Research Memorandum

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An Analytical Framework of Industrial Organization for Policy Analysis

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The responsibility for the contents of this Research Memorandum remains with the author(s)

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1. Introduction and summary[1]

In the past decade, the Dutch government has taken steps to change the regulatory environment in order to enhance economic efficiency. By committing itself to regulatory reform, the government intends to unleash competitive forces as a means of improving product market performance. The Ministry of Economic Affairs has started a campaign to rationalize regulation and to enhance competition in erstwhile state monopolies. Further, in accordance with EU-policy, a new government agency will enforce the competition law that prohibits collusion and other anti-competitive business practices. In order to better evaluate the costs and benefits of (de)regulation, and in order to better understand the dynamics of market structure and competition, CPB started a project for developing an analytical framework and developed a guide for policy analysis.

This paper contains an overview of the analytical framework and describes the guide for policy analysis. It is mainly addressed to three types of policymakers. The agency charged with enforcing the new law on competition policy (NMa[2]) and the designers of industrial policy may be interested in a methodology for detecting anti-competitive behavior and potentials for industrial development. The policymakers entrusted with the regulatory reform in particular markets (MDW[3]) are mainly concerned with the costs and benefits of regulation.

No general economic theory exists that sheds light on all the issues related to competition policy, industrial policy and (de)regulation. Instead, in the discipline of Industrial Organization (IO), many theories and models have been developed that relate to aspects of firm behavior or market structure, such as pricing strategy, product innovation, entry or exit decisions, incentives for collusion, and vertical and horizontal integration. The fragmented nature of the theories calls out for an analytical framework that can serve as a guide for selecting the appropriate theories for the problem at hand.

The framework we intend to develop involves a menu of theoretical Industrial Organization models. Jacquemin suggested that `... we must develop a *menu* of theoretical models from which the best adapted model to the market under study can be selected ...' (Jacquemin, 1996). In line with Porters' `competitive forces', we will define a taxonomy of several theories that consider relations between firms and their opponents (competi-

[1] The author wishes to thank CPB colleagues, in particular E.J. Bartelsman , A.L. Bovenberg, F.W. Suijker, M.F.M. Canoy and Th. van Dijk, and P. van Cayseele (K.U. Leuven), E.E.C. van Damme (KUB), R.C.G. Hafner and J. Nijkamp (Ministry of Economic Affairs) and M.H.C. Lever (EIM) for their useful comments.

[2] I.e. the "Nederlandse Mededingingsautoriteit".

[3] I.e. the governmental project "Marktwerking, Deregulering en Wetgevingskwaliteit".

tors, suppliers, customers etc.) (see Porter, 1985). Firms' behavior typical for each relation may induce market imperfections and harm welfare. These imperfections may open up a potential role for policy to remove these market distortions. By determining the potential gain in dynamic welfare, we will then indicate the effectiveness of several policy options and regulatory reforms.

There are several comprehensive and outstanding reviews of IO theory,[4] but they are not intended to combine diverse subjects in IO theory relevant to policymakers. But since complex combinations occur in reality, analysts and policymakers have to combine various subjects. Our intention is then to take the first steps in designing a framework that provides a means for selecting appropriate theories.

Nevertheless, we must emphasize that our framework remains a menu or taxonomy of concepts with many restrictions. The choice of treated subjects is restricted and certainly not exhaustive. Moreover, this paper contains only mainstream ideas and concepts -- and no complete descriptions of theories that actually hold only for particular situations.

The following sections of this paper provide a guide for policy analysis and a survey of the analytical framework. Section 2 gives a theoretical background of regulation and competition policy, and positions our framework in related IO literature. Section 3 provides two definitions on the primary goals of regulation and discusses several efficiency concepts. In section 4 we take a closer look at the analytical framework and consider several types of firms' strategic behavior that determine the supply conditions and market interactions between firms. Section 5 considers the welfare implications of various policy options to remove market failures caused by firm behavior. Finally, section 6 completes the guide for policy analysis with a `checklist' of market or firm characteristics, directing the analyst to the related models and policy issues for any particular market. This section ends with one example of how to use the framework.

This paper shows different angles for analyzing market structure, competition and policy issues, and results, thus, in unavoidable overlap and duplication of several parts (particularly in sections 4, 5 and 6). We would therefore like to make some suggestions for reading. A reader can start with sections 2, 3 and 4.1. Then the reader interested in a particular policy approach may continue with section 5, and when the text so indicates, return to other parts of section 4 for enlightment and background information. The

[4] See e.g. Carlton and Perloff, 1994, Laffont and Tirole, 1993, Scherer and Ross, 1990, Schmalensee and Willig, 1989 and Tirole, 1988.

reader analyzing a particular market may continue with section 6, and will find out which parts of sections 4 and 5 can be consulted.

2. Several views on regulation

This section will first consider three traditional views on regulation (see e.g. Bos, 1996, and Viscusi et al., 1992). Then we will describe how new insights combine several concepts of the traditional views and result in a modern theory of regulation.

The first traditional, neo-classical view focuses on market imperfections: the government should impose some rules or regulations in order to remove undesired effects (or market imperfections) that may emerge as a result of the behavior of suppliers or customers. Bos, 1996, points to several types of imperfections. First, some suppliers or customers behave in such a way that they harm other agents, even if this behavior results in better cost efficiency. For example, an unregulated monopoly may abuse its dominant position at the expense of customers. Second, competitive behavior may result in undesirable effects outside the scope of the market (external effects), e.g. pollution and other environmental issues, or the failure to produce enough non-excludable or public products. Many of these imperfections are caused by the fact that market players have imperfect information about their opponent's behavior or characteristics. Opponents can take advantage of the information asymmetry, and engage in opportunistic behavior to improve their position.

The second traditional view is often associated with the `Chicago School'. It emphasizes that the *process* of regulation is influenced by (conflicting) objectives. Different communities of interest, such as firm- and consumer organizations, would try to persuade the government to adapt the regulatory framework in their favor. But as the government tries to maximize its political support, it would only comply with those requests of organizations that offer the highest support.

The last traditional view, supported by the contestability theory (see Baumol et al., 1988), stresses the importance of competitive forces. It argues that (the potential for) free entry of new firms would lead to the same efficient production and optimal pricing that would occur under perfect competition, so there would be no need for regulation. Section 4.2.1 will elaborate on the underlying theory as well as its shortcomings. Many real world markets are characterized by entry barriers and market imperfections that distort free entry and perfect competition.

From the observation that entry barriers and imperfections do exist, a more comprehensive approach to regulation has emerged. It combines several concepts from the traditional views and stresses that (preventive) regulation must set prior conditions in order to achieve a socially desirable functioning of markets. More particularly, it emphasizes that the total welfare of both customers and suppliers should be maximized (allocative efficiency). Toward achieving this goal, modern approach promotes free entry and unimpeded competition, and suggests preventive regulation to remove potential entry barriers and market imperfections.

But when considering the evolution of markets, we observe that customers' preferences continuously change, while at the same time new production techniques may emerge. The objective of maximizing total welfare can only be achieved if firms adapt their products to customers' preferences, and adjust their production process in such a way that these renewed products will be produced in the most efficient way (dynamic efficiency) (see Kremers, 1991). In relation to allocative efficiency, note that the short-term objective of allocative or static efficiency may run counter to dynamic efficiency. For example, fierce competition favoring customers but reducing profits may shrink the (necessary) internal funds of risky innovative projects (`Schumpeterian' view (see e.g. Kamien, 1987, and Scherer and Ross, 1990).

