on capital equipment.

At the same time, the monetary expansion is reflected by a decrease in the value of money. To incorporate this, assume that

$$a_1 = \frac{1}{(1+i)} a_0$$

This formulation ensures that the general increase in the price level does not initially lead to real quantity effects.

In the following, we will analyse the pricing behaviour of a firm, and the properties of the variance of the selling price, in response to an exogenous inflation rate $i$. At first, this might seem paradoxical: we study the behaviour of inflation (in terms of the monopolists price) with inflation as an exogenous variable. Yet we try to isolate the effects that different levels of inflation have on the expected price volatility of a sample firm. Our assumptions assure that no conflicting results emerge; the rate of the price increase derived for the individual firm is, on average, the same as the exogenous inflation rate $i$.[6]

[6] This condition, which can be expressed as $\frac{p_1 - p_0}{p_0} = i$, only holds in the behavioural model (which is introduced later) if the error term is symmetrically distributed around 1, i.e. $\gamma = \beta$. If the condition is not fulfilled, the model would require substantially more complexity which would go beyond the scope of this chapter. Specifically, a feedback mechanism between the inflation rate perceived by the firm and the price increase realized as a consequence (and vice versa) could account for this aspect.

We will analyse two different modes of pricing, i.e. variable and full costing, where the difference lies in the costing base onto which the profit mark-up is added by the firm. Specifically, we define the price set by the variable costing firm as

$$p_1^{vc} = (1 + \alpha_1)(1 + i)\, c_0$$

where $\alpha_1$ denotes the profit mark-up under variable costing in period $t = 1$. In contrast, the price under full costing is arrived at by

$$\begin{aligned} p_1^{fc} &= (1 + \lambda_1)(c_1 + f) \\ &= (1 + \lambda_1)(f + c_0(1 + i)) \end{aligned}$$

with $\lambda_1$ as the profit mark-up under full costing in period $t = 1$. The allocated fixed cost $f$ is defined as $f = \frac{F}{q_e}$, where $q_e > 0$ is the quantity the firm expects to sell in the given time period, which the firm is assumed to be able to correctly predict.[7] Throughout, we will denote profits of the variable costing firm in period $t$ as $\pi_t$, and profits of the full-costing firm as $\omega_t$. All parameters are assumed to be real numbers. We will focus on period $t = 1$, after inflation is realized.[8]

### 4.3.2 Optimal Pricing

Consider first the optimal levels of profit mark-ups that the firm should choose if it were able to correctly identify the demand function. Note that we take the position of an external, fully informed observer - as the firm does not know the demand function, it also can not derive its optimal pricing strategy from its profit function. The reason we analyse the case of complete information and

[7] Throughout the analysis, we assume $q_e$ to be exogenously given. Its function is restricted to act as a planning device for the firm; if the firm fails to set the correct expected quantity, and thus miscalculates the overhead share of each sold product, it must and will adjust the profit mark-up accordingly so that it ends up with the optimal price. This is important to realize as we usually should make an assumption on how $q_e$ reacts in $t = 1$ if $i$ is positive. The point is that we can assume that $q_e$ is constant in $t = 0$ and $t = 1$, and the firm controls for this mismatch in expected quantity, and quantity actually sold, by modifying the profit mark-up. As we can see, this is done automatically since the level of $q_e$ influences the optimal profit mark-up $\lambda^{cert\,*}$.

[8] The model was analysed with Mathematica 7.0.0. The source code is available upon request from the author. Most numbered expressions are labeled accordingly in the Mathematica source code for the readers convenience.

optimal pricing is that it allows us to derive the levels of the optimal profit mark-ups that we can later use as a basis on which to set up the heuristic used by the firm.

Under a variable costing regime, profits under certainty in $t = 1$ are[9]

$$\begin{aligned} \pi^{cert} &= p^{vc} q\left(p^{vc}\right) - cq\left(p^{vc}\right) - F \\ &= -c_0(1+i)\alpha\left(a_0 c_0(1+\alpha) - m\right) - F \end{aligned} \tag{4.1}$$

Differentiating with respect to $\alpha$ and setting equal to zero yields

$$\alpha^{cert\,*} = \frac{m - a_0 c_0}{2 a_0 c_0} \tag{4.2}$$

Note that the optimal profit mark-up is independent of the inflation rate $i$. The reason for this is that the demand curve shifts with the same magnitude as the marginal cost curve, leaving the ratio between the optimal price and the variable costing base unchanged. The second order condition is also satisfied. Optimal prices and quantities are the same under variable and full costing and are then given as

$$p^{cert\,*} = \frac{(1+i)\left(a_0 c_0 + m\right)}{2 a_0} \tag{4.3}$$

$$q^{cert\,*} = \frac{m - a_0 c_0}{2} \tag{4.4}$$

Note that, as the inflationary shock initially has no real effects, $q^{cert\,*}$ is independent of $i$ and thus remains constant.

Maximum profits in period $t = 1$ are

$$\pi^{cert\,*} = \frac{\left(a_0^2 c_0^2 + m^2\right)(1+i) - 2a_0\left(2F + c_0(1+i)m\right)}{4 a_0} \tag{4.5}$$

Profits increase with $i$ since they are are a nominal measure that increases with the price level.

[9] As we will only analyse the period $t = 1$ in detail, we will omit the corresponding index from now on. Variables that are denoted with a subscript of 0 are values from $t = 0$, all others refer to $t = 1$.

Now consider the case of optimal full costing. Profits are given as

$$\begin{aligned}\omega^{cert} &= p^{fc}q\left(p^{fc}\right) - cq\left(p^{fc}\right) - F \qquad (4.6)\\ &= -\frac{\left(f + (c_0(1+i)+f)\,\lambda\right)\left(a_0\left(c_0(1+i)+f\right)(1+\lambda) - (1+i)m\right)}{1+i} - F\end{aligned}$$

Differentiation with respect to $\lambda$, substituting $f = \frac{F}{q_e}$ and setting equal to zero gives the optimal mark-up

$$\lambda^{cert\,*} = \frac{(1+i)\,(m - a_0c_0)\,q_e - 2a_0F}{2a_0\,(F + c_0(1+i)q_e)} \qquad (4.7)$$

Note that the mark-up under full costing is not independent of the rate of inflation, $i$. In fact, we can see that

$$\frac{\partial\lambda^{cert\,*}}{\partial i} = \frac{F\,(a_0c_0 + m)\,q_e}{2a_0\,(F + c_0(1+i)q_e)^2} > 0 \qquad (4.8)$$

That this expression is positive is warranted by the general assumptions taken above. The higher the rate of inflation, the higher the optimal mark-up on full costs. As quantities increase in the short run with inflation, the fraction of the fixed cost component $f$ becomes smaller in the cost base, which makes an upward adjustment of the profit mark-up necessary in order to attain $p_t^{cert\,*}$.[10]

Inserting $\lambda^{cert\,*}$ into $\omega^{cert}$ gives maximum profits under full costing, which are equal to optimal profits under variable costing:

$$\omega^{cert\,*} = \frac{\left(a_0^2c_0^2 + m^2\right)(1+i) - 2a_0\,(2F + c_0(1+i)m)}{4a_0} = \pi^{cert\,*} \qquad (4.9)$$

As we can see, profits are the same under both costing regimes: the smaller costing base under variable costing is multiplied with a larger mark-up $\alpha^{cert\,*}$, while $\lambda^{cert\,*}$ is generally smaller than $\alpha^{cert\,*}$ to adjust for the larger cost base. This way, both pricing regimes lead to the optimal price $p^{cert\,*}$. In this very simple standard model, we cannot study the relationship between the level of inflation and price dispersion even if we assume more than one firm to be

[10] As explained in greater detail below, this effect disappears if fixed costs increase with inflation $F_1 = (1+i)F_0$. The consequence is that in this case, $\lambda$ is independent of the rate of inflation $i$. Yet an adjustment of fixed costs in the short run contradicts the definition of fixed costs.

active in the market: any inflation rate $i$ leads to a new price that is optimal since no uncertainties exist. This model does not suggest that there should be any real difference in the pricing behaviour of the firm for a high rate of inflation compared to a low rate.

### 4.3.3 Price Dispersion under Mark-Up Pricing on Historical Costs

Before we continue to study the monopoly case, let us return to the most prominent of the previously mentioned explanations for price dispersion, namely staggered pricing. Price dispersion can quite easily emerge if firms calculate their prices adding a mark-up on cost measures that they obtain from their accounting systems.

Let us, for a moment, consider a different scenario than the monopoly case described above. Suppose $n$ firms produce an identical good with identical technologies and have some sovereignty over their selling price. Assume further that firms have different stocks of inputs - for example due to heterogeneity of procurement contracts or differences in the size of storing capacities. If stocks are depleted, firms buy inputs in bulk and fill their inventories. If a firm restocks its inputs at time $t$, it faces the marginal costs $c_t = c_0(1+i)^t$ for the necessary inputs to produce one unit.[11]

Let us examine a total time span of $T$ periods. At each $t$, $\quad t = 1, 2, .., T$, a share $\frac{1}{T}$ of firms in the market face a depleted inventory and have to restock on inputs at the current input price. For the sake of simplicity, let the firm use a variable cost-plus method to calculate its selling price. Given it has acquired inputs in period $t$, the firms price will be

$$p_t \quad = \quad (1+\alpha)c_0(1+i)^t$$

Note that the profit mark-up $\alpha$ is, as shown above, independent of $i$ and $t$ - it is always a constant percentage share of the underlying cost base. We now analyse what happens in a market if the firms use this cost measure - the price they actually paid for their inputs - for determining their price. In this setting,

[11] Instead of a stock for inputs, this setting would also be compatible with the scenario that the firm produces a stock of products at one point in time at cost $c_t$ per product and then sells off its inventory until it has to produce again.

the firm bases its price on historical costs. The marginalist framework would deem this practice to be flawed: The costs that should determine the selling price should be measured at their "market opportunity cost" (Dorward, 1987, p. 21). In the case of input costs rising each period, the relevant costs, in an marginalistic sense, should be the present or future replacement costs (Drury, 2008, p. 207). Yet, this is typically not the way accounting systems derive costs, as already pointed out by Coase (1973). For example, Drury et al. (1993) found that 90 per cent of British firms surveyed derived decision-relevant costs by using historical figures. Similarly, Alvarez (2007) concluded from a meta-study of firm surveys on price setting behaviour that the majority of firms do not consider future economic outlooks when determining a price. In this light, the assumption of historical costing seems to be more realistic than the marginalist alternative.

In the pricing formulation denoted above, a firm that obtained inputs and set its price in period $t$ will not change this price in consecutive periods if demand stays constant. Consider first the case where $i = 0$ and $c_t$ is constant over all $t$. All firms will then incur the same input costs and thus offer their goods at the same price. Yet, if $i > 0$ (or $i < 0$), price dispersion occurs: firms that restock their inventories earlier will set lower (higher) prices than firms that do so at a later point in time.[12]

[12] An argument could be made that if firms anticipate rising costs, they would try to expand their inventories and buy their inputs as early as possible. Yet input costs might also decrease over time, which would reverse these incentives. It seems to be a reasonable assumption that firms are not perfectly able to predict the price developments of their inputs (if they did they would probably engage in the trading of these goods) and that they have heterogeneous expectations towards price movements and might thus, all other things equal, choose different inventory capacities.

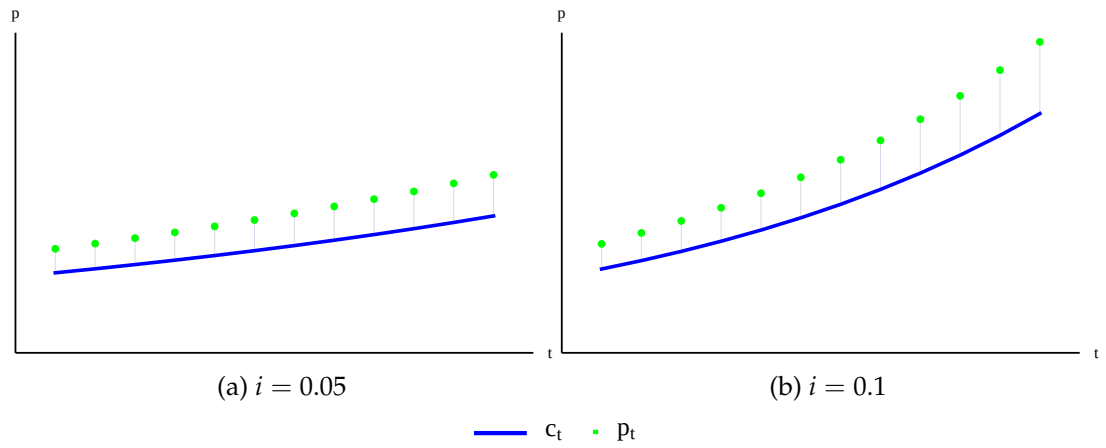



Figure 4.1: Staggered Cost-Based Prices

To illustrate, the case of a positive trend in marginal costs over $T = 12$ periods is depicted in Figures 4.1a and 4.1b, using growth rates of 5 and 10 per cent, respectively.[13] The full line shows costs $c_t$, while the green dots represent the level of the price set by firms in each time period $t$. The connecting line between the price dots and the cost line thus illustrate the absolute value of the profit mark-up, $\alpha c_t$. It is easy to see the effect of inflation on absolute price dispersion: with higher inflation, the absolute differences between the set prices increase. Such an absolute increase in variance seems intuitive: if prices increase, say from 1 to 10, we would also expect the average dispersion of prices, which may have been 0.1 before, to increase to 1.

Studying the economic phenomenon of price dispersion, we are not interested in this absolute increase, but in the relative dispersion of prices independent of the price level. Whether such a relative measure of price dispersion is increasing in our example cannot be as easily be inferred from comparing Figures 4.1a and 4.1b.

[13] For this example, we also assume $c_0 = 1$ and $\alpha = 0.3$.

To measure relative price dispersion in our setting, let us return to the analytical case. For the whole of $T$ periods, the average price in the market is given as

$$\begin{aligned} \overline{p} &= \frac{1}{T}\sum_{t=1}^{T} p_t \\ &= \frac{c_0(1+i)\left((1+i)^T-1\right)(1+\alpha)}{iT} \end{aligned} \tag{4.10}$$

The absolute price variance for $T$ periods can be calculated as

$$\begin{aligned} Var(p_t) &= \frac{1}{T}\sum_{t=1}^{T}\left(p_t^2\right) - \left(\frac{1}{T}\sum_{t=1}^{T} p_t\right)^2 \\ &= \frac{c_0^2(1+i)^2\left(\frac{i\left((1+i)^{2T}-1\right)T}{2+i} - \left((1+i)^T-1\right)^2\right)(1+\alpha)^2}{i^2T^2} \end{aligned} \tag{4.11}$$

To remove the absolute effects of this measure of price dispersion, we can define $K(p_t)$, which is a modified version of the coefficient of variation, as

$$\begin{aligned} K(p_t) &= \frac{Var(p_t)}{\overline{p}} \\ &= \frac{c_0(1+i)\left(2+i+(1+i)^T(i(T-1))+iT-2\right)(1+\alpha)}{i(2+i)T} \end{aligned} \tag{4.12}$$

To study how changes in costs influence relative price dispersion, we can differentiate (4.12) with respect to $i$:

$$\begin{aligned} \frac{\partial K(p_t)}{\partial i} &= \frac{1}{i^2(2+i)^2T}\Big(c_0\Big(i^2T+(1+i)^T(4+i(T-1) \\ &\quad \cdot (i(1+i)T-4))-4-4i-i^2\Big)(1+\alpha)\Big) \end{aligned} \tag{4.13}$$

As can be seen in Figure 4.2, which depicts the absolute and relative price variances for different values of $i$ in our example above, these measures display some interesting properties. Focusing on cost increases ($i > 0$), as we will do for the greater part of this chapter, we can see that both price dispersion measures rise with costs.