In recent work, CPB has considered a simplified analytical framework of competition policy (see CPB, 1997). This framework positions the traditional archetypes of market structure[5] into a matrix with dimensions on the cost structure and the extent of product heterogeneity. For each typical market structure, several issues for competition policy may emerge.

The present framework takes a small step further and considers the potential changes in market structure and technology resulting from firm behavior, such as raising entry barriers, opening new markets and searching for new technology. The sections below will therefore not dwell upon the traditional archetypes, but instead will consider the market structure as endogenous. This paper shows how firm behavior may result in market imperfections and welfare losses, and how the regulatory policy may recover the allocative and dynamic efficiency of competitive markets.

The market failures addressed in this framework predominately concern market power. Specifically, the framework discusses natural monopolies and other forms of imperfect

[5] I.e. the standard microeconomic archetypes of monopoly, oligopoly, monopolistic competition and perfect competition.

competition, and describes regulatory methods for alleviating the detrimental effects of the market failure. Also other forms of market failure, such as informational asymmetries and externalities, prevent markets from functioning efficiently. The only externalities considered in our framework concern non-appropriable benefits of R&D expenditures. Other examples of externalities, such as emissions of pollutants, fall outside the scope of the framework. Informational asymmetries that lead to market power, for example, or lack of consumer knowledge about product quality, are dealt with in the framework. Other forms of informational asymmetries -- such as between regulating authority and regulated firm that distort the effectiveness of regulation (see e.g. Laffont and Tirole, 1993)-- are not explicitly dealt with in the framework.

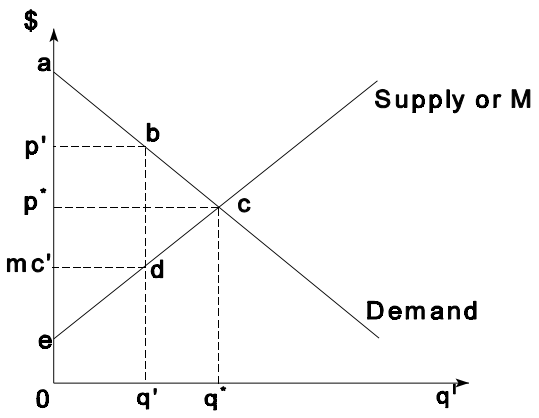
3. Concepts used in the analytical framework

This section will define several concepts and terms that are used in our framework. First, we will elaborate on the concepts of allocative and dynamic efficiency, concepts vital to the analysis of the welfare effects of policy. Then we will introduce a few concepts that typify the technology and cost structure, and two main types of market interactions between firms.

Allocative efficiency

In this and the next subsection we will further discuss the allocative and dynamic efficiency of markets, concepts which we already loosely considered in section 2. We define static or **allocative efficiency** of a market as the extent to which total welfare of both customers and suppliers can be maximized. Figure 1a provides a graphical representation of an allocative efficient market.

Figure 1a allocative efficiency



In a perfectly competitive homoge neous market, total demand will be equal to total supply when the market price is equal to marginal cost, i.e. p^* in figure 1a. Indicating the extent of allocative efficiency requires some analysis of the demand curve and supply curve.

Let's first consider demand for the product. The gain for each individual customer from buying the product is equal to the difference of his/her value or willingness to pay for the product, say p', and the actual competitive equilibrium market price p^*. Summing up, over all customers buying the product at p^*, we get a total customer or **consumer surplus** equal to the surface of triangle *acp** in figure 1a.

The supply curve indicates the production cost of producing an additional marginal unit (marginal cost) if the industry has already reached some total output level.[6] If we sum all incremental mark-ups, say p^*-mc', over total output, we will get the total ***gross* producer surplus** equal to the triangle *p***ce*. The total ***net* producer surplus** or total industry profit (not indicated in the figure) is equal to the total gross producer surplus minus the overall fixed costs.

Combining the consumer surplus and the gross producer surplus, we arrive at the gross **total surplus**. In case of perfect competition, and thus when the equilibrium price p^* equals the marginal cost, the (gross) total surplus will be at the maximal level (in figure 1a equal to the triangle *ace*). If the market price would be set at p', e.g. by restricting competition or imposing a regulatory price, the total surplus will be reduced to the area *abde*. Compared to the (gross) total surplus at the competitive price level p^*, the market will then lose some welfare, in the amount of *bcd* (*ace*–*abde*), which is often referred to the dead-weight loss.

Dynamic efficiency

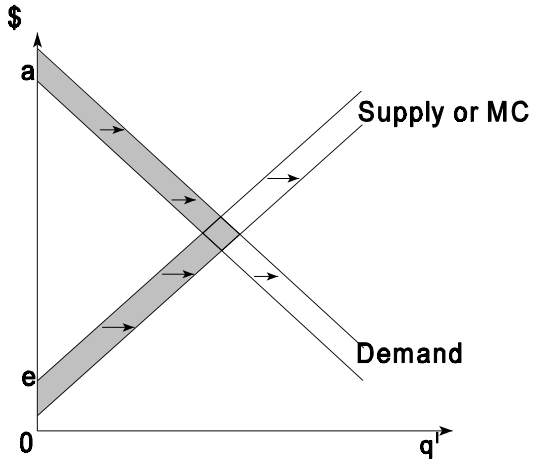
Note that allocative efficiency is a rather static concept since no dynamic elements such as changing customers' preferences or technological progress are involved. Schumpeter was one of the first economists to stress the dynamic aspect. According to Kamien (see Kamien, 1987),

> `... It was Schumpeter who argued most persuasively that it was competition through introduction of new products and methods of production that was far more important than price competition, in the long run. For it was through innovative activity that economic development that resulted in higher per capita income took place... '

[6] The supply or industry marginal cost curve can be determined by the horizontal summation of the marginal cost curves at the firm level (see Sharkey, 1982).

From this view it is only a small step to a definition of **dynamic efficiency**. Kremers defined dynamic efficiency as the extent to which firms are able to meet the changing needs and desires of consumers (product innovation) in the most efficient way (process innovation) (see Kremers, 1991). Turning to figure 1b, we can imagine that product innovation shifts the demand curve to the right, since customers are willing to pay more for the new product. Further, process innovation and technology improvement lower the marginal cost of producing the (renewed) product, thus lowering the supply curve. In a competitive market, the total surplus will increase if firms engage in either product innovation (in figure 1b the upper light shaded area) or process innovation (lower light shaded area), or both.

Figure 1b *allocative efficiency vs. dynamic efficiency*



The figure does not display the market price and quantity before and after the shift. It is possible that static allocations were inefficient in both periods, with a firm using its market power to increase profits by limiting output below what would occur in a competitive equilibrium (with higher prices). In fact, positive future or current profits may be required to induce firms to invest in innovative activity. The dead-weight loss in each period, however, may be smaller than the gains in total surplus resulting from the shifts in demand and supply curves.

In line with this argument, we will adapt slightly the definition of dynamic efficiency to make it more easily comparable to allocative efficiency. Dynamic efficiency will be defined as *the extent to which the present value of a stream of static total welfare (gross total surplus minus fixed costs) can be maximized over a longer period of time, taking account of all possibilities to improve customers' valuation of products (product innovation) and to improve technologies in the most efficient way (process innovation).*

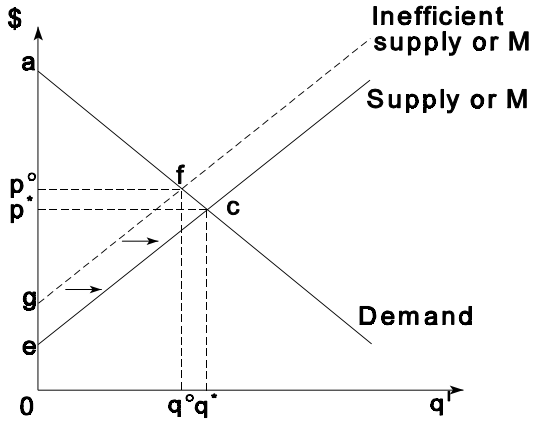
X-inefficiency

Previous subsections assumed that firms make optimal use of the available technology. However, as will be discussed in sections 4.2.5 and 4.2.6, firms may differ in terms of the efficiency with which they use available technology, and may exhibit different rates of innovation.

Leibenstein pointed out that numerous types of inefficiency can be detected,[7] but all are related to three motivational or incentive aspects (see Leibenstein, 1966). First and most striking are intra-plant motivational inefficiencies. These inefficiencies are linked with incomplete contracts of input factors,[8] or (perceived) uncertainties in production technology such as variable and unknown performance of machinery or labor. Second, external motivational inefficiencies are caused by the interdependence of firms, since uncertainty on technological characteristics drive firms to collude and imitate each others' techniques. Finally, inefficiencies of non-marketed input reflect an inefficient use of inputs that are not overtly traded on markets, e.g. managerial effort and the knowledge and capacities of the management.

It is obvious that less inefficiency results in lower marginal costs at the firm level. Therefore, reducing inefficiency will raise the supply of products, and thus shift the (inefficient) industry supply curve to the right (see figure 1c). The (gross) total surplus will then increase by the area *ecfg*. But as the competitive market price will decrease to the (lower) level of marginal cost, consumers will gain the most from reducing X-inefficiency (the area p^*fcp°). Nevertheless, decreasing X-inefficiencies at the firm level have a positive impact on the allocative efficiency of the market.

Figure 1c *allocative efficiency vs. X-inefficiency*



[7] That is why it is called *X*-inefficiency.

[8] For example, labor contracts that cannot sufficiently cope with shirking.

Concepts related to the cost structure

The first issue on the cost structure concerns the *type* of the cost incurred. We define (long-run) **fixed costs** as those costs that cannot be avoided in the short- or medium term (i.e. so long as production is not discontinued). **Sunk costs**, however, are costs that can *never* be eliminated, even after total cessation of production (see Baumol et al., 1988). Both fixed costs and sunk costs do not depend on the output level (or on a relevant range of production capacity). More important, both types of expenditures cannot be reversed during a period when the firm commits itself to incur these costs (see Tirole, 1988). But whereas the commitment period of fixed costs can be *finite*,[9] the commitment period of sunk costs is *infinite* since the firm can never recover the sunk costs. Section 4.2.2 will return to this issue and see how firms may use the commitment to implicit sunk costs as a way to deter entry of new competitors.

Next, consider two concepts pertaining to the relation between total costs and firm size. First, firms can use **economies of scale** (or increasing returns to scale), when the production cost of total output is larger than the sum of incremental or *marginal* production costs per unit (see Baumol et al., 1988). This condition holds when there are fixed costs that are invariant to marginal output changes. Then, if marginal cost per unit does not increase with the level of total output, the firm can attain lower *total* costs per unit[10] if it can increase its output level and spread the fixed costs over a larger quantity of output.

The multi-product variant to economies of scale in a single product industry are **economies of scope**. Suppose that a firm can combine several small facilities for producing distinct (sets of) products to a single facility or plant that can produce the whole product assortment. Then it can use economies of scope if the sum of production costs by the smaller facilities exceeds the cost of producing the same total output by the single large facility.

Types of firms' interactions

Finally, we will consider two types of interactions between firms on a particular market, types that stem from standard microeconomic theory, i.e. **Cournot-Nash** and **Bertrand-Nash** competition (see e.g., Varian, 1984). Both notions are only benchmarks, because

[9] E.g., until the firm ceases (a large part of) production and sells the equipment associated with the fixed costs.

[10] Given the market price of a single product, the firm would then gain higher profits.

the assumptions under which they hold are rarely satisfied. Nevertheless, it is useful to consider these concepts because they can be used as analytical tools for describing markets. For simplicity, we will (at first) only consider a single-product or homogeneous market with firms having the same technology. Since each firm offers the same product, customers will be indifferent about which firm to buy the product from: the market price is the only thing that matters.

In Cournot competition, each firm chooses a profit-maximizing output level, thereby taking as given the output levels of its competitors. If each competitor acts in a similar way, the market ends in an equilibrium with market clearing prices (total demand equal to total supply). In equilibrium, no firm has any incentive to deviate from its chosen output level. The basic Cournot model does not, however, specify the mechanism with which equilibrium prices are attained.

In Bertrand competition, firms set their profit maximizing price given competitors' prices. Whereas in Cournot competition firms can commit to some output level without being `punished', firms on a homogeneous Bertrand market face a trade-off between high market shares but low mark-ups, or high mark ups but low market shares. If a firm would set a high price, it would lose its market share to the competitors undercutting the high price. Therefore, by fierce competition firms have to set prices at the lowest possible level, i.e. equal to their average or marginal cost, and can only gain a low mark-up. The outcome ends in a paradox when noting that each firm would be better off if the threat of undercutting prices would not occur. This `Bertrand paradox' will not emerge if firms can differentiate their products, thus relaxing competition.

4. The analytical framework

4.1 Overview

Turning to the analysis of a particular market, one might use the Structure, Conduct and Performance paradigm (in short, the SCP paradigm), developed by Industrial Organization economists in the 1950s and 60s. The main idea of this paradigm is that the basic conditions of the market, in particular the demand structure and available technologies, determine the structure of the market. The market structure, described by the concentration of sellers and the technologies adopted by firms, then determines the conduct of firms. Finally, the conduct of firms, embodied in short-term and long-term strategies, determines the performance of the market.

However, this paradigm has come under considerable attack. As Scherer and Ross, 1990, point out, the conduct of firms may influence basic conditions and market structure. For example, process innovation changes production technology and cost structure, and product innovation alters product varieties available in the market.

Moreover, high profitability due to limited competition may attract new firms, thereby increasing competition in the market. The next box (box 1) shows the impact of variability of the market structure on market performance.

Instead of using SCP, we consider the relations between firms and other agents,[11] and find out in what way firms take up their positions and act against these agents. Porter argued that, to be successful, firms must find a combination of relational behavior that improves their competitive advantage and market attractiveness for customers (see Porter, 1985). Our framework will therefore focus on the strategic behavior of firms, or potential entrants, for operating on the market under study.

[11] I.e. competitors, suppliers, customers, etc.

Box 1 Simulation of model with investment, entry and exit

Pakes and McGuire, 1994, provide a dynamic model to simulate the evolution of industry structure in a market for differentiated goods, with sunk costs of entry. The model describes firms' investment behavior as well as entry and exit decisions. Investments lead to a positive, but uncertain, improvement in efficiency or product quality. The equilibrium outcome of the model shows the size and profitability distributions of firms operating in each period.