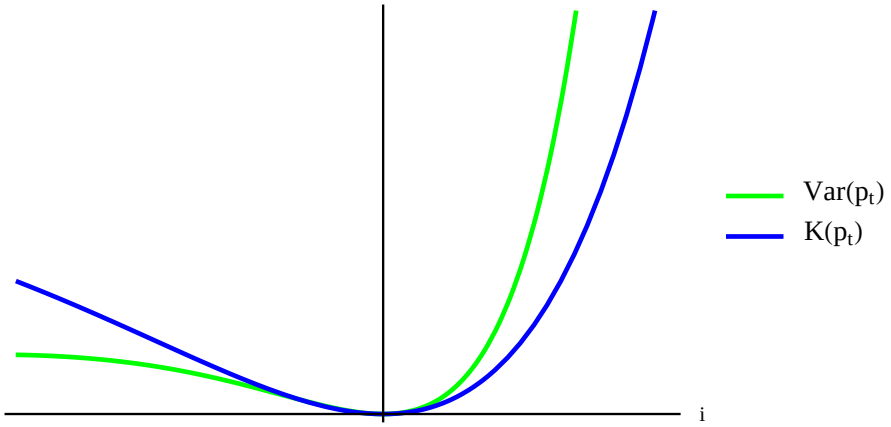



Figure 4.2: Absolute and Relative Price Variances and Rates of Inflation

The link between price dispersion and inflation is, in this simple model, a direct consequence of the use of historical costs, which are, as empirical evidence suggests, widely utilized by firms for pricing decisions. As shown in this example, the way that firms conceive and use costs can have real economic consequences.

The explanation for the interplay between inflation and price dispersion through historical costs does not, similar to the second hypothesis developed below, depend on rigidities generated by menu costs or sticky contracts/information. These particular effects can generate staggered price-setting and are usually incorporated in macroeconomic models by pricing mechanisms such as the one described by Calvo (1983). Although the empirical evidence of price rigidities is indisputable, it is not clear if this phenomenon causes price dispersion to increase with inflation. In fact, Baharad and Eden (2004), who examined Israeli price micro data from 1990-1991, find no evidence that price rigidity as measured by the frequency of nominal price changes is related to price dispersion. No matter what role price stickiness plays in the correlation between price dispersion and inflation, the two explanations for the phenomenon explained here emerge more or less directly from what we know of actual firm pricing behaviour. The mechanisms that lead to an increase of price dispersion in the case of a monetary expansion developed here do not contradict the previous explanations described above. They may as well exist

in a complementary way without compromising any of the hypotheses so far brought forward regarding the phenomenon.

In the following section, we will focus on a second possible explanation for a correlation between price dispersion and inflation by lifting the assumption of non-marginalist cost definitions. We will study, based on the model developed in the previous chapter, how price dispersion can emerge if firms use cost-plus pricing heuristics.

### 4.3.4 Pricing Using a Nearly-Optimal Cost-Plus Heuristic

Analogous to the analysis in Chapter 3, the monopolist introduced above is now assumed not to be able to observe the demand function. Instead, it arrives at its profit mark-up by using a heuristic which we will not impose any details upon.

Specifically, we assume that

1. Firms calculate their prices by multiplying a profit mark-up with a cost base. In line with empirical evidence, we distinguish between the two most common forms of cost bases used, variable costs and full costs.

2. Not knowing the demand function, and being unable or, facing costs of information, unwilling to estimate it, firms have to rely on heuristics to determine the profit mark-up.

3. These heuristics might be reasonably sophisticated and may lead to optimal results on average, but generally lead to mark-ups that are distorted away from their individually optimal levels.

The first assumption builds on survey evidence that found most firms to use full costing systems in combination with mark-up procedures to calculate their selling price (Govindarajan and Anthony, 1983; Shim and Sudit, 1995; Fabiani et al., 2007). The second assumption is related to ideas developed within the framework of the behavioural theory of the firm (Cyert and March, 1963). The idea of a cognitive error in the price setting process described in point three bears methodological resemblance to the concept of near-optimality brought forward in Akerlof and Yellen (1985) and developed further in Akerlof et al. (2000).

For the purpose of explaining the underlying mechanics that drive our results, we will first discuss the model for the monopoly case - although, of course, the concept of intramarket price dispersion is meaningless in the case of a single seller - and afterwards extend our findings to a market characterised by imperfect competition.

We assume that due to experimentation and adaptation, an evolutionary selection of best routines or even a conscious attempt to derive the optimal mark-up according to economic principles - or any combination of these - this heuristic is reasonably sophisticated as the profit mark-up it leads to fluctuates around the optimal mark-up value under certainty. Yet it is not perfect; each time the heuristic is used, the calculated profit mark-up usually deviates from its optimal value. As before, we model this as a multiplicative error term that is applied to the optimal mark-up $\alpha_t^{cert*}$ or $\lambda_t^{cert*}$, respectively. Following the previous notation, we denote the error term as $z$. We assume that $z$ is characterized by a Beta distribution within the domain delimited by the minimum $v$ and the maximum $w$. For reasons of simplicity, we assume the distribution of $z$ to be symmetric around its mean. The according probability density function of $z$ is then given as[14]

$$f(z;\beta) = \frac{(z-v)^{\beta-1}(w-z)^{\beta-1}(w-v)^{1-2\beta}}{\mathrm{B}(\beta,\beta)} \tag{4.15}$$

where $\beta > 0$ is a shape parameter, and $\mathrm{B}(\cdot)$ is the Euler Beta function.

Figure 4.3 demonstrates that this formulation of the distribution of $z$ lets us include a wide variety of possible characteristics of the inaccuracy of the pricing heuristic.

We will delimit the distribution by setting $v = 0$ and $w = 2$. This way, as seen below, we assume that the distortion caused by the error term can reach a

[14]The general form of the Beta probability density function is given as

$$f(z;\gamma,\beta,v,w) = \frac{1}{\mathrm{B}(\gamma,\beta)} \frac{(z-v)^{\gamma-1}(w-z)^{\beta-1}}{(w-v)^{\gamma+\beta-1}} \tag{4.14}$$

where $\gamma$ and $\beta$ are the shape parameters of the distribution. The symmetric version is obtained by assuming $\gamma = \beta$. Symmetry ensures that the median and the expected value fall together, which would, if not fulfilled, create some technical problems and make an interpretation of the nature of the distortion that emerges from the use of the heuristic difficult.

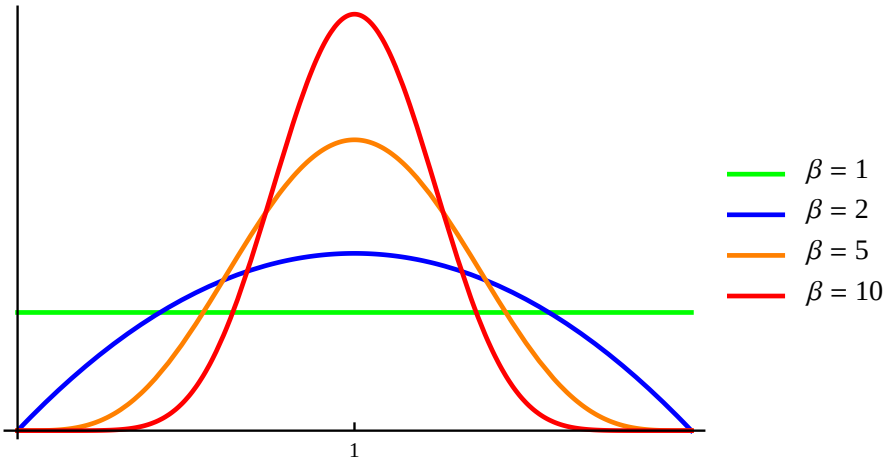



Figure 4.3: The Probability Density Function of $z$ for Different Values of $\beta$

maximum of 100 per cent in both directions. The expected value and variance of the error term are then given as

$$E(z) = 1 \tag{4.16}$$

$$Var(z) = \frac{1}{1+2\beta} \tag{4.17}$$

Two remarks on the consistency of the model seem worthwhile. First, while the firm cannot observe its environment in terms of its demand function, we assume that it can correctly identify the overall increase in the price level, $i$. This might seem to run against a realistic modelling philosophy: how could a firm that finds it prohibitively expensive or cognitively too demanding to estimate a demand function, correctly predict the current increase in supplier prices, wages, and nominal purchasing power? The reason for this assumption is that it strengthens the argument this contribution is trying to make. As pointed out above, a part of the previous work - the signal extraction works by Barro (1977) and Lucas (1972) in particular - sought to explain the relationship between the level of inflation and price dispersion by arguing that higher inflation leads to decreased predictability of the rate of price change. I show that even if the firm is able to correctly identify the inflation level and no lack of predictability or other ambiguities exists, higher rates of inflation lead to a higher degree in the dispersion of relative prices. As such, the phenomenon can be directly ex-

plained with this model through individual firm behaviour, without imposing any further assumption on market dynamics. The mechanisms described in previous contributions that focused on the additional uncertainty that occurs with high levels of inflation can thus be seen as complementary to this one.

Secondly, we implicitly assume that the heuristic used to identify the profit mark-up fares equally well under any rate of inflation, and thus correctly handles the encompassing increases in both marginal costs and nominal purchasing power. In the variable costing case, we have seen that the optimal profit mark-up is independent of the inflation rate $i$, so the heuristic is not influenced by the increase in the general price level. Yet for full costing, adjustment of $\lambda$ becomes necessary. As inflation is a common phenomenon that occurs regularly, we assume that the heuristic is flexible enough to provide a nearly optimal solution for all rates of inflation, although for higher and thus more uncommon rates of inflation, the heuristic might fare worse. This aspect could be included in future discussions of the topic.

#### 4.3.4.1 Variable Costing

As in the previous chapter, the price set by the variable costing firm is, given the mark-up distortion $z$:[15]

$$p_{vc}^{mdist} = (1 + z \cdot \alpha^{mdist}) c_0 (1 + i)$$

As we assume the heuristic to be optimal on average, it is defined by being based on a profit mark-up $\alpha^{mdist\,*}$that maximizes expected profits given that this baseline mark-up is subject to the error term $z$. To derive $\alpha^{mdist\,*}$, we set up the expected profit function in the variable costing case by plugging in $p_{vc}^{mdist}$ into the profit function and taking its expected value. It is then given as:

$$\begin{aligned} E(\pi_{vc}^{mdist}) \;=\; & -\frac{1}{1+2\beta}\,(F(1+2\beta) + c_0(1+i)\alpha\,(a_0 c_0(1+2\alpha \\ & + 2(1+\alpha)\beta) - m(1+2\beta)\Big)\Big) \end{aligned} \tag{4.18}$$

[15] The theoretical analysis focuses on the crucial aspects regarding the connection between inflation and price dispersion. For a more detailed discussion of this model setup, see Chapter 3.

Differentiation with respect to $\alpha$, setting equal to zero and solving for $\alpha$ yields the optimal profit mark-up base given the mark-up distortion:

$$\alpha^{mdist*} = \frac{(m - a_0 c_0)(1 + 2\beta)}{4 a_0 c_0 (1 + \beta)} \tag{4.19}$$

The price that the firm actually sets is then given as:

$$p_{vc}^{mdist} = c_0(1 + i)\left(1 - \frac{(a_0 c_0 - m) z (1 + 2\beta)}{4 a_0 c_0 (1 + \beta)}\right) \tag{4.20}$$

Inserting this price into the demand function gives the quantity as

$$q_{vc}^{mdist} = \frac{(a_0 c_0 - m)(z - 4 + 2(z - 2)\beta)}{4(1 + \beta)} \tag{4.21}$$

Plugging $p_{vc}^{mdist}$ into the profit function yields

$$\pi_{vc}^{mdist} = -\frac{(1 + i)(m - a_0 c_0)^2 z (1 + 2\beta)(z - 4 + 2(z - 2)\beta)}{16 a_0 (1 + \beta)^2} - F \tag{4.22}$$

The expected value of profits is then

$$\begin{aligned} E\left(\pi_{vc}^{mdist}\right) &= \int_v^w \pi^{mdist} f(z)\, dz \qquad (4.23)\\ &= \frac{1}{8 a_0 (1 + \beta)}\Big(a_0^2 c_0^2 (1 + i)(1 + 2\beta) + (1 + i) m^2 (1 + 2\beta) \\ &\quad - 2 a_0 \left(4F(1 + \beta) + c_0 (1 + i) m (1 + 2\beta)\right)\Big) \end{aligned}$$

Note again that the firm does observe the value of profits and the other expressions derived here, but not their structural form.

Expected prices and quantities are given as

$$E(p_{vc}^{mdist}) = \frac{(1 + i)(m + 2m\beta + a_0 c_0 (3 + 2\beta))}{4 a_0 (1 + \beta)} \tag{4.24}$$

$$E(q_{vc}^{mdist}) = \frac{(m - a_0 c_0)(3 + 2\beta)}{4(1 + \beta)} \tag{4.25}$$

The realization of the price depends on the value of the error term $z$. We can now analyse a measure of expected dispersion of this selling price. Denote the variance of the price set by the variable costing firm as $\sigma^2_{vc}$:

$$\begin{aligned}
\sigma^2_{vc} &= Var\left(p^{mdist}_{vc}\right) \\
&= E\left(\left(p^{mdist}_{vc}\right)^2\right) - E\left(p^{mdist}_{vc}\right)^2 \\
&= \int_v^w \left(\frac{(1+i)\left(m+2m\beta+a_0c_0(3+2\beta)\right)}{4a_0(1+\beta)}\right)^2 f(z)\,dz \\
&\quad - \left(\int_v^w \left(\frac{(1+i)\left(m+2m\beta+a_0c_0(3+2\beta)\right)}{4a_0(1+\beta)}\right) f(z)\,dz\right)^2 \\
&= \frac{(1+i)^2\left(m-a_0c_0\right)^2(1+2\beta)}{16a_0^2(1+\beta)^2}
\end{aligned} \tag{4.26}$$

This measure gives the expected dispersion of the absolute price that is set by the firm, depending on the shape of the distribution of the error term $z$, as well as the inflation rate $i$. The term "price dispersion" has here a different initial meaning compared to the definition given in the introductory part of this chapter. There, we defined price dispersion as the variation of relative prices of a given product across different sellers. Yet here, we only study one exemplary firm, whose price of the good it sells exhibits a variance due to the error term $z$, which transforms the price into a stochastic variable whose dispersion is characterized by the variance given in (4.26). This variance thus describes how much the price is expected to deviate from its optimal value when it is fixed in $t = 1$. It is straightforward to see how this individual price variance could transfer into an intramarket dispersion of prices if more than one firm is in the market. As will be shown below in the analysis of the model with imperfect competition, an increase in the expected deviation of the price of each individual firm from its optimal value leads to a higher (expected) dispersion of those prices in the market.

To study how the price variance is influenced by the rate of price change, we differentiate with respect to the rate of inflation $i$:

$$\frac{\partial \sigma_{vc}^2}{\partial i} = \frac{(1+i)\,(m-a_0c_0)\,^2(1+2\beta)}{8a_0^2(1+\beta)^2} > 0 \tag{4.27}$$

This shows that the price exhibits a greater variance if the level of inflation increases, as the effect of the error term $z$ on the price is amplified. Note that this is a nominal effect: since the nominal value of the price increases, so does its variance. For very low levels of inflation, there is no drastic change in the mean of prices and we could disregard this issue and derive relative dispersion from absolute dispersion (Fengler and Winter, 2007).[16] Yet as we want to analyse the effect of inflation on relative price dispersion for all rates of price change, we cannot infer an increase in the real dispersion of prices from (4.27).

To test if there is a relative increase in price dispersion, we can examine the coefficient of variation, which purges our measure of nominal effects. It is defined as

$$\begin{aligned} k_{vc} &= \frac{\sigma_{vc}}{E\left(p_{vc}^{mdist}\right)} \\ &= \frac{\frac{(1+i)(m-a_0c_0)\sqrt{1+2\beta}}{4a_0(1+\beta)}}{\frac{(1+i)(m+2m\beta+a_0c_0(3+2\beta))}{4a_0(1+\beta)}} \\ &= \frac{(m-a_0c_0)\,\sqrt{1+2\beta}}{m+2m\beta+a_0c_0(3+2\beta)} \end{aligned} \tag{4.28}$$

[16] Tommasi (1993) measures relative price dispersion using the coefficient of variation to measure relative price dispersion, arguing that this measure is free of the absolute variance which "explodes" as the price level explodes (Tommasi, 1993, p. 13). He defines and estimates the coefficient of variation of good $i$, sold by $n_i$ sellers $j$ at time $t$ as

$$CV_{it} = \frac{n_i^{\frac{1}{2}}}{\sum_{j=1}^{n_i} P_{ijt}} \left( \sum_{j=1}^{n_i} \left(P_{ijt} - P_{it}\right)^2 \right)^{\frac{1}{2}}$$

with $P_{it} = \frac{1}{n_i} \sum_{j=1}^{n_i} P_{ijt}$. Since he analyses data from a high inflation period in Argentina (reaching weekly averages of 8 per cent prices increases), he uses this definition rather than the absolute variance. Fengler and Winter (2007, p. 792) in contrast, use an absolute measure of price dispersion, arguing that in the low inflation period studied (with an average rate of weekly price change of -0.02 per cent), deviations of the mean of prices are negligible.

Relative dispersion under variable costing thus depends positively on (among other factors) the standard deviation of the error term in the pricing heuristic, but it is not influenced by the level of inflation ($\frac{\partial k_{vc}}{\partial i} = 0$). We can thus note that under variable costing, the increase in inflation is of absolute nature: a higher nominal price level corresponds to a higher nominal variance and standard deviation. A relative increase in price dispersion with the level of inflation, as measured by the coefficient of variation $k_{vc}$, does not occur under variable costing. Yet we can note that $k_{vc} > 0$: in this model, price dispersion emerges even without inflation as a stable phenomenon.

#### 4.3.4.2 Full Costing

We now analyse the case of full costing. The price under mark-up distortion is given as

$$p_{fc}^{mdist} = \left(1 + z \cdot \lambda^{mdist}\right)\left(c_0(1+i) + f\right) \tag{4.29}$$

As before, we will have to find the optimal mark-up $\lambda^{mdist\,*}$ that maximizes expected profits given that the mark-up is subject to a distortion. This ensures optimality of the used heuristic on average.

We thus plug in $p_{fc}^{mdist}$ into the profit function under full costing and form its expected value:

$$\begin{aligned} E(\omega^{mdist}) = \frac{1}{(1+i)q_e^2(1+2\beta)}\Big((1+i)q_e(1+2\beta)\left(c_0(1+i)mq_e\lambda\right. \\ + F\left(m - q_e + m\lambda\right)) + a_0\left(F + c_0(1+i)q_e\right)\Big(-c_0(1+i)q_e\lambda \\ \left.\cdot\left(1 + 2\lambda + 2\beta(1+\lambda)\right) - F\left(1 + 2\lambda(1+\lambda) + 2\beta(1+\lambda)^2\right)\right)\Big) \end{aligned} \tag{4.30}$$

Differentiating with respect to $\lambda$, setting equal to zero and solving for $\lambda$ results in the optimal mark-up the heuristic will be based on:

$$\lambda^{mdist\,*} = \frac{\left((1+i)\left(m - a_0c_0\right)q_e - 2a_0F\right)(1+2\beta)}{4a_0\left(F + c_0(1+i)q_e\right)(1+\beta)} \tag{4.31}$$

Expected values of prices and quantities are

$$E(p_{fc}^{mdist}) = \frac{(1+i)mq_e(1+2\beta) + a_0\left(2F + c_0(1+i)q_e(3+2\beta)\right)}{4a_0q_e(1+\beta)} \quad (4.32)$$

$$E(q_{fc}^{mdist}) = \frac{(1+i)mq_e(3+2\beta) - a_0\left(2F + c_0(1+i)q_e(3+2\beta)\right)}{4(1+i)q_e(1+\beta)} \quad (4.33)$$

As above, we can now calculate the variance of the price under full costing, $\sigma_{fc}^2$:

$$\begin{aligned} \sigma_{fc}^2 &= Var\left(p_{fc}^{mdist}\right) \\ &\quad E\left(\left(p_{fc}^{mdist}\right)^2\right) - E\left(p_{fc}^{mdist}\right)^2 \\ &= \frac{\left(2a_0F + (1+i)\left(a_0c_0 - m\right)q_e\right)^2(1+2\beta)}{16a_0^2q_e^2(1+\beta)^2} \end{aligned} \quad (4.34)$$

Differentiating $\sigma_{fc}^2$ with respect to $i$ yields

$$\frac{\partial\sigma_{fc}^2}{\partial i} = \frac{\left(a_0c_0 - m\right)\left(2a_0F + (1+i)\left(a_0c_0 - m\right)q_e\right)(1+2\beta)}{8a_0^2q_e(1+\beta)^2} \quad (4.35)$$

In general, we can note that $\frac{\partial\sigma_{fc}^2}{\partial i} > 0$, so an increase in the rate of inflation leads to an increase in the absolute variance of the selling price, as under variable costing. A special case occurs if the full costing base $\frac{F}{q_e} + c_0(1+i)$ is greater than the optimal selling price. As long as $p_t^{cert\,*} > c_0(1+i)$, the firm should try to sell its product, and if $\frac{F}{q_e} + c_0(1+i) > p_t^{cert\,*}$, $\lambda$ should assume a negative value up to the point where $p_t^{cert\,*} = c_0(1+i)$. We can see that expression (4.35) is only positive as long as the price is larger than the full costing base, i.e the profit mark-up $\lambda^{mdist\,*}$ is not negative:

$$\begin{aligned} \frac{\left((1+i)\left(m - a_0c_0\right)q_e - 2a_0F\right)(1+2\beta)}{4a_0\left(F + c_0(1+i)q_e\right)(1+\beta)} &> 0 \\ (1+i)\left(m - a_0c_0\right)q_e &> 2a_0F \\ \frac{(1+i)\left(m - a_0c_0\right)}{2a_0} &> \frac{F}{q_e} \end{aligned} \quad (4.36)$$

If condition (4.36) is fulfilled, we see that expression (4.35) is positive. At the same time, if condition (4.36) is not fulfilled, inflation has no ($p_t^{cert*} > f + c_0(1+i)$, $\lambda = 0$) or a negative effect on absolute price variance - a result that contradicts most of the empirical evidence.[17] The reason that the model produces a declining variance with rising $i$ for $\lambda < 0$ is that, in this case, the error $z$ is multiplied with the negative profit mark-up, and the distortion thus has a smaller absolute effect on the costing base which rises due to inflation. The smaller the difference between the full costing base and the price, the smaller the variance becomes, until it reaches zero at $\lambda = 0$. It rises from then onwards. We will thus assume that $\lambda \geq 0$, as negative profit mark-ups are most likely rarely encountered in reality.

To analyse relative price dispersion, we derive, as above, the coefficient of variation $k_{fc}$ in the case of full costing as[18]

$$\begin{aligned} k_{fc} &= \frac{\sigma_{fc}}{E\left(p_{fc}^{mdist}\right)} \\ &= \frac{\frac{\sqrt{1+2\beta}|2a_0F+(1+i)(a_0c_0-m)q_e|}{4a_0q_e(1+\beta)}}{\frac{(1+i)mq_e(1+2\beta)+a_0(2F+c_0(1+i)q_e(3+2\beta))}{4a_0q_e(1+\beta)}} \\ &= \frac{\sqrt{1+2\beta}\left((1+i)\left(m-a_0c_0\right)q_e-2a_0F\right)}{(1+i)mq_e(1+2\beta)+a_0\left(2F+c_0(1+i)q_e(3+2\beta)\right)} \end{aligned} \tag{4.37}$$

We can see that in contrast to variable costing, the relative variation of the price depends on the level of inflation $i$. In fact, we have

$$\frac{\partial k_{fc}}{\partial i} = \frac{4a_0F\left(a_0c_0+m\right)q_e(1+\beta)\sqrt{1+2\beta}}{\left((1+i)mq_e(1+2\beta)+a_0\left(2F+c_0(1+i)q_e(3+2\beta)\right)\right)^2} \tag{4.38}$$

which is greater than zero. So we find that under a symmetrical distribution, relative price variance increases with the rate of inflation. This relationship between the rate of inflation and the dispersion of relative prices is in line with the empirical evidence in Parsley (1996), Tommasi (1993) and Fengler and Winter (2007).

[17] See the appendix for a graphical representation of this case.

[18] Note that $|2a_0F + (1+i)\left(a_0c_0 - m\right)q_e| = (1+i)\left(m - a_0c_0\right)q_e - 2a_0F$ which follows from the assumption of a non-negative profit mark-up under full costing, see expression (4.31).

### 4.3.5 Overview and Interpretation of Results

In the heuristics model presented here, we have first seen that the absolute variance of the price set by a monopolist under both variable and full costing increases with the level of inflation. The increase in absolute variance seems intuitive: we would think that an expected price of 1 would have a lower absolute variance than an expected price of 10. In order to be able to study relative price dispersion, adjusted for these absolute effects, we have introduced the coefficient of variation $k_{vc}$ and $k_{fc}$, respectively. Some differences emerge between pricing decisions based on variable or full costing. In the first case, expected relative price variance is constant, while it increases with $i$ in the full costing case.

Figure 4.4 shows basic variables for the two cost-plus approaches and their behaviour for different rates of inflation for the case of a numerical example.[19] Full lines refer to the case of variable costing, dashed lines to the full costing case. Depicted are the expected prices (green, overlapping since the prices are identical), the costing bases (blue) and profit mark-ups (orange) against the inflation rate, $i$. Several points are noteworthy. Because of the added share of fixed costs, the full costing base is always higher than variable costs. As a consequence, the profit mark-up under variable costing is always larger than under full costing. Both cost bases increase with inflation. As derived above, it can be seen that $\alpha_{mdist}$ is independent of the rate of inflation, while $\lambda_{mdist}$ is increasing with $i$.[20]

The reason the model replicates price dispersion even without inflation lies in the imperfect heuristic that the firm applies to set its mark-up. Even at a zero rate of inflation, deviations from the optimal price level lead to a positive absolute price variance under both variable and full costing. The size of the effect of this distortion is, however, different under the two costing regimes. For all rates of inflation and all possible parameter values that fulfill our basic assumptions, we can see that variable costing is characterized by a higher absolute variance in the selling price than under full costing. This can also be

[19] For the numerical example of the monopoly case, we will use the following parameter values: $\gamma = 2; \beta = 2; m_0 = 21; F = 12; c_0 = 1; a = 4; q_e = 10;$

[20] In the full costing case, the share of fixed costs could also decrease since (expected) sold quantity is likely to increase with the rate of inflation. This would only be the case if the expected quantity $q_e$ rises at a higher rate than $i$, which seems improbable.

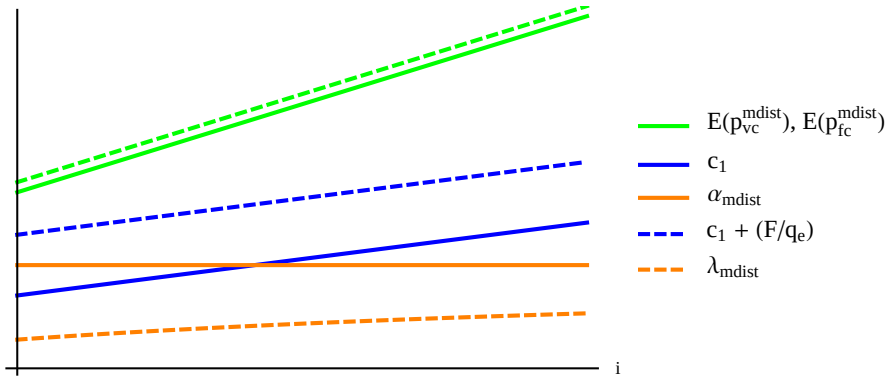



Figure 4.4: Expected Prices, Costs and Profit Mark-Ups against Inflation

seen in Figure 4.5, which shows the absolute variances $\sigma^2_{vc}$ and $\sigma^2_{fc}$ for different rates of inflation and their derivatives with respect to $i$. As can be seen, the line depicting $\sigma^2_{vc}$ always lies above $\sigma^2_{fc}$. The mechanism that drives this result is that in general, since the profit mark-up which is multiplied with the costing base is smaller in the full costing case, errors in the determination of the profit mark-up have a larger weight in the variable costing case since the error term influences a larger profit mark-up. From this follows directly that the variance of the price is higher under variable costing than in the full costing case: the same relative error (say an overestimation of the profit mark-up of 10 per cent) leads to a larger absolute deviation from the optimal price under variable costing than under full costing. The variance measures ${\sigma^2}_{vc/fc}$ reflect this intuition.

Introducing the notion of inflation, we see that absolute price variance rises with the rate of inflation under both variable and full costing. Under both costing regimes, a positive rate of inflation leads to a larger cost base, which is multiplied with the (nearly-optimal) profit mark-up $\alpha$ or $\lambda$, respectively. Multiplication of the increased costing base with the profit mark-up (which is independent of $i$ in the variable costing case) leads the absolute value of price deviations due to errors in the mark-up to increase, which is expressed in the measures of price variance. Since the profit mark-up is applied multiplicatively, the marginal influence of an increase in the rate of inflation on price volatility increases as $i$ rises.

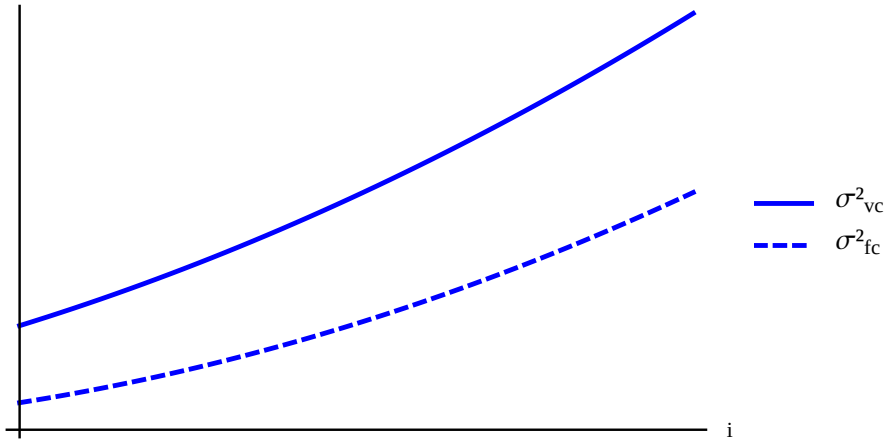



Figure 4.5: Absolute Price Variances

Furthermore, we can compare the marginal effect of the inflation rate $i$ on absolute price variance under both costing regimes. Comparing expressions (4.27) and (4.35), we find that

$$\frac{\partial \sigma^2_{vc}}{\partial i} > \frac{\partial \sigma^2_{fc}}{\partial i}$$

for all parameter values fulfilling our basic assumptions. This leads to the conclusion that while higher levels of inflation lead to higher absolute variance under variable and full costing, a cost-plus heuristic on variable costing entails a stronger effect of the inflation level on nominal price variance. The intuition behind this result is as follows. A positive rate of inflation leads to an increase in the costing base under both costing regimes. Since the profit mark-up in the variable costing case is always larger than under full costing (and thus the error produced by the heuristic leads to a larger absolute deviation in the variable costing case), a proportional increase of both costing bases with rate $i$ leads to a larger absolute price change and thus a larger change in price variance - due to wrongly estimated profit mark-ups - in the variable costing case than under full costing. In addition, since the allocated fixed costs $f$ are not subject to inflationary increases, a marginal increase in $i$ has a larger effect on the cost base in the variable costing case than under full costing. Errors thus have a higher

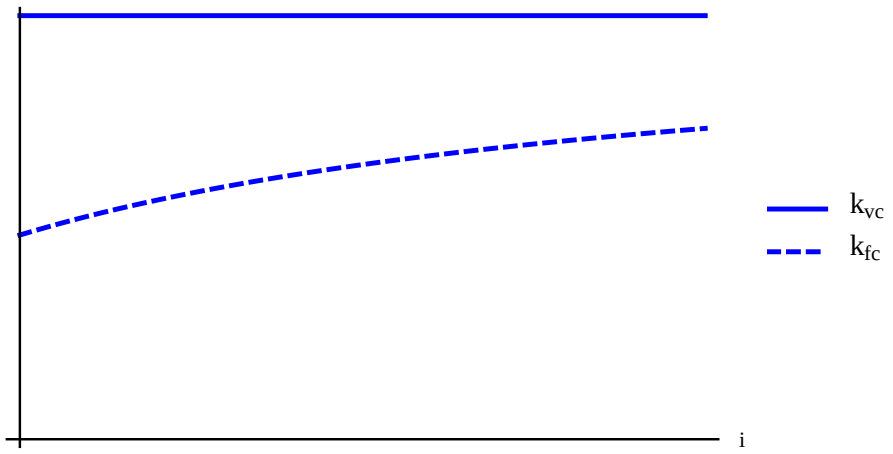



Figure 4.6: Coefficients of Price Variation

absolute influence under variable costing and hence price volatility increases more strongly under variable costing.