The simulation illustrates that on a market with low sunk costs, entry and exit rates are rather high. Further, the industry structure varies widely over time, with periods of high and low concentration. However, only a limited number of firms become sufficiently profitable to remain in the market for an extended period. A sample selected from firms active over a certain time-span thus will display supra-normal profits, even though the expected lifetime returns at entry just cover sunk costs. Larger sunk costs severely reduce entry and generate, on average, a much more concentrated industry. However, price-cost margins do not change seriously, nor does total welfare drop significantly.

More results show that in this example policies to restrict market concentration, or to allow a monopoly for a limited time-span both end up reducing total welfare. Moreover, with `the complexities of investment, entry, and exit processes, there is no simple way to relate changes in the descriptive statistics we generally use to describe market structure to changes in welfare'.

In fact, the basic supply and demand conditions and market structure are closely related to the strategic behavior of firms, and thus become endogenous. Regarding the supply conditions, the firm may e.g. invent new technologies, but if the suppliers cannot offer the necessary inputs at moderate prices, the firm will not be able to implement the innovation. Similarly, firms may open up new segments by conducting product innovation. But if many customers do not like the new product, insufficient demand will make the segment unprofitable. Finally, if the market is concentrated and incumbents

gain high profits, they may raise entry barriers for new firms in order to maintain their own favorable positions.

Industry structure in two perspectives

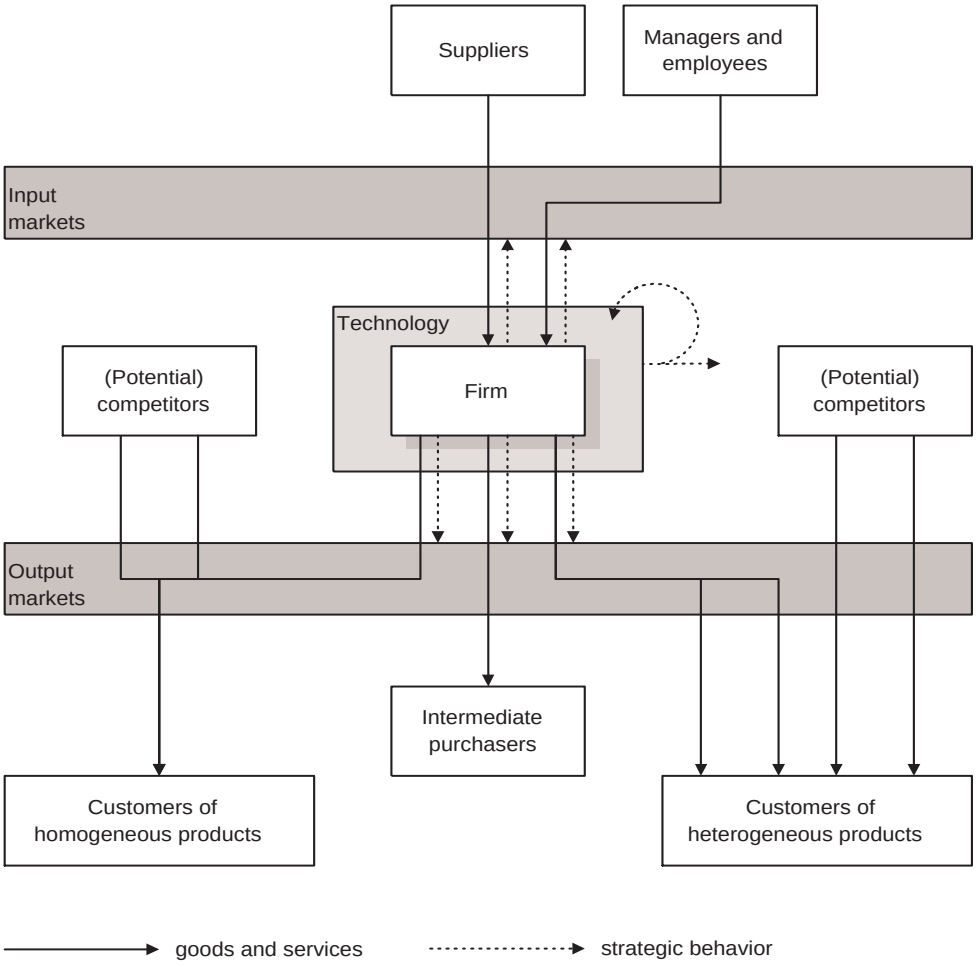
A convenient starting point for amalyzing a market is to consider the position of the offering firms in the industry structure and/or supply chain. Figure 2 gives a stylized representation of an industry structure.[12] The industry structure will be discussed from the vantage point of a typical firm. Operating under its current stage of technology, the typical firm offers its products, like its competitors, to the market under study. This market may be an output market with customers demanding homogeneous or heterogeneous products, or a wholesale market of intermediate products.[13] The customers then constitute the bottom of the industry structure or the downstream entities in the supply chain. On the input markets, the suppliers of the typical firm offer capital or intermediate products, while managers and employees provide the firm human inputs. The suppliers, managers and employees then constitute the top of the industry structure or the upstream entities in the supply chain.

The firm's behavior -- the subject of our framework -- can similarly be classified into two groups or perspectives. The classification not only specifies behavior, but also indicates to which particular input or output market that behavior is related, and which agents are involved. The first perspective, which we call the **supply conditions**, concerns the firms' internal housekeeping, production methods and technology, and its relation to the agents on the input markets, the suppliers and employees. The second perspective, the **market interactions**, focuses on the competitive interaction between firms on intermediate- or final- output markets, the lower part of the industry structure. The outcome of the supply conditions, i.e. the production cost structure, serves as the conditional setting for the competitive behavior on the output markets.

[12] Based on Porter, 1985 , ch. 1 figure 1-2: "Elements of Industry Structure", and on Van Witteloostuijn, 1990, ch. 19 figure 19.1: "Multi market dimensions", but now extended to the supply chain.

[13] Note that the intermediate products can be used for producing either homogeneous final products or heterogeneous final products. However, we will abstain from this feature in the text below.

Figure 2 Industry structure and strategic behaviour



Supply conditions

What are the firm's options in the short- and long term to make the best of its supply conditions? The standard production framework used in economics --firms using a given production technology to convert purchased capital, labor, and intermediate inputs into output-- can aid in describing the options. First, firms try to ensure low input prices (or better input characteristics) and reduce transaction costs by altering their relationship with upstream suppliers, for example through vertical integration or strategic alliances.

Next, firms may attempt to reduce inefficient use of intermediate inputs (X-inefficiency). But since this target can only be realized if their managers and employees provide sufficient effort to realize this target, firms may have to motivate their managers and employees and offer them stimulating wage contracts. Finally, firms can try to improve the production process by conducting R&D to find better ways of using existing technology, or for creating a new, advanced technology. Moreover, they can imitate better technologies from other firms. The behavioral options related to the supply conditions thus concern altering the cost structure of output -- either by changing technology, the efficiency of input use, or input prices.

The cost structure of producing output, i.e. the types of costs incurred (such as sunk costs) and the properties of total cost that are related to the technology (such as economies of scale or scope), is one of the main aspects that determine on which downstream markets each core firm can operate. Therefore, changes in the cost structure can affect the competitive structure of the downstream markets. For example increasing returns to scale or scope of incumbent firms may restrict the `market room' for new competitors (see section 4.2.1).

Market interactions

From the last point, it is only a small step to the second perspective, the market interactions between firms and customers and among firms themselves. This part of the framework will highlight some of the firms' actions that influence their competitive position, such as decisions regarding production capacity, pricing, product quality and variety, marketing strategy, and alliances or cooperation with other firms. The choices made by the firms will determine the competitive structure of the market, and will set the borders of the relevant market. But defining the relevant market depends on the extent of product substitutability.