The main result from the monopoly model is that the expected dispersion of relative prices increases under full costing, while remaining constant in the case of variable costing. The reason lies in the allocated fixed costs $f$ that do not increase with inflation. While the variable costing base increases, $f$ remains constant, creating the need for the profit mark-up $\lambda$ to rise in order to achieve the optimal selling price (which also rises by the rate of inflation). This rise in $\lambda$ has the side effect of amplifying the effects of distortions by the error term $z$ on the selling price, and thus the variance. As $\lambda$ rises, so does the effect of $z$ on the price, and so does the variance. This effect thus shows up in the coefficient of variation $k_{fc}$. That this mechanism is responsible for the rise in relative volatility becomes apparent if the case of $F_1 = F_0(1+i)$ is considered, where fixed costs are also exposed to increases due to inflation. Then, as discussed earlier, the full cost base rises at rate $i$, making no readjustment of $\lambda$ necessary to lead to a price $p_1 = p_0(1+i)$ and leading to a $\lambda$ that is independent of $i$. The relative distorting effect of the error $z$ thus also remains constant. As a consequence, the coefficient of variation $k_{fc}$ is independent of $i$ and thus does not change for different levels of inflation, $\frac{\partial k_{fc}}{\partial i} = 0$ if fixed costs are subject to inflation. Yet, as we pursue a short run analysis, we will generally not consider this case.

## 4.4 A Model of Imperfect Competition

### 4.4.1 Model Setup

Assuming that the firm is a monopolist may, at this point, be one of the biggest restrictions limiting this model's applicability. To extent our findings to a more realistic scenario, we now introduce a model of imperfect competition that resembles the model we introduced earlier in the discussion of demand and mark-up uncertainty. Firms are selling goods with a degree of substitutability $\mu \in [0, \infty[$.[21] Of $n$ firms in the market, a share $\eta \in [0; 1]$ are setting their prices using a variable costing method, while the share $1 - \eta$ apply a profit mark-up on full costs. Let us further denote the price of a variable costing firm $j$ as $p_j^{vc}$, and the price of a full costing firm $k$ as $p_k^{fc}$. We assume that within the two groups of variable and full costing firms, firms are symmetric with regard to their cost functions and the pricing heuristics used. Further, we assume the number of firms $n$, the degree of substitutability $\mu$, the ratio $\eta$ as well as all other exogenously given parameters to remain constant between the periods $t = 0$ and $t = 1$. Throughout, we will analyse values in $t = 1$ and will thus drop the period subscript (except for $a_0$,$\mu_0$ and $c_0$). The particular formulation of imperfect competition which the model is based on was first introduced by Shubik and Levitan (1980).

Firms are assumed to possess general knowledge about the characteristics of the heuristics employed by the other firms, their cost structure, as well as their expected prices and mark-ups. For simplicity, we also assume that all firms expect to sell the same fixed quantity $q_e$.

For any firm $i$, the individual demand function in period $t = 1$ is given as[22]

$$q_i\left(p_i, p_j^{vc}, p_k^{fc}\right) = \frac{1}{n}\left(m - (a+\mu)p_i + \frac{\mu}{n}\left(\sum_{j=1}^{\eta n} p_j^{vc} + \sum_{k=1}^{(1-\eta)n} p_k^{fc}\right)\right) \quad j,k \neq i$$

[21] The limited substitutability may not arise from differentiated product characteristics, but, for example, branding. This is important since we want to study comparable products where the dispersion of prices is not caused by a difference between products offered by the firms in the market.

[22] Note that in the basic version of the model, the degree of substitutability $\mu$ is derived from an optimal consumption decision by a consumer (Motta, 2004, p. 568). A monetary change due to inflation is thus reflected in both $a_1 = \frac{1}{1+i}a_0$ and $\mu_1 = \frac{1}{1+i}\mu_0$.

$$= \frac{1}{n}\left(m - \frac{(a_0+\mu_0)}{(1+i)}p_i + \frac{\mu_0}{(1+i)}\eta\left((1+\alpha_j)(1+i)c_0 + (1-\eta)(1+\lambda_k)(f+(1+i)c_0)\right)\right) \quad (4.39)$$

Note that the symmetry within the two subgroups of firms allows us to make the substitution $\sum_{j=1}^{\eta n} p_j^{vc} = \eta n p_j^{vc}$ and $\sum_{k=1}^{(1-\eta)n} p_k^{fc} = (1-\eta)n p_k^{fc}$.

Market demand, as the sum of quantities of the $n$ firms, is then given as

$$\begin{aligned} Q &= \sum_{i=1}^{n} q_i\left(p_i, p_j^{vc}, p_k^{fc}\right) \\ &= m - a_0\left(\eta p_j^{vc} + (1-\eta)p_k^{fc}\right) \end{aligned}$$

## 4.4.2 Pricing Using a Nearly-Optimal Cost-Plus Heuristic

We will now reintroduce the assumption that firms have no knowledge of the demand function and resort to heuristics for the determination of their mark-up.

### 4.4.2.1 Variable Costing

If we assume firm $i$ to use a variable costing approach, the price of the variable costing firm is given as

$$p_i^{vc} = (1 + \alpha_i \cdot z_i)(1+i)\, c_0$$

At the same time, the prices of other firms in both costing groups are derived using imperfect heuristics as well, and are thus subject to the individual mark-up distortions. For all $\eta n$ variable costing firms $j$, $j \neq i, j \neq k$, and $(1-\eta)n$ full costing firms $k$, $k \neq i, k \neq j$ the price is given as

$$\begin{aligned} p_j^{vc} &= \left(1 + \alpha_j \cdot z_j\right)(1+i)\, c_0 \\ p_k^{fc} &= (1 + \lambda_k \cdot z_k)(1+i)(c_0 + f) \end{aligned}$$

assuming that the errors $z_i$, $z_j$ and $z_k$ are iid. We assume that all errors are distributed with a probability density function defined in (4.14).

Firm $i$'s individual demand function depends on the expected values of the prices of the other firms:

$$E\left(q_i\left(p_i, p_j^{vc}, p_k^{fc}\right)\right) = \frac{1}{n}\left(m-(a+\mu)p_i+\frac{\mu}{n}\left(\sum_{j=1}^{\eta n} E\left(p_j^{vc}\right) + \sum_{k=1}^{(1-\eta)n} E\left(p_k^{fc}\right)\right)\right) \quad j,k \neq i$$

The sum over the expected values of prices can be simplified due to the imposed symmetry of firms sharing the same costing systems, which implies these firms will set the same mark-up. We can thus write

$$\begin{aligned} E\left(q_i\left(p_i, p_j^{vc}, p_k^{fc}\right)\right) = \frac{1}{n}\Bigg(m-(a+\mu)p_i+\mu\Bigg(\eta\int_v^w \left(1+\alpha_j\cdot z_j\right) \\ \cdot\ (1+i)\, c_0 f(z_j)dz_j + (1-\eta)\int_v^w (1+\lambda_k\cdot z_k) \\ \cdot\ (1+i)\,(c_0+f)\, f(z_k)dz_k\Bigg)\Bigg) \quad j,k\neq i \end{aligned} \tag{4.40}$$

The expected values of $p_j^{vc}$ and $p_k^{fc}$ are given as

$$\begin{aligned} E(p_j^{vc}) &= \int_v^w \left(1+\alpha_j\cdot z_j\right)(1+i)\, c_0 f(z_j)dz_j \\ &= c_0(1+i)\left(1+\alpha_j\right) \end{aligned} \tag{4.41}$$

$$\begin{aligned} E(p_k^{fc}) &= \int_v^w (1+\lambda_k\cdot z_k)(1+i)\,(c_0+f)\, f(z_k)dz_k \\ &= (c_0+f+c_0 i)(1+\lambda_k) \end{aligned} \tag{4.42}$$

which we can plug in into (4.39) and simplify to obtain firm $i$'s expected demand function

$$\begin{aligned} E\left(q_i\left(p_i, p_j^{vc}, p_k^{fc}\right)\right) = \frac{1}{n}(m-(a+\mu)p_i+\mu(\eta c_0(1+i)\left(1+\alpha_j\right) \\ +\ (1-\eta)\,(c_0+f+c_0 i)\,(1+\lambda_k))) \quad j,k\neq i \end{aligned} \tag{4.43}$$

We can now write firm $i$'s expected profit function as:

$$E(\pi_i) = \int_v^w \Bigg(\left(1+\alpha_i\cdot z_i\right)(1+i)\, c_0 \frac{1}{n}\left((m-(a+\mu)p_i\right.$$

$$
\begin{aligned}
&+ \mu \left(\eta c_0(1+i)\left(1+\alpha_j\right) + (1-\eta)\left(c_0+f+c_0 i\right)\left(1+\lambda_k\right)\right)\Big) \\
&- c_0\left(1+i\right)\frac{1}{n}\Big(m-(a+\mu)p_i+\mu\left(\eta c_0(1+i)\left(1+\alpha_j\right)\right. \\
&\left.+\ (1-\eta)\left(c_0+f+c_0 i\right)\left(1+\lambda_k\right)\right)\Big) - F\Bigg) f(z_i)dz_i \\
= \ & -\frac{1}{nq_e}\Bigg(F(nq_e + c_0\alpha(\eta-1)\left(1+\lambda_k\right)\mu_0) \\
&+ \frac{2c_0^2(1+i)q_e\alpha^2(1+\beta)\left(a_0+\mu_0\right)}{1+2\beta} + c_0(1+i)q_e\alpha\left(a_0 c_0\right. \\
&\left.- m - c_0\left(\alpha_j\eta+\lambda_k-\eta\lambda_k\right)\mu_0\right)\Bigg)
\end{aligned}
\tag{4.44}
$$

To find the optimal profit mark-up of firm $i$, we differentiate $\pi_i$ with respect to $\alpha_i$, set equal to zero and solve for $\alpha_i$.[23] This yields firm $i$'s reaction function:

$$
\begin{aligned}
\alpha_i^*(\alpha_j,\lambda_k) \ = \ & \frac{1}{2c_0(1+i)q_e\left(a_0+\mu_0\right)}\left(-a_0c_0(1+i)q_e + (1+i)mq_e\right. \\
&+ \left.\left(-F(\eta-1)\left(1+\lambda_k\right) + c_0(1+i)q_e\left(\alpha_j\eta+\lambda_k-\eta\lambda_k\right)\right)\mu_0\right)
\end{aligned}
\tag{4.45}
$$

#### 4.4.2.2 Full Costing

The same proceeding is now used to derive the reaction function of a sample full costing firm. If firm $i$ employs a full costing system, its price is given as

$$p_i^{fc} = \left(1+\lambda_i\cdot z_i\right)\left(1+i\right)\left(c_0+f\right)$$

[23] Note that, similarly to the model of imperfect competition and mark-up heuristics discussed in Chapter 3, we will use an approximation for the optimal mark-up values in both the variable and the full costing cases. Instead of using the mark-up that maximizes $E(\pi_i)$ and $E(\omega_i)$, we will use the values that maximize $\pi_i$ and $\omega_i$, respectively. The analtical evaluation of the case of optimal mark-ups was attempted in Mathematica 7.0.0. but had to be aborted. Yet, numerical simulations for different parameter values fulfilling our basic assumptions were run and analysed using Mathematica 7.0.0 and led to the same qualitative conclusions that we will present in the following. The source code of the model is available from the author upon request.

Prices of firms of type $j$ and $k$ are as above, and we can use the individual demand function expressed in (4.39) and similar calculations as above to arrive at the expected profit function in the full costing case:

$$\begin{aligned} E(\omega_i) &= \frac{1}{(1+i)nq_e^2}\left((1+i)q_e\left(c_0(1+i)mq_e\lambda + F\left(m - nq_e + m\lambda\right)\right)\right. \\ &\quad - a_0\left(F + c_0(1+i)q_e\right)(1+\lambda)\left(F + \left(F + c_0(1+i)q_e\right)\lambda\right) \\ &\quad - \left(F + \left(F + c_0(1+i)q_e\right)\lambda\right)\left(F\left(\eta + \lambda + (\eta-1)\lambda_k\right)\right. \\ &\quad \left.\left. + c_0(1+i)q_e\left(\lambda - \alpha_j\eta + (\eta-1)\lambda_k\right)\right)\mu_0\right) \end{aligned} \tag{4.46}$$

Differentiation with respect to $\lambda_i$, setting equal to zero, solving for $\lambda_i$ and simplifying yields the optimal reaction function in the full costing case:

$$\begin{aligned} \lambda_i^*(\alpha_j, \lambda_k) &= \frac{1}{2\left(F + c_0(1+i)q_e\right)\left(a_0 + \mu_0\right)}\left((1+i)mq_e\right. \\ &\quad - a_0\left(2F + c_0(1+i)q_e\right) + \left(-F\left(1 + \eta + (\eta-1)\lambda_k\right)\right. \\ &\quad \left.\left. + c_0(1+i)q_e\left(\alpha_j\eta + (\eta-1)\lambda_k\right)\right)\mu_0\right) \end{aligned} \tag{4.47}$$

#### 4.4.2.3 Equilibrium

The necessary condition for equilibrium is that all profit mark-ups of firms with the same costing system are equal:

$$\begin{aligned} \alpha_i &= \alpha_j \\ \lambda_i &= \lambda_k \end{aligned}$$

Using this and the reaction functions (4.45) and (4.47), we can solve the model for the optimal profit mark-ups under pricing with nearly-optimal heuristics and obtain:

$$\alpha^* = \frac{m - a_0c_0}{c_0\left(2a_0 + \mu_0\right)} \tag{4.48}$$

$$\lambda^* = \frac{(1+i)mq_e - a_0\left(2F + c_0(1+i)q_e\right) - F\mu_0}{\left(F + c_0(1+i)q_e\right)\left(2a_0 + \mu_0\right)} \tag{4.49}$$

These are the optimal mark-ups that a variable or full costing firm would set given that all other firms in the two costing subgroups set their price using the

heuristic. As such, these mark-ups constitute the best response of a fully informed and rational firm $i$ given all other firm's prices are subject to distortions caused by the price setting heuristic.

Yet, firm $i$ is, like all other firms, not informed enough to identify this optimal mark-up directly, but also employs the heuristic to derive the profit mark-up.

Taking the distortive effect of firm $i$'s mark-up heuristic into account by plugging in the optimal mark-ups into the variable and full costing prices, we obtain:

$$p_i^{vc*} = c_0(1+i)\left(1+\frac{(m-a_0c_0)\,z}{c_0\,(2a_0+\mu_0)}\right) \tag{4.50}$$

$$p_i^{fc*} = \frac{F+c_0(1+i)q_e-Fz}{q_e}-\frac{(1+i)\,(a_0c_0-m)\,z}{2a_0+\mu_0} \tag{4.51}$$

Expected prices of firm $i$ in the variable or full costing case are then, respectively:

$$\begin{aligned} E\left(p_i^{vc*}\right) &= \int_v^w (1+\alpha_i^* z_i)\,(1+i)\,c_0 f(z_i)dz_i,\ i=1,...,\eta n \\ &= \frac{(1+i)\,(m+c_0\,(a_0+\mu_0))}{2a_0+\mu_0} \end{aligned} \tag{4.52}$$

$$\begin{aligned} E\left(p_i^{fc*}\right) &= \int_v^w (1+\lambda_i^* z_i)\,((1+i)\,c_0+f)\,f(z_i)dz_i,\ i=1,...,(1-\eta)\,n \\ &= \frac{(1+i)\,(m+c_0\,(a_0+\mu_0))}{2a_0+\mu_0} \end{aligned} \tag{4.53}$$

These prices characterize the equilibrium in the market. The mark-ups expressed in (4.48) and (4.49) are the best response for, respectively, a variable or full costing firm, given that all other firms in the market set their prices by using imperfect heuristics. As the heuristics are, by assumption, reasonably sophisticated, they will on average lead to these optimal prices (given that distortions cancel each other out on average, $\beta=\gamma$).

Using these equilibrium prices, we are thus now in a position to study the effect of the rate of inflation on price dispersion in the competition model.

#### 4.4.2.4 Price Variance and the Rate of Inflation

##### Variable Costing

As above, we can derive the variance of the price of the variable costing firm $i$ as

$$\begin{aligned} \sigma_{vc}^2 &= Var\left(p_i^{vc*}\right) \\ &= E\left(\left(p_i^{vc*}\right)^2\right) - E\left(p_i^{vc*}\right)^2 \\ &= \frac{(1+i)^2\left(m - a_0 c_0\right)^2}{(1+2\beta)\left(2a_0 + \mu_0\right)^2} \end{aligned} \tag{4.54}$$

To analyse the effect of inflation on the (absolute) variance of the variable costing price, we differentiate (4.54) with respect to $i$:

$$\frac{\partial \sigma_{vc}^2}{\partial i} = \frac{2(1+i)\left(m - a_0 c_0\right)^2}{(1+2\beta)\left(2a_0 + \mu_0\right)^2} > 0 \tag{4.55}$$

This marginal effect is, as above, always positive - the rate of inflation leads to increasing absolute price volatility.

Deriving the standard deviation from expression (4.54) and the expected price in the variable costing case (expression (4.52)), we can now also calculate the coefficient of variation, which lets us analyse the relative dispersion of the price. It is given as:

$$\begin{aligned} k_{vc} &= \frac{\sigma_{vc}}{E\left(p_{vc}^*\right)} \\ &= \frac{m - a_0 c_0}{\sqrt{1+2\beta}\left(m + c_0\left(a_0 + \mu_0\right)\right)} \end{aligned} \tag{4.56}$$

As in the monopoly case, we can see that $k_{vc}$ is independent of $i$, and inflation has no influence on relative price dispersion.

### Full Costing

We can run the same analysis for full costing. The absolute price variance is given as

$$\begin{aligned}\sigma_{fc}^2 &= Var\left(p_i^{fc*}\right) \\ &= E\left(\left(p_i^{fc*}\right)^2\right) - E\left(p_i^{fc*}\right)^2 \\ &= \frac{\left(2a_0F + a_0c_0(1+i)q_e - (1+i)mq_e + F\mu_0\right)^2}{q_e^2(1+2\beta)\left(2a_0+\mu_0\right)^2}\end{aligned} \tag{4.57}$$

Differentiation with respect to $i$ yields

$$\frac{\partial\sigma_{fc}^2}{\partial i} = \frac{2\left(a_0c_0 - m\right)\left(2a_0F + a_0c_0(1+i)q_e - (1+i)mq_e + F\mu_0\right)}{\left(q_e + 2q_e\beta\right)\left(2a_0+\mu_0\right)^2} \tag{4.58}$$

It is shown in the appendix that the marginal effect of $i$ on $\sigma_{fc}^2$ is positive if we make the assumption (as before) that $\lambda$ is positive.

To measure relative dispersion, we construct the coefficient of variation $k_{fc}$ as above:

$$\begin{aligned}k_{fc} &= \frac{\sigma_{fc}}{E\left(p_{kc}^*\right)} \\ &= \frac{\left|2a_0F + a_0c_0(1+i)q_e - (1+i)mq_e + F\mu_0\right|}{(1+i)q_e\sqrt{1+2\beta}\left(m + c_0\left(a_0+\mu_0\right)\right)}\end{aligned} \tag{4.59}$$

The derivative of $k_{fc}$ with respect to $i$ is

$$\begin{aligned}\frac{\partial k_{fc}}{\partial i} = &\frac{1}{(1+i)^2q_e\sqrt{1+2\beta}\left(m + c_0\left(a_0+\mu_0\right)\right)} \\ &\left(-\left|2a_0F + a_0c_0(1+i)q_e - (1+i)mq_e + F\mu_0\right|\right. \\ &\left.- (1+i)\left(a_0c_0 - m\right)q_e\right)\end{aligned} \tag{4.60}$$

We show in the appendix that $\frac{\partial k_{fc}}{\partial i} > 0$ if $\lambda > 0$. Thus our findings of the monopoly case are replicated under imperfect competition: absolute price variance increases with the rate of inflation under both costing regimes, while rel-

ative price variance increases with the inflation rate under full costing, but is independent of the rate of inflation under variable costing.

#### 4.4.2.5 Aggregate Price Variance

In order to link individual price variance to relative price dispersion at the intramarket level, we can construct a measure similar to the coefficient of variation used in Tommasi (1993) and others. For this purpose, we first define the overall price level in the market $P$ as

$$P = \sum_{j=1}^{\eta n} p_j^{vc} + \sum_{k=1}^{(1-\eta)n} p_k^{fc}$$

The expected aggregate price level is then

$$\begin{aligned} E(P) &= \eta n E\left(p_j^{vc}\right) + (1-\eta) n E\left(p_k^{fc}\right) \\ &= \frac{(1+i)n\left(m + c_0\left(a_0 + \mu_0\right)\right)}{2a_0 + \mu_0} \end{aligned} \tag{4.61}$$

We can write the absolute variance of the price level $P$ as

$$Var(P) = Var(\sum_{j=1}^{\eta n} p_j^{vc} + \sum_{k=1}^{(1-\eta)n} p_k^{fc})$$

At this point, we can use the Bienaymé equality[24], which states that

$$Var\left(\sum_{i=1}^{n} X_i\right) = \sum_{i=1}^{n} Var\left(X_i\right)$$

if $X_i, i = 1, 2, ..., n$ are independent. Since each of the $p_j^{vc}, j = 1, 2, ..., \eta n$ is subject to an individual and independent distortion term $z_j$ (and the same is true for all $p_k^{fc}, k = 1, 2, ..., (1-\eta)n$ and $z_k$, respectively) we can write

[24] See, for example Loève (1977).

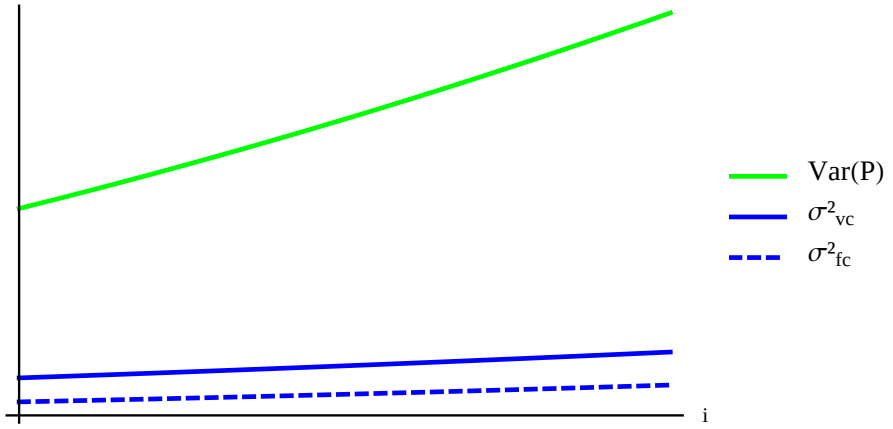



Figure 4.7: Absolute Variances of Individual and Aggregated Prices

$$\begin{aligned} Var(P) &= \sum_{j=1}^{\eta n} Var(p_j^{vc}) + \sum_{k=1}^{(1-\eta)n} Var(p_k^{fc}) \\ &= \eta n \sigma_{vc}^2 + (1-\eta) n \sigma_{fc}^2 \\ &= \frac{n}{(1+2\beta)\left(2a_0+\mu_0\right)^2} \Big( (1+i)^2 \left(m - a_0 c_0\right)^2 \eta \\ &\quad + \frac{(1-\eta)\left(2a_0 F + a_0 c_0 (1+i) q_e - (1+i) m q_e + F\mu_0\right)^2}{q_e^2} \Big) \end{aligned} \tag{4.62}$$

Differentiation with respect to $i$ yields the effect of the rate of inflation on the variation of the price aggregate $P$:

$$\begin{aligned} \frac{\partial Var(p)}{\partial i} &= \frac{1}{\left(q_e + 2q_e\beta\right)\left(2a_0+\mu_0\right)^2} \left(2\left(a_0 c_0 - m\right) n \left(-(1+i) m q_e \right.\right. \\ &\quad \left.\left. + a_0 \left(c_0 (1+i) q_e - 2F(\eta - 1)\right) - F(\eta-1)\mu_0\right)\right) \end{aligned} \tag{4.63}$$

This expression is positive as shown in the appendix. This is eveident since $P$ is defined as the (weighted) sum of $\sigma_{vc}^2$ and $\sigma_{fc}^2$, and we showed above that $\frac{\partial \sigma_{vc}^2}{\partial i} > 0$ and $\frac{\partial \sigma_{fc}^2}{\partial i} > 0$ if profit mark-ups are positive. As derived above, we see that absolute (nominal) price variation increases with inflation.

Figure 4.7 exemplifies how absolute price variances of individual firms add up to the absolute aggregate price variance.[25] Even though individual variances might be small on a firm-level scale because of errors in the determination of the profit mark-up, they might become significant on a market scale.

To construct an overall measure of relative price dispersion, we can use the variance derived above to construct an overall coefficient of variation.

The coefficient of variation for the whole market is given as

$$K = \frac{Var(P)}{E\left(\overline{P}\right)}$$

with

$$\begin{aligned} E\left(\overline{P}\right) &= \frac{1}{n}\sum_{i=1}^{n} E\left(p_i\right) \\ &= \frac{1}{n}\left(\sum_{j=1}^{\eta n} E\left(p_j^{vc}\right) + \sum_{k=1}^{(1-\eta)n} E\left(p_k^{fc}\right)\right) \\ &= \eta E\left(p_j^{vc}\right) + (1-\eta)E\left(p_k^{fc}\right) \\ &= \frac{(1+i)\left(m + c_0\left(a_0 + \mu_0\right)\right)}{2a_0 + \mu_0} \end{aligned} \tag{4.64}$$

$K$ is then given as

$$\begin{aligned} K = {} & \frac{n}{(1+i)(1+2\beta)\left(2a_0+\mu_0\right)\left(m + c_0\left(a_0+\mu_0\right)\right)} \\ & \cdot \left( (1+i)^2 \left(m - a_0 c_0\right)^2 \eta + \frac{1}{q_e^2}(1-\eta)\left(2a_0 F + a_0 c_0 (1+i) q_e \right.\right. \\ & \left.\left. - (1+i) m q_e + F\mu_0\right)^2 \right) \end{aligned} \tag{4.65}$$

The effect of $i$ on $K$ can be examined by differentiation with respect to $i$:

$$\frac{\partial K}{\partial i} = \frac{1}{(1+i)^2 q_e^2 (1+2\beta)\left(2a_0+\mu_0\right)\left(m + c_0\left(a_0+\mu_0\right)\right)} \tag{4.66}$$

[25] In the case shown, there are $n = 10$ firms in the market, the degree of substitutability is $\mu = 2$ and the share of variable costing firms is $\eta = 0.3$. The other parameters are given as $\gamma = 2; \beta = 2; m_0 = 21; t = 2; F = 4; c_0 = 1; a = 2; q_e = 2$.

$$\cdot \left(n\left(-2a_0c_0(1+i)^2mq_e^2 + (1+i)^2m^2q_e^2 + a_0^2\left(c_0^2(1+i)^2q_e^2 + 4F^2(\eta-1)\right) + 4a_0F^2(\eta-1)\mu_0 + F^2(\eta-1)\mu_0^2\right)\right)$$

As shown in the appendix, this expression is positive if $\lambda > 0$. The increase in the intramarket dispersion of relative prices with the rate of price change under competition is thus also reflected in this aggregate measure.

## 4.5 Conclusion

In the two models presented here, price dispersion is a prevailing phenomenon due to pricing behaviour of firms. The first explanation demonstrated the link between the use of historical costs for the pricing decision and the dispersion of prices. The second model, which was a modified version of the framework introduced in the previous chapter, returned to the assumption of marginalist costs, but included errors that stem from the use of cost-plus pricing heuristics, which lead to price dispersion even if prices are constant. It was shown that under both monopoly and imperfect competition, inflation leads to a greater expected relative dispersion of prices if firms employ a full cost pricing heuristic. Interestingly, this effect is absent in the case of variable costing, where relative price dispersion is independent of the rate of inflation.

This model's results allow us to draw connections to the empirical evidence. First, we have seen that full-cost pricing can be directly linked to a positive relationship between inflation and relative price dispersion that finds wide empirical support. As has been confirmed in many empirical investigations of pricing behaviour, this method of price setting dominates all others. Furthermore, the analysis in the previous chapter offers a reason why firms might prefer to calculate their prices using a full cost heuristic, as it leads to higher expected profits than the variable costing alternative. As the majority of firms employ a full-cost pricing routine, it is likely that the effect demonstrated here plays a role in the observed connection of relative price dispersion and inflation.

In addition, and in contrast to the other theoretical explanations, our results are consistent with the work of Reinsdorf (1994), who finds a negative correlation between price dispersion and inflation during disinflation (the Volcker period) in the U.S.. The decrease in inflation - in Reinsdorf's data measured

as prices for foodstuffs - was rapid, from 10.4 per cent in 1980 to 3.7 per cent in 1981 and 1 per cent in 1982 (Reinsdorf, 1994, p. 722). During this period, he finds a correlated decrease in the dispersion of relative prices. In the model presented here, price dispersion moves in the same direction as the level of inflation. Following a period of comparatively high inflation in 1980, the subsequent decrease in inflation in the years 1981 and 1982 lead, in our model, to a decrease in relative price dispersion.

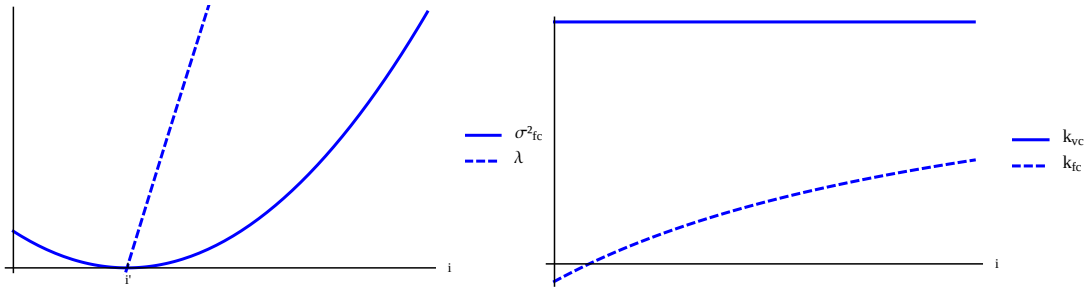
In this analysis it was demonstrated that under realistic assumptions regarding the pricing behaviour of firms, such as the use of cost measures supplied by an imperfect accounting system, informational and/or cognitive constraints and the use of fast and frugal cost-plus heuristics, the range of phenomena that can be explained is widened in comparison with the framework of the common as-if approach that assumes firms that are fully informed and rational profit maximizers. Of course, the approach chosen here is merely a starting point for further investigations that analyse the implications of observed pricing behaviour.

# 4.A Appendix

## Negative Profit Mark-Ups under Full Costing

Depicted below is the case for a negative profit mark-up in the full costing case. As discussed above, a negative $\lambda$ leads to a negative relationship between the rate of inflation and the price variance.

Figure 4.8: Standard Price Deviations and Rates of Inflation




(a) $\lambda$ and Absolute Price Variance

(b) Relative Standard Deviations

In the Figure, the variance $\sigma^2_{fc}$ starts to increase at the point $i'$, at which the profit mark-up $\lambda$ becomes positive. Roughly at $i' = 0.083$ (8.3 per cent), relative volatility starts to increase as well, yet at a decreasing rate, as shown by the dashed curve displaying $\frac{\partial k_{fc}}{\partial i}$.