The distinction between a homogeneous and heterogeneous market is similarly related to the extent of product substitutability. When products of a (properly defined) market are perfectly substitutable, the market is homogeneous. But if the products are not perfectly substitutable, the market becomes heterogeneous and may consist of several related segments.

Firms operating on a market for heterogeneous or differentiated products are mainly involved in searching for profitable niches of new product varieties (product innovation). Then firms can provoke changes in product demand as new segments are created, for example by raising customers' assessment of product value through advertising.

However, the process of product creation may destroy other niches of existing varieties. In the short run, firms can exploit the market power they enjoy in meeting the specific needs and desires of their customers, and charge prices above marginal cost.

Box 2 Definition of relevant markets

Defining the relevant market for analytical purposes is quite difficult. This is not only a theoretical problem but also a practical issue, such as in anti-trust cases where outcomes often hinge on the determination of the definition of the relevant market. The definition of markets depends on the extent to which consumers can substitute between products (see e.g. Carlton and Perloff, 1994). We can define a relevant market of products in such a way that the products related to this market are not substitutable with other products outside the market. But if products are not perfectly substitutable, demarcation of markets becomes less well defined.

Firms in competitive, perfectly homogeneous markets have limited choices for maximizing profits. Customers only care about product price, leaving firms a choice of the level of output or capacity (as on a Cournot market). Incumbent firms on (expanding) homogeneous markets may, however, attempt to use capacity as a strategic variable in order to prevent entry of firms who are attracted by the size and potential profitability of the market.

Other market interactions discussed in the framework concern direct cooperation between firms. The types of cooperation range from horizontal collusion (cartels and mergers) to vertical integration. Regarding horizontal collusion, we will only consider collusion (cartels) restricting output on a homogeneous Cournot market and research joint ventures for technology development. With respect to vertical integration, we will also consider downstream integration as a means to reduce transaction costs or to control intermediate output markets in favor of the upstream firm (so-called market foreclosure).

Organization of the framework

Table 1 summarizes several types of firms' behavior or actions that set their supply conditions and make up their market interactions. Each type of behavior will be elaborated in the stated sections.

Table 1 Types of firm behavior discussed in our framework

Supply conditions		Market interactions	
- integration/bargaining with suppliers	(4.2.4)	- competitive behavior on homogeneous markets	(4.2.1)
- enhancing efficient input use	(4.2.5)	- raising entry barriers by excess capacity/output or advertising	(4.2.2)
- process innovation			
- without cooperation			
- with cooperation	(4.2.6)	- differentiation in qualities or product attributes	(4.2.3)
	(4.2.7)	- integration/price squeeze of intermediate purchasers/retailers	
		- output restriction by collusion	(4.2.4)
			(4.2.7)

Use of indicators

In order to determine whether each type of behavior is important for a typical market, e.g. in case-studies, we will try to derive several indicators of such behavior. The traditional indicators that are often used in IO analysis display the market structure (such as concentration ratios, entry and exit of firms) or market performance (price-cost margins and profitability). Analysts then try to determine their mutual relationships in order to make statements about the extent of competition on the markets under study (see e.g. Kleijweg, Lever and Wennekers, 1996). Nevertheless, traditional indicators on market structure and performance are only indirect indicators to firm behavior.

Instead, the indicators to be derived in section 4.2 should be directly related to firm behavior and the conditions on which that behavior occurs. Only when there are no clear indicators that can identify firm behavior we will resort to indicators on market structure and performance. Moreover, we will try to specify the indicators in such a way that they are quantifiable, although several conditional indicators can only be defined in qualitative terms. For example, whereas firms may plan promotional campaigns or build up large stocks and the capacity to raise entry barriers for new firms, high advertising outlays and building large stocks may point to concentrated markets with firms creating a dominant position.

Related Issues

We will end this subsection with two potential extensions to our framework, although further development of these ideas is beyond the scope of our research.

First, note that the firm's behavior regarding supply conditions is related to its (inter)actions on the output market. For example, a firm may commit to sunk investments for searching a new input-saving technology, thus raising an entry barrier to new firms (see section 4.2.2). However, the firm may refrain from developing new technologies if its mission is to continuously introduce new products on a fast evolutionary heterogeneous market, where existing products and related technologies become obsolete after a short period of time.

Second, firm's behavior influence the dynamic evolution of an industry or the life cycle of a product (see e.g. De Jong, 1993). When a product is introduced, considerable uncertainty exists about customer preferences and the technological means for satisfying them (i.e. the production technology). Firms will enter the market by innovating and introducing new product variants. But when the customers experiment with several types and producers start to learn how to design the most preferred product, further opportunities to improve the product are depleted and a dominant design emerges. At this stage, the fear that investments in the production process will be rendered obsolete by introduction of new products will be reduced. Firms will then pay more attention to process innovation, invest in more efficient production processes and force other, small and less competitive firms to leave the market. Efficient but capital intensive technologies will raise the minimum efficient scale of firms. Moreover, since large firms benefit more from process innovation that saves unit production costs, they put more emphasis on process innovation than do smaller firms.

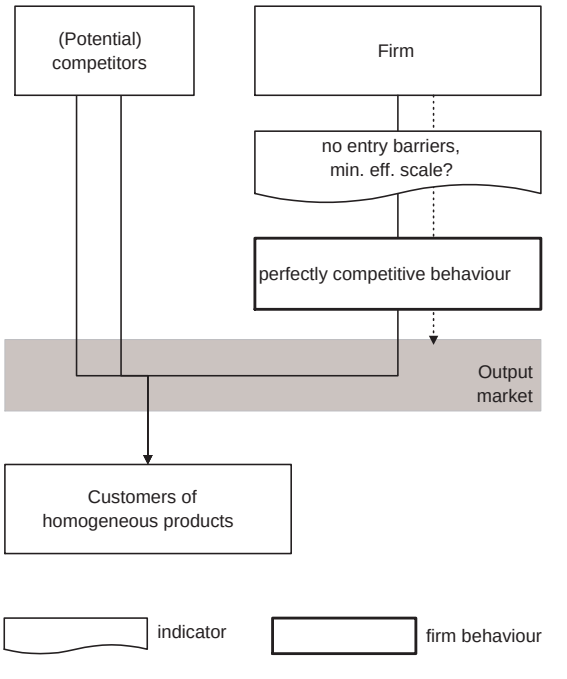
4.2 The elements of the analytical framework

This section provides an overview from IO theory on each type of firm's behavior mentioned in the previous section. Each subsection provides a graphical representation of firm behavior to be discussed, explains how to detect that behavior and sketches the impact on industry structure as outlined in figure 2. Then we will discuss the main items and ideas that emerge from economic theory, followed by some typical applications that can also be observed in practice. Finally we will try to define several indicators that point out whether the type of behavior discussed is important for a typical market, and thus whether a case study should pay attention to this type of behavior.

4.2.1 Perfectly competitive behavior: the Contestability Theory

Figure 2.1 shows the relations that are important for a firm on a perfectly competitive output market. Similar figures will be used in all the subsections below.

Figure 2.1 *Perfectly competitive behaviour on homogeneous markets*



As mentioned in section 2, the traditional view of regulation stresses that the possibility of free entry of potential competitors (no entry barriers) constrains the behavior of incumbents and results in efficient production and pricing, so there would be no need for regulation. Baumol, Panzar and Willig formalized this idea in their well-known contestability theory (see Baumol et al., 1988). However, their results only hold for homogeneous Cournot markets.