## Absolute Price Variance under Competition and Full Costing

In general, we assume in the following that the profit mark-up under full costing, $\lambda$, is not negative, so that:

$$\begin{aligned} \frac{(1+i)mq_e - a_0\left(2F + c_0(1+i)q_e\right) - F\mu_0}{\left(F + c_0(1+i)q_e\right)\left(2a_0 + \mu_0\right)} &\geq 0 \qquad (4.67) \\ (1+i)mq_e &\geq 2a_0F + a_0c_0(1+i)q_e + F\mu_0 \end{aligned}$$

The derivative of $\sigma^2_{fc}$ with respect to $i$, expression (4.58), is positive if:

$$\left(a_0c_0 - m\right)\left(2a_0F + a_0c_0(1+i)q_e - (1+i)mq_e + F\mu_0\right) > 0 \qquad (4.68)$$

That this inequality is fulfilled is warranted by (4.67). As the expression in the second pair of parentheses must be negative, the positivity of the left hand side is certain.

## Relative Price Variance under Competition and Full Costing

A positive effect of $i$ on $k_{fc}$ is warranted if expression (4.60) is positive, which is true if (the denominator is always positive, hence we will analyse the enumerator):

$$\begin{aligned} (1+i)\,(a_0c_0 - m)\,q_e &> |2a_0F + a_0c_0(1+i)q_e \\ \cdot \operatorname{Sgn}\left(2a_0F + a_0c_0(1+i)q_e - (1+i)mq_e + F\mu_0\right) &\quad - (1+i)mq_e + F\mu_0| \\ \\ (1+i)\,(m - a_0c_0)\,q_e &> |(1+i)\,(a_0c_0 - m)\,q_e \\ &\quad + 2a_0F + F\mu_0| \end{aligned} \tag{4.69}$$

Again, the assumption that $\lambda > 0$ given in (4.67) assures that this inequality is true: the absolute value of $(1+i)(a_0c_0 - m)q_e$ on the right hand side (which is initially negative) is identical to the left hand side, but is further decreased by the two additional summands on the right hand side.

## Absolute Aggregate Price Variance under Competition

The positive effect of $i$ on absolute aggregate variance can be assessed trough expression (4.63). It is positive if

$$\begin{aligned} (1+i)mq_e + a_0\left(-c_0(1+i)q_e + 2F(\eta-1)\right) &> -F(\eta-1)\mu_0 \\ (1+i)q_e\,(m - a_0c_0) + 2Fa_0(\eta-1) &> -F(\eta-1)\mu_0 \\ m(1+i)q_e &> a_0c_0(1+i)q_e - 2Fa_0(\eta-1) \\ &\quad - F(\eta-1)\mu_0 \end{aligned} \tag{4.70}$$

This matches (4.67), except of $-2a_0F(\eta-1) - F(\eta-1)\mu_0$, which is smaller than $2a_0F + F\mu_0$, so that the inequality is fulfilled.

## Relative Aggregate Price Variance under Competition

The positive influence of $i$ on relative price dispersion is given in expression (4.66). This is positive if:

$$\begin{aligned}(1+i)^2m^2q_e^2+a_0^2c_0^2(1+i)^2q_e^2+4a_0^2F^2(\eta-1) &> 2a_0c_0(1+i)^2mq_e^2\\ +4a_0F^2(\eta-1)\mu_0+F^2(\eta-1)\mu_0^2 &\end{aligned} \tag{4.71}$$

$$\begin{aligned}\left((1+i)\,mq_e-a_0c_0\,(1+i)\,q_e\right)^2 &> -4a_0^2F^2(\eta-1)\\ &\quad -4a_0F^2(\eta-1)\mu_0\\ &\quad -F^2(\eta-1)\mu_0^2\end{aligned}$$

Going back to the assumption that $\lambda > 0$, we can write (4.67) as

$$\begin{aligned}(1+i)mq_e-a_0c_0(1+i)q_e &> 2a_0F+F\mu_0\\ \left((1+i)mq_e-a_0c_0(1+i)q_e\right)^2 &> \left(2a_0F+F\mu_0\right)^2\\ \left((1+i)mq_e-a_0c_0(1+i)q_e\right)^2 &> 4a_0^2F^2+4a_0F^2\mu_0+F^2\mu_0^2\end{aligned}$$

The two conditions are equal besides the fact that all summands on the right hand side are multiplied with $(\eta-1)$, which leads to $4a_0^2F^2+4a_0F^2\mu_0+F^2\mu_0^2 > -4a_0^2F^2(\eta-1)-4a_0F^2(\eta-1)\mu_0-F^2(\eta-1)\mu_0^2$. It has thus been shown that the inequality is true.

# Epilogue

In his 1893 article "On rent", Alfred Marshall defended his marginalist approach to economic analysis against its critics. In a footnote, he wrote:

> I admit that these terms ['final utility', 'marginal production', &c.] and the diagrams connected with them repel some readers, and fill others with the vain imagination that they have mastered difficult economic problems, when really they have done little more than learn the language in which parts of those problems can be expressed, and the machinery by which they can be handled. When the actual conditions of particular problems have not been studied, such knowledge is little better than a derrick for sinking oil-wells erected where there are no oil-bearing strata.
> (Marshall, 1893, p. 81. comments added)

As one of the most important figures in the development of the marginalist price theory that predominates today, Marshall clearly saw the limitations of this framework and the necessity for studying the relevant factors that govern real-world phenomena. Yet his words of caution are mostly disregarded in contemporary economics. Implications derived from neoclassical models, often extended to include notions of particular problems, are often treated as positive predictions instead of results obtained from normative models that could be compared to reality. In contrast to Marshall's understanding, marginalism is not used as a tool in the analysis of the real world, but rather as an engine that directly generates purportedly reliable insights into economic phenomena. Most economists thus rely on the validity of as-if justifications of the neoclassical postulates, despite their weak theoretical foundations and the contradictions of both assumptions and results with empirical experience. Observed phenomena that cannot be explained initially are incorporated through arbitrary extensions of the neoclassical model that allow for a reformulation of the

empirical facts as a result of a maximization problem in the specific context. The result is a plethora of rigorous models, each highly specific to the particular aspect it is designed to replicate. At the same time, the economist is left with no insight into the real mechanisms that govern industrial pricing, as he is unable to distinguish which of the countless specifications of the marginalist pricing model is applicable in the case he wants to investigate. In this sense, the instrumentalist approach to marginalist price theory is not only conceptually flawed, but also fails its proclaimed purpose to serve as a reliable tool for economic analysis. Yet alternative approaches to price theory fail to be recognized by the majority of the profession, as do the many shortcomings of the prevailing approach.

In this work, I aimed at giving both a description of the development that led to this dominance of implicit marginalist price theory, and tried to generate new impulses towards a novel theoretical approach of modelling pricing behaviour that is more oriented towards realism than the predominating framework. The phenomenon of full-cost pricing served as a pivotal point for pursuing both motivations. Through its prominence in the marginalist controversy, its demise as an alternative theoretical concept to marginalist price theory signified the movement away from studying actual pricing behaviour towards the retreat of economists to an instrumentalist understanding of the neoclassical framework. In addition, full-cost pricing as an empirical phenomenon remains one of the most prominent yet largely inexplicable facts and is, as such, a testament to our inability to identify the factors that really govern pricing behaviour. As standard marginalist price theory cannot give a reason for its persistence, I argued that we have to look elsewhere to find answers.

In Chapters 2 and 3, respectively, I therefore drew upon institutional economics on the one hand, and on aspects of the behavioural theory of the firm on the other hand, to shed light on the prevalence of full-cost pricing. In the institutional analysis, it was discussed how full-costing techniques gained importance and prominence through historical, organizational and political developments and persist despite being criticized for their inefficiency and the availability of more sophisticated costing systems. In the course of this investigation, several factors, such as the influence of regulations for financial accounting on internal costing, were identified which contribute towards the persistence of full-cost methods. In Chapter 3, the cost-plus mechanism as for-

mulated in the neoclassical framework was contrasted to an approach that incorporated notions of the firm's limited cognitive resources and subsequent reliance on heuristics. It was shown that in this context, full-cost pricing might be a favourable strategy due to increased robustness in the face of uncertainty when compared to a cost-plus approach that is oriented toward marginalist principles.

The two explanations given for the persistence of full-cost pricing methods exemplified that many factors exert an influence on the pricing decision that are not accounted for by marginal price theory. That such an approach can yield insights into phenomena at the market level was exemplified in Chapter 4. It was demonstrated that if the behavioural pricing model introduced earlier is modified to incorporate inflationary shocks, it can replicate the empirical finding that inflation leads to an increase in the dispersion of relative prices.

As such, the final chapter demonstrated that a theoretical departure from standard marginalist price theory, and a new empiricism that does not rest on an interpretation of observed phenomena along marginalist lines, are worthwhile endeavours. From such an effort, new insights into both the pricing behaviour of firms and many other economic phenomena can be expected. It is thus hoped that economics will lose its firm belief in the validity of marginalist price theory as an accurate description of reality and will extend its research agenda towards a more thorough understanding of pricing behaviour.

# Bibliography

Ahmed, M. N. and Scapens, R. W. (1991), Cost Allocation Theory and Practice: The Continuing Debate, *in* D. Ashton, T. Hopper and R. W. Scapens, eds, 'Issues in Management Accounting', Prentice Hall, New York, pp. 39–60.

Ahmed, M. N. and Scapens, R. W. (2000), "Cost Allocation in Britain: Towards an Institutional Analysis", *European Accounting Review*, Vol. 9, pp. 159–204.

Aiginger, K. (1987), *Production and Decision Theory Under Uncertainty*, Blackwell Publishers, Oxford.

Akerlof, G. A., Dickens, W. T., Perry, G. L., Bewley, T. F. and Blinder, A. S. (2000), "Near-Rational Wage and Price Setting and the Long-Run Phillips Curve", *Brookings Papers on Economic Activity*, Vol. 2000, pp. 1–60.

Akerlof, G. A. and Yellen, J. L. (1985), "Can Small Deviations from Rationality Make Significant Differences to Economic Equilibria?", *The American Economic Review*, Vol. 75, pp. 708–720.

Al-Najjar, N., Baliga, S. and Besanko, D. (2008), "Market Forces Meet Behavioral Biases: Cost Misallocation and Irrational Pricing", *RAND Journal of Economics*, Vol. 39, pp. 214–237.

Alchian, A. A. (1950), "Uncertainty, Evolution, and Economic Theory", *Journal of Political Economy*, Vol. 58, pp. 211–221.

Aldcroft, D. H. (1962), "Government Control and the Origin of Restrictive Trade Practices in Great Britain", *Accountants Magazine*, Vol. 65, pp. 681–687.

Alvarez, L. J. (2007), What Do Micro Price Data Tell Us on the Validity of the New Keynesian Phillips Curve?, *in* Kiel Institute for the World Economy, ed., 'Conference on 'The Phillips Curve and the Natural Rate of Unemployment".

Anderson, S. W. (1995), "A Framework for Assessing Cost Management System Changes: The Case of Activity Based Costing Implementation at General Motors, 1986-1993", *Journal of Management Accounting Research*, Vol. 7, pp. 1–51.

Andrews, P. (1949), *Manufacturing Business*, Macmillan, London.

Armitage, H. M. and Nicholson, R. (1993), "Activity-Based Costing: A Survey of Canadian Practice", *CMA Magazine*, Vol. 67, p. 22.

Ask, U., Ax, C. and Jönsson, S. (1996), Cost Management in Sweden: From Modern to Post-Modern, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York, pp. 199–217.

Atkin, B. and Skinner, R. (1977), *How British Industry Prices*, Industrial Market Research Ltd., London.

Baba, N. (1997), "Markup Pricing and Monetary Policy: A Reexamination of the Effectiveness of Monetary Policy under Imperfect Competition", *Monetary and Economic Studies*, Vol. 15, pp. 27–62.

Baharad, E. and Eden, B. (2004), "Price Rigidity and Price Dispersion: Evidence from Micro Data", *Review of Economic Dynamics*, Vol. 7, pp. 613–641.

Balakrishnan, R. and Sivaramakrishnan, K. (2002), "A Critical Overview of the Use of Full-Cost Data for Planning and Pricing", *Journal of Management Accounting Research*, Vol. 14, pp. 3–32.

Balkin, N. (1956), "Prices in the Clothing Industry", *Journal of Industrial Economics*, Vol. 5, pp. 1–15.

Barback, R. H. (1964), *The Pricing of Manufactures*, Macmillan, London.

Barbato, M. B., Collini, P. and Quagli, A. (1996), Management Accounting in Italy: Evolution within Tradition, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York, pp. 140–163.

Barro, R. J. (1977), "Unanticipated Money Growth and Unemployment in the United States", *The American Economic Review*, Vol. 67, pp. 101–115.

Baumes, C. G., ed. (1963), *Allocating Corporate Expenses*, National Industrial Conference Board, New York.

Baumol, W. (1959), *Business Behaviour, Value and Growth*, Hartcourt, Brace and World, New York.

Benabou, R. (1988), "Search, Price Setting and Inflation", *The Review of Economic Studies*, Vol. 55, pp. 353–376.

Bergmann, B. R. (2007), "Needed: A New Empiricism", *The Economists' Voice*, Vol. 4, pp. 1–4.

Bertola, G. and Caballero, R. J. (1990), "Kinked Adjustment Costs and Aggregate Dynamics", *NBER Macroeconomics Annual*, Vol. 5, pp. 237–288.

Bertrand, J. (1883), "Revue de la Theorie Mathematique de la Richesse Sociale et des Recherches sur les Principles Mathematiques de la Theorie des Richesses.", *Journal des Savants*, Vol. 67, pp. 499–508.

Bils, M. (1987), "The Cyclical Behavior of Marginal Cost and Price", *The American Economic Review*, Vol. 77, pp. 838–855.

Bils, M. and Klenow, P. J. (2004), "Some Evidence on the Importance of Sticky Prices", *Journal of Political Economy*, Vol. 112, pp. 947–985.

Blackwell, R. (1954), "The Pricing of Books", *The Journal of Industrial Economics*, Vol. 2, pp. 174–183.

Blinder, A., Canetti, E., Lebow, D. and Rudd, J. (1998), *Asking about Prices: A New Approach to Understanding Price Stickiness*, Russell Sage Foundation, New York.

Blume, L. E. and Easley, D. (2002), "Optimality and Natural Selection in Markets", *Journal of Economic Theory*, Vol. 107, pp. 95–135.

Boland, L. (1979), "A Critique of Friedman's Critics", *Journal of Economic Literature*, Vol. 17, pp. 503–522.

Boland, L. (1981), "On the Futility of Criticizing the Neoclassical Maximization Hypothesis", *The American Economic Review*, Vol. 71, pp. 1031–1036.

Brierley, J. A., Cowton, C. J. and Drury, C. (2001), "Research into Product Costing Practice: A European Perspective", *European Accounting Review*, Vol. 10, pp. 215–256.

Bromwich, M. and Hong, C. (1999), "Activity-Based Costing Systems and Incremental Costs", *Management Accounting Research*, Vol. 10, pp. 39–60.

Bruggeman, W., Slagmulder, R. and Dominique, W. (1996), Management Accounting Changes: The Belgian Experience, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York, pp. 1–30.

Buchheit, S. (2004), "Fixed Cost Magnitude, Fixed Cost Reporting Format, and Competitive Pricing Decisions: Some Experimental Evidence", *Contemporary Accounting Research*, Vol. 21, pp. 1–24.

Buchheit, S. and Feltovich, N. (2008), 'Experimental Evidence of a Sunk Cost Paradox: A Study of Pricing Behavior in Bertrand Edgeworth Duopoly'.
**URL:** *http://www.uh.edu/ nfelt/papers/sunkcost.pdf*

Burgstahler, D. and Noreen, E. W. (1997), "Full-Cost Pricing and the Illusion of Satisficing", *Journal of Management Accounting Research*, Vol. 9, pp. 239–263.

Burns, J. and Scapens, R. W. (2000), "Conceptualizing Management Accounting Change: An Institutional Framework", *Management Accounting Research*, Vol. 11, pp. 3–25.

Burrows, G. H. (1994), "Allocations and Common Costs in Long-Run Investing and Pricing Decisions: An Historical Analysis", *Abacus*, Vol. 30, pp. 50–64.

Calvo, G. A. (1983), "Staggered Prices in a Utility-Maximizing Framework", *Journal of Monetary Economics*, Vol. 12, pp. 383–398.

Caplin, A. S. and Spulber, D. F. (1987), "Menu Costs and the Neutrality of Money", *The Quarterly Journal of Economics*, Vol. 102, pp. 703–725.

Cecchetti, S. G. (1986), "The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazines", *Journal of Econometrics*, Vol. 31, pp. 255–274.

Chamberlin, E. H. (1933), *The Theory of Monopolistic Competition: A Re-Orientation of the Theory of Value*, Harvard University Press, Cambridge, Mass.

Clarke, P., ed. (1992), *Management Accounting Practices and Techniques in Irish Manufacturing Firms: The 15th Annual Congress of the European Accounting Association, Madrid, Spain*.

Coase, R. H. (1937), "The Nature of the Firm", *Economica*, Vol. 4, pp. 386–405.

Coase, R. H. (1946), "The Marginal Cost Controversy", *Economica*, Vol. 13, pp. 169–182.

Coase, R. H. (1955), Comment to: Full Costs, Cost Changes, and Prices by Richard B. Heflebower, *in* National Bureau of Economic Research, ed., 'Business Concentration and Price Policy', Princeton University Press, pp. 392–394.

Coase, R. H. (1973), Business Organization and the Accountant: (1938), *in* J. M. Buchanan and G. F. Thirlby, eds, 'LSE Essays on Cost', New York University Press, New York, pp. 95–132.

Coase, R. H. (1990), "Accounting and the Theory of the Firm", *Journal of Accounting and Economics*, Vol. 12, pp. 3–13.

Considine, T. (2001), "Markup Pricing in Petroleum Refining: A Multiproduct Framework", *International Journal of Industrial Organization*, Vol. 19, pp. 1499–1526.

Cooper, R. and Kaplan, R. S. (1988), "How Cost Accounting Distorts Product Costs", *Management Accounting*, Vol. 69, pp. 20–27.

Coutts, K., Godley, W. and Nordhaus, W. (1978), *Industrial Pricing in the United Kingdom*, Cambridge University Press, Cambridge, UK.

Coutts, K. and Norman, N. R. (2007), "Global Influences on UK Manufacturing Prices: 1970 - 2000", *European Economic Review*, Vol. 51, pp. 1205–1221.

Cowan, R. (1990), "Nuclear Power Reactors: A Study in Technological Lock-In", *The Journal of Economic History*, Vol. 50, pp. 541–567.

Cruccolini, R. (2010), Primat der Form: Zur Methodologie und Geschichte der modernen Makroökonomik, PhD thesis, Ludwig-Maximilians-Universität München, mimeo, München.

Cyert, R. M. and March, J. G. (1963), *A Behavioral Theory of the Firm*, Blackwell Publishing, Oxford.

Danziger, L. (1987), "Inflation, Fixed Cost of Price Adjustment, and Measurement of Relative-Price Variability: Theory and Evidence", *The American Economic Review*, Vol. 77, pp. 704–713.

David, P. A. (1985), "Clio and the Economics of QWERTY", *The American Economic Review*, Vol. 75, pp. 332–337.

Dean, J. (1936), "Statistical Determination of Cost with Special Reference to Marginal Cost", *Studies in Business Administration*, Vol. 7.

Dean, J. (1941*a*), "Statistical Cost Functions of a Hosiery Mill", *Studies in Business Administration*, Vol. 14.

Dean, J. (1941*b*), *The Relation of Cost to Output for a Leather Belt Shop*, Vol. 2, National Bureau of Economic Research, Cambridge, Mass.

Dickhaut, J. W. and Lere, J. C. (1983), "Comparison of Accounting Systems and Heuristics in Selecting Economic Optima", *Journal of Accounting Research*, Vol. 21, pp. 495–513.

Dorward, N. (1986), "Overhead Allocations and 'Optimal' Pricing Rules of Thumb in Oligopolistic Markets", *Journal of Accounting and Business Research*, Vol. 16, pp. 309–317.

Dorward, N. (1987), *The Pricing Decision: Economic Theory and Business Practice*, Harper and Row, Cambridge, UK.

Dosi, G. (2007), Statistical Regularities in the Evolution of Industries. A Guide through some Evidence and Challenges for the Theory, *in* F. Malerba and S. Brusoni, eds, 'Perspectives on Innovation', Cambridge University Press, Cambridge, UK.

Downward, P. (1999), *Pricing Theory in Post Keynesian Economics: A Realist Approach*, Edward Elgar Publishing, Cheltenham, Northampton.

Drury, C. (2008), *Management and Cost Accounting*, International Thomson Business Press, London.

Drury, C., Braund, S., Osborne, P. and Tayles, M. (1993), *A Survey of Management Accounting Practices in UK Manufacturing Companies*, Certified Accountants Educational Trust, London.

Drury, C. and Tayles, M. (2000), *Cost System Design and Profitability Analysis in UK Companies*, CIMA, London.

Drury, C. and Tayles, M. (2005), "Explicating the Design of Overhead Absorption Procedures in UK Organizations", *The British Accounting Review*, Vol. 37, pp. 47–84.

Dutta, P. K. and Radner, R. (1999), "Profit Maximization and the Market Selection Hypothesis", *The Review of Economic Studies*, Vol. 66, pp. 769–798.

Earley, J. S. (1956), "Marginal Policies of Excellently Managed Companies", *The American Economic Review*, Vol. 46, pp. 44–70.

Edwards, R. S. (1937), "Some Notes on the Early Literature and Development of Cost Accounting in Great Britain", *The Accountant*, Vol. 97, pp. 193–195.

Edwards, R. S. (1952), "The Pricing of Manufactured Products", *Economica*, Vol. 19, pp. 298–307.

Eichner, A. S. (1973), "A Theory of the Determination of the Mark-Up under Oligopoly", *The Economic Journal*, Vol. 83, pp. 1184–1200.

Eiteman, W. (1945), "The Equilibrium of the Firm in Multi-Process Industries", *The Quarterly Journal of Economics*, Vol. 59, pp. 280–286.

Eiteman, W. (1947), "Factors Determining the Location of the Least Cost Point", *The American Economic Review*, Vol. 37, pp. 910–918.

Eiteman, W. and Guthrie, G. (1952), "The Shape of the Average Cost Curve", *The American Economic Review*, Vol. 42, pp. 832–838.

Elwertowski, T. C. and Vining, JR., D. R. (1976), "The Relationship between Relative Prices and the General Price Level", *American Economic Review*, Vol. 66, pp. 699–708.

Ezekiel, M. and Wylie, K. (1940), "The Cost Curve for Steel Production", *Journal of Political Economy*, Vol. 48, pp. 777–821.

Fabiani, S., Loupias, C., Martins, F. and Sabbatini, R. (2007), *Pricing Decisions in the Euro Area*, Oxford University Press, New York.

Fengler, M. R. and Winter, J. K. (2007), "Price Variability and Price Dispersion in a Stable Monetary Environment: Evidence from German Retail Markets", *Managerial and Decision Economics*, Vol. 28, pp. 789–801.

Fischer, S. (1986), *Indexing, Inflation, and Economic Policy*, Vol. 1, The MIT Press, Cambridge, Mass.

Fischer, S., Hall, R. E. and Taylor, J. B. (1981), "Relative Shocks, Relative Price Variability, and Inflation", *Brookings Papers on Economic Activity*, Vol. 1981, pp. 381–441.

Fog, B. (1960), *Industrial Pricing Policies: An Analysis of Pricing Policies of Danish Manufacturers*, North-Holland Publ. Comp., Amsterdam.

Fogarty, M. P. (1943), "The Incidence of Rates on Houses", *The Review of Economic Studies*, Vol. 10, pp. 81–105.

Fraser, R. (1985), "Uncertainty and the Theory of Mark-Up Pricing", *Bulletin of Economic Research*, Vol. 37, pp. 55–64.

Fremgen, J. M. and Liao, S. S. (1981), *The Allocation of Corporate Indirect Costs*, National Association of Accountants, New York.

Friedl, G., Hammer, C., Pedell, B. and Küpper, H. U. (2009), "How Do German Companies Run Their Cost Accounting Systems?", *Management Accounting Quarterly*, Vol. 10, pp. 38–52.

Friedman, A. L. and Lyne, S. R. (1995), *Activity-Based Techniques: The Real Life Consequences*, Chartered Institute of Management Accountants, London.

Friedman, D., Pommerenke, K., Lukose, R., Milam, G. and Huberman, B. A. (2007), "Searching for the Sunk Cost Fallacy", *Experimental Economics*, Vol. 10, pp. 79–104.

Friedman, M. (1953), The Methodology of Positive Economics, *in* M. Friedman, ed., 'Essays in Positive Economics', University of Chicago Press, Chicago.

Friedman, M. (1977), "Nobel Lecture: Inflation and Unemployment", *The Journal of Political Economy*, Vol. 85, pp. 451–472.

Friedman, M. and Savage, L. J. (1948), "The Utility Analysis of Choices Involving Risk", *The Journal of Political Economy*, Vol. 56, pp. 279–304.

Gigerenzer, G. and Todd, P. M. (1999), *Simple Heuristics That Make Us Smart*, Oxford University Press, New York.

Gordon, R. A. (1948), "Short-Period Price Determination in Theory and Practice", *American Economic Review*, Vol. 38, pp. 265–288.

Gosselin, M. (1997), "The Effect of Strategy and Organizational Structure on the Adoption and Implementation of Activity-Based Costing", *Accounting Organisations and Society*, Vol. 22, pp. 105–122.

Govindarajan, V. and Anthony, R. (1983), "How Firms Use Cost Data in Price Decisions", *Management Accounting*, Vol. 65, pp. 30–36.

Grant, S. and Quiggin, J. (1994), "Nash Equilibrium with Mark-Up-Pricing Oligopolists", *Economics Letters*, Vol. 45, pp. 245–251.

Grier, K. B. and Perry, M. J. (1996), "Inflation, Inflation Uncertainty, and Relative Price Dispersion: Evidence from Bivariate GARCH-M Models", *Journal of Monetary Economics*, Vol. 38, pp. 391–405.

Güth, W. (1995), "On Ultimatum Bargaining Experiments – A Personal Review", *Journal of Economic Behavior & Organization*, Vol. 27, pp. 329–344.

Hall, R. E. (1988), "The Relation between Price and Marginal Cost in US Industry", *The Journal of Political Economy*, Vol. 96, pp. 921–947.

Hall, R. L. and Hitch, C. J. (1939), "Price Theory and Business Behavior", *Oxford Economic Papers*, Vol. 2, pp. 12–45.

Hanson, W. (1992), "The Dynamics of Cost-Plus Pricing", *Managerial and Decision Economics*, Vol. 13, pp. 149–161.

Harcourt, G. C. and Kenyon, P. (1976), "Pricing and the Investment Decision", *Kyklos*, Vol. 29, pp. 449–477.

Harrod, R. F. (1939), "Price and Cost in Entrepreneurs' Policy", *Oxford Economic Papers*, Vol. 2, pp. 1–11.

Harrod, R. F. (1952), *Economic Essays*, Macmillan, London.

Heflebower, R. B. (1955), Full Costs, Cost Changes and Prices, *in* Universities-National Bureau Committee for Economic Research, ed., 'Business Concentration and Price Policy', Princeton University Press, Cambridge, Mass., pp. 361–396.

Heien, D. M. (1980), "Markup Pricing in a Dynamic Model of the Food Industry", *American Journal of Agricultural Economics*, Vol. 62, pp. 10–18.

Hey, J. D. (1983), "Whither Uncertainty?", *The Economic Journal*, Vol. 93, pp. 130–139.

Hilton, R. W., Swieringa, R. J. and Turner, M. J. (1988), "Product Pricing, Accounting Costs and Use of Product-Costing Systems", *Accounting Review*, Vol. 63, pp. 195–218.

Hopper, T. and Armstrong, P. (1991), "Cost Accounting, Controlling Labour and the Rise of Conglomerates", *Accounting, Organizations and Society*, Vol. 16, pp. 405–438.

Hopper, T., Kirkham, L., Scapens, R. W. and Turley, S. (1992), "Does Financial Accounting Dominate Management Accounting - A Research Note", *Management Accounting Research*, Vol. 3, pp. 307–311.

Innes, J., Mitchell, F. and Sinclair, D. (2000), "Activity-Based Costing in the UKs Largest Companies: A Comparison of 1994 and 1999 Survey Results", *Management Accounting Research*, Vol. 11, pp. 349–362.

Israelsen, P., Andersen, M., Rohde, C. and Poul, S. E. (1996), Management Accounting in Denmark: Theory and Practice, *in* A. Bhimani, ed., 'Management

Accounting: European Perspectives', Oxford University Press, New York, pp. 31–53.

Jobber, D. and Hooley, G. (1987), "Pricing Behaviour in UK Manufacturing and Services Industries", *Managerial and Decision Economics*, Vol. 8, pp. 167–171.

Johnson, H. T. and Kaplan, R. S. (1987), *Relevance Lost: The Rise and Fall of Management Accounting*, Harvard Business School Press, Boston, Mass.

Jones, H. (1985), *Accounting, Costing, and Cost Estimation: Welsh Industry, 1700-1830*, University of Wales Press, Cardiff.

Kahn, R. F. (1952), "Oxford Studies in the Price Mechanism", *The Economic Journal*, Vol. 62, pp. 119–130.

Kalecki, M. (1943), *Studies in Economic Dynamics*, G. Allen & Unwin ltd, London.

Kaplan, R. S. and Cooper, R. (1998), *Cost & Effect: Using Integrated Cost Systems to Drive Profitability and Performance*, Harvard Business School Press, Boston, Mass.

Knight, F. H. (1933), *Risk, Uncertainty and Profit*, Houghton Mifflin, Boston.

Konieczny, J. D. and Skrzypacz, A. (2005), "Inflation and Price Setting in a Natural Experiment", *Journal of Monetary Economics*, Vol. 52, pp. 621–632.

Koutsoyiannis, A. (1984), "Goals of Oligopolistic Firms: An Empirical Test of Competing Hypotheses", *Southern Economic Journal*, Vol. 51, pp. 540–567.

Krumwiede, K. P. (1998), "ABC Why its Tried and How it Succeeds", *Strategic Finance*, Vol. 79, pp. 32–38.

Lach, S. and Tsiddon, D. (1992), "The Behavior of Prices and Inflation: An Empirical Analysis of Disaggregat Price Data", *The Journal of Political Economy*, Vol. 100, pp. 349–389.

Langholm, O. (1969), *Full Cost and Optimal Price: A Study in the Dynamics of Multiple Production*, Universitetsforlaget, Bergen, Oslo, Tromsö, Norway.

Langlois, C. C. (1989), "Markup Pricing versus Marginalism: A Controversy Revisited", *Journal of Post-Keynesian Economics*, Vol. 12, pp. 127–151.

Lanzillotti, R. (1958), "Pricing Objectives in Large Companies", *The American Economic Review*, Vol. 48, pp. 921–940.

Lavoie, M. (1992), *Foundations of Post-Keynesian Economic Analysis*, New Directions in Modern Economics, Elgar, Aldershot.

Lavoie, M. (2001), Pricing, *in* R. P. F. Holt and S. Pressman, eds, 'A New Guide to Post-Keynesian Economics', Vol. 6 of *Contemporary Political Economy Series*, Routledge, London, pp. 21–31.

Lebas, M. (1996), Management Accounting Practice in France, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York, pp. 74–99.

Lee, F. S. (1984), "The Marginalist Controversy and the Demise of Full-Cost Pricing", *Journal of Economic Issues*, Vol. 18, pp. 1107–1132.

Lee, F. S. (1994), "From Post-Keynesian to Historical Price Theory, Part 1: Facts, Theory and Empirically Grounded Pricing Model", *Review of Political Economy*, Vol. 6, pp. 303–336.

Lee, F. S. and Irving-Lesserman, J. (1992), "The Fate of an Errant Hypothesis: The Doctrine of Normal-Cost Prices", *History of Political Economy*, Vol. 24, pp. 273–309.

Leibenstein, H. (1979), "A Branch of Economics is Missing: Micro-Micro Theory", *Journal of Economic Literature*, Vol. 17, pp. 477–502.

Leland, H. E. (1972), "Theory of the Firm Facing Uncertain Demand", *The American Economic Review*, Vol. 62, pp. 278–291.

Lere, J. C. (1986), "Product Pricing Based on Accounting Costs", *Accounting Review*, Vol. 61, pp. 318–324.

Lester, R. A. (1946), "Shortcomings of Marginal Analysis for Wage-Unemployment Problems", *American Economic Review*, Vol. 36, pp. 63–82.