Two main objections exist to the theory of contestability. First, the conditions for free entry may not exist. In fact entry barriers may have been created through explicit actions of the incumbents. Second, even if free entry exists, the contestability theory assumes that incumbents do not respond to entry, so that potential entrants base their decisions on pre-entry prices. But in fact,

entrants may expect actions from incumbents which make entry unprofitable. Therefore, incumbents become unconstrained by potential entry.

Another important complaint is that the contestability theory is rather static. Even with the assumption of a constant, or at least exogenous, technology, it is difficult to apply in a multi-period setting because of increased complexity. Nevertheless, the theory remains important because it emphasizes the fact that counting the number of firms, or measuring market concentration, is not sufficient to determine the need for regulation.

The contestability theory states that the threat of competition from potential entrants is a better method of improving market outcomes than regulation. If firms attempt to exert market power by raising prices, thus earning positive economic profits, entrants would contest their position by undercutting the incumbents until profits were driven back to zero. Incumbents are therefore unable to exert market power, and will behave as if they were operating in a competitive market. The market position of each incumbent is said to be sustainable if no potential entrant can earn a positive (economic) profit by selling at or below the market price.

If the production technology has continuously increasing returns to scale on the relevant range of output, the market becomes a so-called natural monopoly. In this case, production by one firm will ensure minimum costs of producing industry output. However, the threat of free entry still may prevent the monopolist from behaving as one. The entrant attracted by the monopoly profits is willing to replace the monopolist. This may induce the incumbent firm to lower prices far enough to inhibit entry.

But if production technology is such that average costs are U-shaped, i.e. declining over some region until minimum efficient scale (MES) output is reached and increasing beyond that scale, the size of the market may be large enough for two or more firms (natural oligopoly). With no barriers to entry, prices above minimum average cost would attract entrants, driving profits back to zero. Moreover, if the incumbents deliver to several homogeneous Cournot markets,[14] each incumbent has to avoid cross subsidies.[15]

In a market with growing demand, entrants will fill the gap in demand, and total production stays efficient. Indeed, the incumbents cannot increase their output level

[14] I.e. customers cannot substitute a product (not even at some adaption cost) for a product on another market or segment.

[15] If the conditions of efficiency and avoidance of cross subsidies do not hold, some potential entrant may still enter the market, and offer only those profitable products at slightly lower prices but above marginal costs.

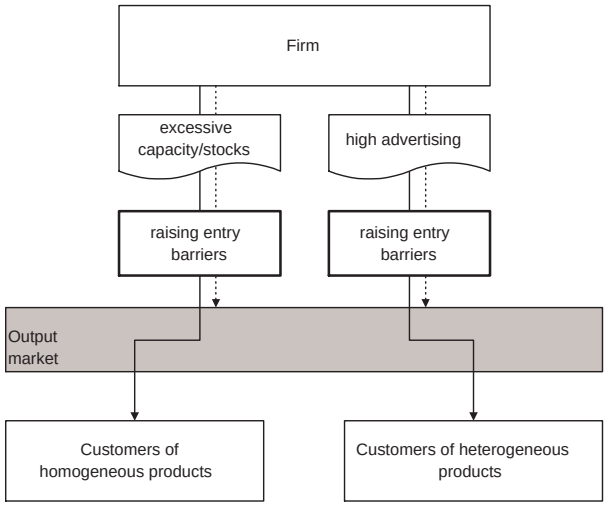
beyond the MES. The contestability of the market thus ensures efficient production at the MES by all firms, thus providing industry output at lowest total costs.

If a potential entrant has a better technology, it can serve the growing market more efficiently than the incumbent, and therefore may drive the incumbent from the market. However, it is (theoretically) prossible that the positve benefits of the entry by a new firm are offset by the destruction of sunk capital of the prior incumbent.[16]

4.2.2 Entry barriers by sunk cost: advertising and limit strategies

The contestability theory described above points to an efficient market structure if certain conditions hold. However, potential entrants may find a host of entry barriers. Only then can incumbents gain profits and produce less output at higher prices than would be allocatively efficient (see e.g. Gilbert 1989).

Figure 2.2 Raising entry barriers on homogeneous and heterogeneous markets



Non-regulatory entry barriers are often related to sunk costs. As mentioned in section 3, sunk costs are (a portion of) fixed costs invariant to production, and cannot be recovered if operations were to cease. Examples of sunk costs are investments in brand-image through advertising, investments in intangibles such as firm-specific human capital, or even invest-ments in specific tangible assets such as underground cable. We can distinguish two types of sunk costs, i.e. exogenous sunk costs and endogenous sunk costs. Exogenous sunk costs are those costs that are related to production technology and need to be made in order to operate on the market. Endogenous sunk costs, however, are costs that firm deliberately incur for strategic reasons (see Sutton, 1991).

[16] A similar supra-optimal level of creation and destruction in patent races will be discussed in section 5.2.

Incumbents may commit to endogenous sunk cost, and show to potential entrants that they will be tough competitors in the post-entry stage. This threat is credible because at the time when entry may occur, incumbents are able to continue operations as long as revenue covers variable costs and non-sunk fixed costs. Entrants, however, also have to incur and cover (exogenous) sunk costs, and thus will not enter the market unless revenue is expected to cover *all* costs.

Now consider two specific applications. On a homogeneous market, incumbents may use sunk investments in extra capacity or output stocks as a strategic move to deter entry (see Dixit, 1980). By committing sunk resources to excess capacity or stocks, incumbents can use the resulting cost asymmetry by credibly threatening to lower prices (increase output) to the point at which entry would become unprofitable. On a heterogeneous market where customers perceive brand-image as a particular product quality, incumbents may use extra advertising on brand awareness to create a large barrier for entrants (see Sutton, 1991). This entry barrier will arise especially when the cost of attracting customers to a new product increases with the market total of advertising outlays.

Indicator

Limit output and excessive capacity:
If the incumbents' output or capacity is above the minimum efficient scale (MES; see section 4.2.1), incumbents may have deliberately raised an entry barrier. Although in reality the MES is hard to observe, high capacity and maintained low capacity utilization as well as large stocks of output may point to an entry barrier.

Advertising:
A high level of advertising and promotional outlays on a market with brand-image and quality assessment may identify the incumbents' strategy to raise entry barriers.

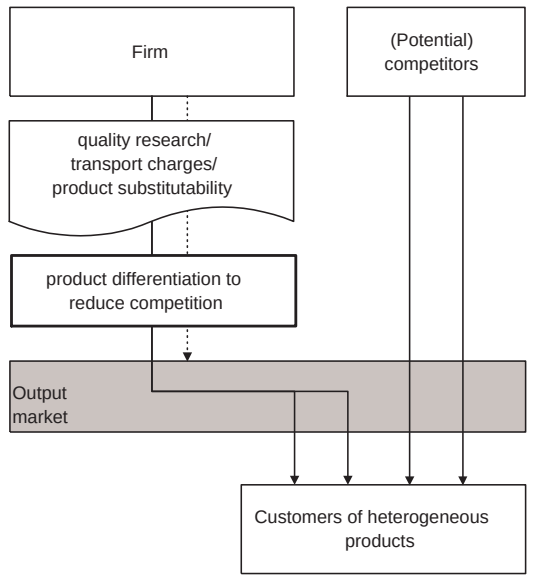
4.2.3 Product differentiation

In section 3 we observed that product diversity is one of the two main aspects of dynamic efficiency. Differentiated products can better fit customers' preferences; in this

way more product variety increases a customer's value or willingness to pay. By differentiating and focusing on a particular niche, incumbent firms may exert some market power on a particular segment and thus gain positive profits. However, if new firms enter the market and introduce new products, competition from newly created segments may reduce firms' profits.

Note that there are several types of product differentiation. Firms may diversify their products in quality (vertical differentiation) or in product characteristics, e.g. location or other product attributes (horizontal differentiation). In the sections below we will consider two examples of product differentiation.

Figure 2.3 Product differentiation on a heterogeneous market



In vertically differentiated markets, all consumers prefer more quality, but vary in their willingness to pay for that.[17] If production costs do not vary with quality, firms will divide the market into separate quality segments (see Rosenkranz, 1995). In such a differentiated market, natural oligopolies may occur in which each firm supplies a separate quality segment of the market and has positive but sustainable mark-up. If firms attempt to supply the same segment, competition will drive profits down to zero. Therefore, an incentive exists for firms to coordinate the positioning of their products into separate quality segments.

However, if firms need to conduct R&D to be able to offer higher quality goods, a wasteful R&D race may ensue in which firms attempt to reach the high quality segment first. R&D coordination may mitigate the losses from duplication in R&D efforts, but may increase the chances that firms make agreements on quality segmentation in the output market.

[17] In the previous section we considered advertising and (perceived) quality differentiation in the context of sunk costs and entry barriers, but in this section we will focus on the extent of product differentiation per se.

In horizontally differentiated markets, introduction of a new product variety has an ambiguous effect on equilibrium prices. On the one hand, mark-ups are reduced, owing to increased competition between
substitute varieties. On the other had, consumers' love of variety will induce increased demand for all segments and thus raises prices, all else equal. In a free market, entry, or introduction of new products, will take place as long as expected profits are larger than zero. Entrants do not take into account that profits of incumbents are reduced following entry, often denoted as the business stealing effect.

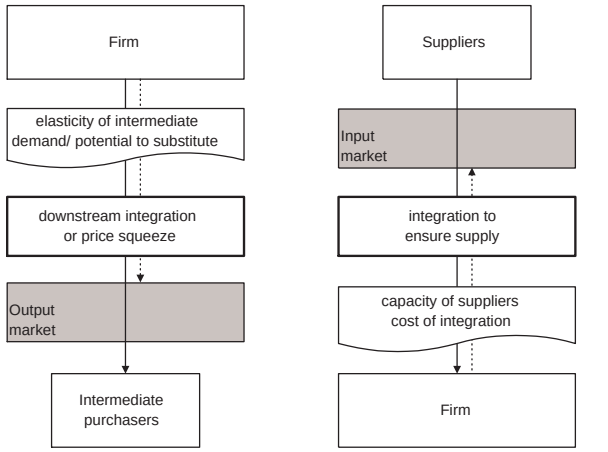
Another issue that may occur in horizontally differentiated markets is the benefit to an incumbent to supply new market segments. For example, if customers on spatial markets have to pay high transport charges to reach a more distant shop, incumbents may exert monopoly power on the region close to its site (see Tirole, 1988, based on Hotelling's concept). Now suppose that *in future* the market will grow so that building and operating a single new shop becomes profitable. Any incumbent (on an adjacent site) will start to build before any entrant could, even if it has to incur extra (sunk) interest cost until the moment the market has actually grown. Only in this way can the incumbent maintain its dominant position and gain from monopoly rents.

Indicator
Vertical product (quality) differentiation: *Differences in product quality and customers valuation of quality are difficult to measure. High research intensity and short time-to-market may indicate high quality products, whereas low research and long time-to-market points to low quality products.*
Horizontal product differentiation: *When markets literally are spatial, geographic distances and transportation costs can give an indication of substitutability between products and thus the market power of a local supplier. If product attributes vary in other dimensions, other means must be found to estimate substitution elasticities between goods in neighbouring segments.*

4.2.4 Vertical contracts and vertical integration

This section treats the vertical relations between firms in successive stages of the supply chain. Vertical integration concerns the bundling of two successive production processes, where (a part of) the output of the upstream process serves as a direct input to the downstream or intermediate process. Integration may induce a welfare gain if the integrated firm incorporates and eventually reduces the total industry mark-up in the downstream processes, but may equally turn into an abuse of a dominant position or monopolization of the industry.

Figure 2.4 Integration with suppliers or intermediate purchasers



Although both suppliers and intermediate purchasers may have an incentive to increase joint profits by vertical integration, they have different motives to do so. First we will look at the incentive of suppliers to integrate with intermediate firms or to control the downstream final markets in its own benefit. Then, we will discuss the motive of intermediate purchasers to integrate with a single upstream supplier.

Motives for upstream suppliers to integrate

First consider an upstream supplier selling its products to several downstream purchasers on different segments of the intermediate output market (see Perry, 1989). The downstream firms sell final products to customers on the final output market. A common example is an upstream manufacturer who sells intermediate products to retailers on the wholesale market, while the retailers sell or distribute final products to the final customers.

The upstream firm may try to control the market structure (number of downstream firms) and the outcome (actual prices and demand) of the final market to its own benefit. The upstream firm has an incentive to integrate with some downstream firm if the downstream firm has an *elastic* demand for intermediate products. For example, if a

downstream firm can easily substitute between different intermediate inputs (thus it has elastic demand), it limits the ability of upstream suppliers to exert market power. The upstream firm, on the other hand, will try to extract higher prices from downstream firms with inelastic demand for the intermediate product (price squeeze). In this way the upstream firm can capture some of the mark-ups of downstream firms, while saving the cost of integration on the downstream market.

Finally, assume that there are several upstream suppliers that need different levels of capital to produce intermediate products (see Hart and Tirole, 1990). The efficient supplier with less required capital will try to prevent the inefficient supplier from integrating or supplying (independent) downstream purchasers, thus eventually forcing the inefficient firm to leave the industry. In the next step the integrated firm may cease to supply the non-integrated downstream firms and force them to leave the market as well, and thus monopolize both the upstream and downstream stage in the industry.

Motives for downstream firms to integrate

Most models on scarce supply assume that downstream firms propel intermediate products to final markets by adding other inputs[18] to increase the value of the products. If a (single) upstream supplier lacks capacity to offer all downstream purchasers sufficient supply, each (competitive) downstream firm has an incentive to integrate with a supplier in order to be ensured of sufficient supply. The outcome (whether or not integration actually occurs) is difficult to determine, even if the required additional inputs are exogenous. It depends on several conditions that must hold at the same time -- in particular on the capacity of each upstream firm -- the cost of integration, the bargaining power of opponents and the level of downstream input (see Hart and Tirole, 1990).

Something can be said, however, about a change in firms' input levels if integration actually occurs (see Bolton and Whinston, 1993). Assume that downstream firms have to commit to some inputs before they know whether there will be sufficient supply for all firms. The non-integrated firm has an increased chance of non-supply if other purchasers can integrate. Since the cost of unused input will be foregone, it will provide less input than the optimal input level if no integration would occur.

[18] E.g. managerial or employee effort.

Instead, the integrated firm will be ensured of supply. In that case using more inputs is always profitable.[19] The integrated firm will then increase its input and provide more value added than the optimal level under non-integration.