Liebowitz, S. J. and Margolis, S. E. (1990), "The Fable of the Keys", *Journal of Law and Economics*, Vol. 33, pp. 1–25.

List, F. (1841), *Das nationale System der politischen Ökonomie*, J. G. Cotta'scher Verlag, Stuttgart/Tübingen.

Loève, M. (1977), *Probability Theory. 1: Graduate Texts in Mathematics*, 4th edition edn, Springer, Berlin, New York.

Loft, A. (1986), "Towards a Critical Understanding of Accounting: The Case of Cost Accounting in the UK, 1914-1925", *Accounting, Organizations and Society*, Vol. 11, pp. 137–169.

Loft, A. (1988), *Understanding Accounting in its Social and Historical Context*, Garland Pub., New York.

Lucas, M. (1999), "The Pricing Decision: Economists versus Accountants", *Management Accounting*, Vol. 77, pp. 34–35.

Lucas, M. (2000), "Practice Defies Theory: The Reality of Product Costing", *Management Accounting*, Vol. 78, pp. 28–31.

Lucas, M. (2003), "Pricing Decisions and the Neoclassical Theory of the Firm", *Management Accounting Research*, Vol. 14, pp. 201–217.

Lucas, R. E. (1972), "Expectations and the Neutrality of Money", *Journal of Economic Theory*, Vol. 4, pp. 103–124.

Lukka, K. and Granlund, M. (1996), "Cost Accounting in Finland: Current Practice and Trends of Development", *European Accounting Review*, Vol. 5, pp. 1–28.

Macal, C. M. and North, M. J. (2007*a*), Agent-Based Modeling and Simulation: Desktop ABMS, *in* S. G. Henderson, B. Biller, M.-H. Hsieh, J. Shortle, J. D. Tew and R. R. Barton, eds, 'Proceedings of the 2007 Winter Simulation Conference', IEEE Press, Piscataway, NJ, USA, pp. 95–106.

Macal, C. M. and North, M. J. (2007*b*), *Managing Business Complexity: Discovering Strategic Solutions with Agent-Based Modeling and Simulation*, Oxford University Press, New York.

Machlup, F. (1946), "Marginal Analysis and Empirical Research", *American Economic Review*, Vol. 36, pp. 519–554.

Malmi, T. (1997), "Towards Explaining Activity-Based Costing Failure: Accounting and Control in a Decentralized Organization", *Management Accounting Research*, Vol. 8, pp. 459–480.

Marshall, A. (1893), "On Rent", *The Economic Journal*, Vol. 3, pp. 74–90.

Martin, C. (1997), "Price Formation in an Open Economy: Theory and Evidence for the United Kingdom, 1951-1991", *The Economic Journal*, Vol. 107, pp. 1391–1404.

Martins, J. O., Scarpetta, S. and Pilat, D. (1996), "Mark-Up Ratios in Manufacturing Industries", *OECD Discussion Papers*, Vol. 162.

Mautz, R. and Skousen, K. F. (1968), Influence of Non-Inventoriable Common Cost Allocation on Segment Net Income, *in* R. K. Mautz, ed., 'Financial Reporting by Diversified Companies', Financial Executives Research Foundation, pp. 357–373.

Means, G. C. (1972), "The Administered-Price Thesis Reconfirmed", *The American Economic Review*, Vol. 62, pp. 292–306.

Mills, F. C. (1927), *The Behavior of Prices*, National Bureau of Economic Research, New York.

Mills, R. W. (1988), "Pricing Decisions in UK Manufacturing and Service Companies", *Management Accounting*, Vol. 66, pp. 38–39.

Mongin, P. (1990), "The Early Full-Cost Debate and the Problem of Empirically Testing Profit-Maximization", *Journal of Post-Keynesian Economics*, Vol. 13, pp. 236–251.

Mongin, P. (1997), The Marginalist Controversy, *in* J. Davis, W. Hands and U. Maki, eds, 'Handbook of Economic Methodology', Edward Elgar, London, pp. 558–562.

Motta, M. (2004), *Competition Policy: Theory and Practice*, Cambridge University Press, Cambridge, UK.

Neild, R. R. (1964), *Pricing and Employment in the Trade Cycle: A Study of British Manufacturing Industry, 1950-61*, Cambridge University Press, Cambridge, UK.

Nelson, R. R. and Winter, S. G. (1982), *An Evolutionary Theory of Economic Change*, Belknap Press, Cambridge, Mass.

Nordhaus, W. and Godley, W. (1972), "Pricing in the Trade Cycle", *The Economic Journal*, Vol. 82, pp. 853–882.

Noreen, E. (1991), "Conditions under which Activity-Based Cost Systems Provide Relevant Costs", *Journal of Management Accounting Research*, Vol. 3, pp. 159–168.

Offerman, T. and Potters, J. (2006), "Does Auctioning of Entry Licences Induce Collusion? An Experimental Study", *Review of Economic Studies*, Vol. 73, pp. 769–791.

Oi, W. Y. (1962), "Labor as a Quasi-Fixed Factor", *The Journal of Political Economy*, Vol. 70, pp. 538–555.

Olive, M. (2002), *Price and Markup Behaviour in Manufacturing: A Cross Country Study*, Edward Elgar, Cheltenham, Northampton.

Park, T. and Lohr, L. (1996), "Wholesaler Markup Decisions Under Demand Uncertainty", *University of Georgia, Department of Agriculture and Applied Economics Faculty Series*, Vol. FS 96-13.

Parks, R. W. (1978), "Inflation and Relative Price Variability", *The Journal of Political Economy*, Vol. 86, pp. 79–95.

Parsley, D. C. (1996), "Inflation and Relative Price Variability in the Short and Long Run: New Evidence from the United States", *Journal of Money, Credit & Banking*, Vol. 28, pp. 323–341.

Pasche, M. (1997), "Markup Pricing and Demand Uncertainty", *Discussion Paper Series, Friedrich-Schiller-Universität Jena*, Vol. B97/08.

Pearce, I. F. (1956), "A Study in Price Policy", *Economica*, Vol. 23, pp. 114–127.

Pearce, I. F. and Amey, L. R. (1956), "Price Policy with a Branded Product", *The Review of Economic Studies*, Vol. 24, pp. 49–60.

Pool, A. G. and Llewellyn, G. (1958), *The British Hosiery Industry: A Study in Competition: Third Report*, Leicester University Press, Leicester.

Prakash, P. and Rappaport, A. (1977), "Information Inductance and its Significance for Accounting", *Accounting, Organizations and Society*, Vol. 2, pp. 29–38.

Puffert, D. J. (2000), "The Standardization of Track Gauge on North American Railways, 1830-1890", *The Journal of Economic History*, Vol. 60, pp. 933–960.

Puffert, D. J. (2004), Path Dependence, Network Form, and Technological Change, *in* T. Guinnane, W. A. Sundstrom and W. C. Whatley, eds, 'History Matters: Essays on Economic Growth, Technology, and Demographic Change', Stanford University Press, Palo Alto, CA, pp. 63–95.

Puffert, D. J. (2008), Path Dependence, *in* R. Whaples, ed., 'EH.Net Encyclopedia of Economic and Business History'.
**URL:** *http://eh.net/encyclopedia/article/puffert.path.dependence*

Puty, C. C. B. (2005), Rates of Profit, Technical Change and Distribution: Essays on the Short-Run Dynamics of Classical Competition, PhD thesis, New School University, New York.

Ramey, V. A. (1991), "Nonconvex Costs and the Behavior of Inventories", *Journal of Political Economy*, Vol. 99, pp. 306–334.

Reinsdorf, M. (1994), "New Evidence on the Relation Between Inflation and Price Dispersion", *The American Economic Review*, Vol. 84, pp. 720–731.

Robinson, A. (1939), "Review of Oxford Economic Papers, ed. R.F. Harrod et al.", *The Economic Journal*, Vol. 49, pp. 538–543.

Robinson, A. (1950), "The Pricing of Manufactured Products", *The Economic Journal*, Vol. 60, pp. 771–780.

Robinson, J. (1933), *The Economics of Imperfect Competition*, Macmillan, London.

Robinson, J. (1953), "Imperfect Competition Revisited", *Economic Journal*, Vol. 63, pp. 579–593.

Rotemberg, J. J. (1982), "Monopolistic Price Adjustment and Aggregate Output", *The Review of Economic Studies*, Vol. 49, pp. 517–531.

Rotemberg, J. J. and Woodford, M. (1999), The Cyclical Behavior of Prices and Costs, *in* J. B. Taylor and M. Woodford, eds, 'Handbook of Macroeconomics', North-Holland Elsevier, Amsterdam, New York.

Rothschild, M. (1973), "Models of Market Organization with Imperfect Information: A Survey", *The Journal of Political Economy*, Vol. 81, pp. 1283–1308.

Rushdy, F. and Lund, P. J. (1967), "The Effect of Demand on Prices in British Manufacturing Industry", *The Review of Economic Studies*, Vol. 34, pp. 361–373.

Saez-Torrecilla, A., Fernandez-Fernandez, A., Texeira-Quiros, J. and Vaquera-Mosquero, M. (1996), Management Accounting in Spain: Trends in Thought and Practice, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York.

Salop, S. and Stiglitz, J. (1977), "Bargains and Ripoffs: A Model of Monopolistically Competitive Price Dispersion", *The Review of Economic Studies*, Vol. 44, pp. 493–510.

Samiee, S. (1987), "Pricing in Marketing Strategies of U.S.- and Foreign-Based Companies", *Journal of Business Research*, Vol. 15, pp. 17–30.

Scapens, R. W. (1994), "Never Mind the Gap: Towards an Institutional Perspective on Management Accounting Practice", *Management Accounting Research*, Vol. 5, pp. 301–321.

Scapens, R. W., Gameil, M. Y. and Cooper, D. J. (1983), Accounting Information for Pricing Decisions: An Empirical Study, *in* J. Arnold, D. Cooper and R. W. Scapens, eds, 'Management Accounting Research and Practice', CIMA, London, pp. 283–306.

Scapens, R. W. and Jazayeri, M. (2003), "ERP Systems and Management Accounting Change: Opportunities or Impacts", *European Accounting Review*, Vol. 12, pp. 201–233.

Scherrer, G. (1996), Management Accounting: A German Perspective, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York, pp. 100–122.

Schlicht, E. (1998), *On Custom in the Economy*, Oxford University Press, New York.

Sharman, P. A. and Vikas, K. (2004), "Lessons from German Cost Accounting", *Strategic Finance*, Vol. 85, pp. 28–35.

Sheshinski, E. and Weiss, Y. (1977), "Inflation and Costs of Price Adjustment", *The Review of Economic Studies*, Vol. 44, pp. 287–303.

Shiller, R. (1991), "Comment on: Why are Prices Sticky? Preliminary Results From an Interview Study", *American Economic Review*, Vol. 81, pp. 97–98.

Shim, E. and Sudit, E. (1995), "How Manufacturers Price Products", *Management Accounting*, Vol. 76, pp. 37–39.

Shipley, D. D. (1983), "Pricing Flexibility in British Manufacturing", *Managerial and Decision Economics*, Vol. 4, pp. 224–233.

Shubik, M. and Levitan, R. (1980), *Market Structure and Behaviour*, Harvard University Press, Cambridge, Mass.

Silberston, A. (1951), "The Pricing of Manufactured Products: A Comment", *The Economic Journal*, Vol. 61, pp. 426–429.

Simon, H. (1955), "A Behavioral Model of Rational Choice", *The Quarterly Journal of Economics*, Vol. 69, pp. 99–118.

Simon, H. (1979), "Rational Decision Making in Business Organizations", *The American Economic Review*, Vol. 69, pp. 493–513.

Simon, H. (1997), *Models of Bounded Rationality: Empirically Grounded Economic Reason: Vol, 3*, MIT Press, Cambridge, Mass.

Skinner, R. C. (1970), "The Determination of Selling Prices", *The Journal of Industrial Economics*, Vol. 18, pp. 201–217.

Solomons, D. (1950), "Uniform Cost Accounting-A Survey", *Economica*, Vol. 17, pp. 237–253.

Stigler, G. J. (1947), "The Kinky Oligopoly Demand Curve and Rigid Prices", *The Journal of Political Economy*, Vol. 55, pp. 432–449.

Stigler, G. J. and Kindahl, J. K. (1970), *The Behavior of Industrial Prices*, National Bureau of Economic Research, New York.

Sweezy, P. (1939), "Demand Under Conditions of Oligopoly", *The Journal of Political Economy*, Vol. 47, pp. 568–573.

Thépot, J. and Netzer, J. L. (2008), "On the Optimality of the Full-Cost Pricing", *Journal of Economic Behavior and Organization*, Vol. 68, pp. 282–292.

Thomson, J. and Gurowka, J. (2005), "Sorting Out the Clutter", *Strategic Finance*, Vol. 87, pp. 27–33.

Tommasi, M. (1993), Inflation and Relative Prices: Evidence from Argentina, *in* E. Sheshinski and Y. Weiss, eds, 'Optimal Pricing, Inflation, and the Cost of Price Adjustment', MIT Press, Cambridge, Mass., pp. 485–511.

Tommasi, M. (1994), "The Consequences of Price Instability on Search Markets: Toward Understanding the Effects of Inflation", *The American Economic Review*, Vol. 84, pp. 1385–1396.

Troughton, F. (1963), "The Teaching Concerning Costs of Production in Introductory Economics", *The Journal of Industrial Economics*, Vol. 11, pp. 96–115.

Turner, M. J. and Hilton, R. W. (1989), "Use of Accounting Product-Costing Systems in Making Production Decisions", *Journal of Accounting Research*, Vol. 27, pp. 297–312.

van Dalen, J. and Thurik, R. (1998), "A Model of Pricing Behavior: An Econometric Case Study", *Journal of Economic Behavior and Organization*, Vol. 36, pp. 177–195.

van Hoomissen, T. (1988), "Price Dispersion and Inflation: Evidence from Israel", *The Journal of Political Economy*, Vol. 96, pp. 1303–1314.

van Nguyen, H. and Brooks, A. (1997), "An Empirical Investigation of Adoption Issues Relating to Activity-Based Costing", *Asian Review of Accounting*, Vol. 5, pp. 1–18.

Varian, H. R. (1980), "A Model of Sales", *The American Economic Review*, Vol. 70, pp. 651–659.

Virtanen, K., Malmi, T., Vaivio, J. and Kasanen, E. (1996), Drivers of Management Accounting in Finland, *in* A. Bhimani, ed., 'Management Accounting: European Perspectives', Oxford University Press, New York, pp. 218–241.

Vromen, J. (2009), Friedman's Selection Argument Revisited, *in* U. Mäki, ed., 'The Methodology of Positive Economics. Reflections on the Milton Friedman Legacy', Cambridge University Press, pp. 257–284.

Waller, W. S., Shapiro, B. and Sevcik, G. (1999), "Do Cost-Based Pricing Biases Persist in Laboratory Markets?", *Accounting, Organizations and Society*, Vol. 24, pp. 717–739.

Walters, A. A. (1963), "Production and Cost Functions: An Econometric Survey", *Econometrica*, Vol. 31, pp. 1–66.

Wied-Nebbeling, S. (1975), *Industrielle Preissetzung*, Mohr-Siebeck, Tübingen.

Wiles, P. (1950), "Empirical Research and the Marginal Analysis", *The Economic Journal*, Vol. 60, pp. 515–530.

Williamson, O. E. (1963), "Managerial Discretion and Business Behavior", *The American Economic Review*, Vol. 53, pp. 1032–1057.

Winter, S. G. (1964), "Economic Natural Selection and the Theory of the Firm", *Yale Economic Essays*, Vol. 4, pp. 225–272.

Woodford, M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press, Princeton, New Jersey.

Wraith, P. (1998), "Activity Based Costing: Principles, Practice and Applications", *Company Accountant (UK)*, Vol. 147, pp. 31–35.

Yntema, T. O. (1940), "Steel Prices, Volume and Cost", *United States Steel Corporation TNEC Papers*, Vol. 2.

Zimmerman, J. L. (1979), "1978 Competitive Manuscript Award: The Costs and Benefits of Cost Allocations", *The Accounting Review*, Vol. 54, pp. 504–521.

# Curriculum Vitae

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**Education**

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