Indicator

Downstream integration:
The elasticity of intermediate demand by the downstream firms is one of the most important indicators that point out whether or not an upstream firm has an incentive to integrate. If an upstream supplier can produce intermediate products more efficiently than other upstream firms, it will integrate with a few downstream purchasers and subsequently try to monopolize both the intermediate and final market.

Upstream integration:
The outcome of integration to ensure supply depends on several conditions -- such as the capacity of upstream firms, the cost of integration and the bargaining power of each firm -- that must hold at the same time.

4.2.5 Enhancing efficient input use

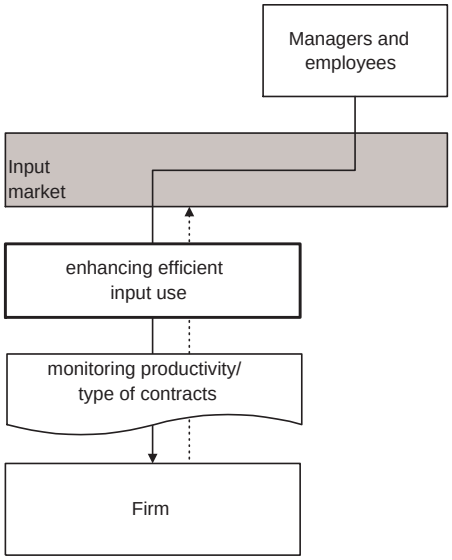
This section will look at the efficiency with which firms make use of existing technology. Although any firm, either a monopolist or a price-taker, gains from using an efficient technology, internal efficiency is a *necessary* condition for a firm to survive in a competitive market. Therefore, a maintained level of internal inefficiency may point to the possibility that firms exert some market power. Moreover, reduction of X-inefficiency by enhancing efficient input use may reduce the market price.

Now, suppose that the firms use intermediate inputs inefficiently, or that firms produce below their potential (production frontier) unless managers and employees provide unmeasurable effort. In this case, owners benefit from increases in managers or

[19] Particularly if final customers are willing to pay more for a high value product.

employees effort. In an uncertain environment -- for example, with fluctuations in the production frontier -- owners will not be able to distinguish whether output changes result from low effort or a from bad environment. If it is costly for managers to provide extra effort, and if owners cannot monitor effort, managers will shirk unless proper incentives are offered.

Figure 2.5 Enhancing efficient input use by human effort



Incentive schemes have been proposed that reward managers so as to provoke the optimal amount of effort. Such schemes should reward managers for output increases resulting from increased effort, but shield them from income risk resulting from the fluctuations in the external environment. One such scheme, by Nalebuff and Stiglitz, 1983, pays managers a fixed fee plus a proportion of *operational* profits.[20] In a perfectly contestable and competitive market, firms receive a zero *net* profit, while managers and employees receive all operational profits[21] and thus will will be motivated to provide sufficient effort.[22] In a non-perfect competitive market, managers will provide less-than-optimal levels of effort (see Nalebuff and Stiglitz, 1983). In fact, managers will only get a limited proportion of the profits gained by more effort, while they have to incur all incremental costs of higher effort. With increasing incremental cost for providing managerial effort, the hired manager has a lower `break even point' than the owner who would manage the firm himself, since the manager-owner would receive all profits. Moreover, when opportunities for cost reductions arise, managers will instead trade off some of the benefits for even less effort and greater leisure (this phenomenon is well-known as managerial slack).

[20] I.e. total sales minus the costs of intermediate products and the cost of capital.

[21] The owners' share of operational profits will be completely foregone to the fixed premium of the manager or employees.

[22] Note that in this case managers and employees bear all the risk of low profits due to less effort, because they gain all operational profits. If they would shirk, they would only harm themselves with releases of jobs due to losses and possibly bankruptcy.

Indicator

The effectiveness of methods used to reduce shirking depends on the type of reward system of managers and employees, and whether or not owners or shareholders of the firm can monitor their productivity level. These two issues can serve as qualitative indicators for identifying the extent to which firms use their input as efficiently as possible.

Slow adoption of process innovation by firms, especially firms with market power, may also be an indicator of managerial slack. In that case managers put insufficient effort to improve the production process.

If firms operate inefficiently but can still maintain their market share, competition forces must be weak.

Box 3 Relation competition and productivity

Nickell states that there is no hard theoretical evidence that more competition results in more labor productivity and technological development (see Nickell, 1996). But his empirical research suggests that market power and high market shares generate reduced productivity levels, while increased competition in terms of more firms on the market is associated with high rates of productivity growth.

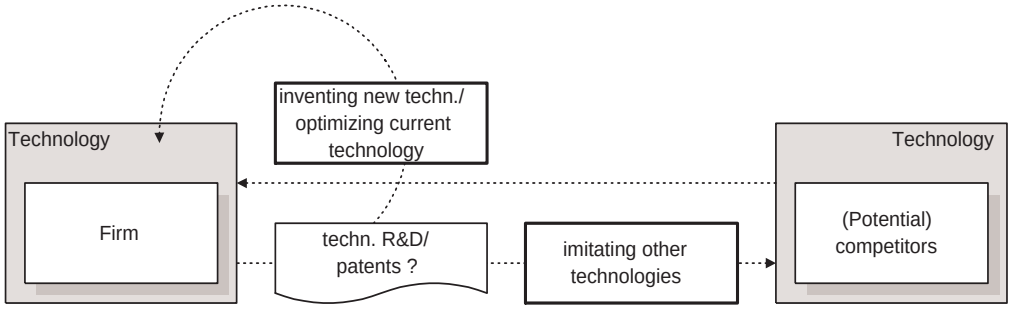
4.2.6 Process innovation and technology improvement

Many economists, especially those of the `Schumpeterian school', put forward that one of the crucial conditions for staying in business is the innovation of new products and technologies. The modern endogenous growth theory even suggests that economic growth can be driven `... by technological change that arises from intentional decisions

made by profit-maximizing agents ...' (see Romer, 1990). But firms will, in fact, only decide to innovate when the quasi rents, i.e. the return of the project,[23] exceeds (the present value of) the costs of research and development.

The earlier R&D models focus on the timing of innovation and patent races between incumbents and entrants. More recent models consider both process innovation and -imitation in an evolutionary market with firms using different technologies. Nevertheless, both types of models show that firms that have not yet invested in a particular technology are prepared to undertake risky and pioneering research projects. Firms that have much invested in some technology and have gained a profitable market position are more conservative in developing new technologies or production methods.

Figure 2.6 Process innovation and technology innovation



The timing of innovation and patent races

Most of the earlier models on innovation and R&D assume that a patent of a *potential* innovation will be `auctioned' (see Reinganum, 1989). The winner of the patent will be the only firm that will conduct the research because it is the only firm that is allowed to use and gain from the results of the innovation. In these models, two important but related issues are at stake. The first issue concerns the winner of the patent race -- for example, the incumbent firm or the (potential) entrant. The second issue involves the speed at which the innovation will be achieved, depending on the research capacity of firms.

[23] In particular the present value of future sales minus the costs of production.

If the innovation involves low uncertainty, the incumbent has more incentive to win the patent. The gain for the incumbent, i.e. the difference between the monopoly profit and the profit in a duopoly, is larger than the gain of the entrant, i.e. the profit in a duopoly. However, if there is much uncertainty surrounding the innovation, the incumbent will be reluctant to invest in research capacity and stick with its existing but safe and profitable technology. Only then can the entrant take its chance in entering the market by conducting the risky research and applying the innovation.

Finally, if patents allow only a single firm to conduct some research, they may successfully remove social over-investment in R&D effort. However, patents may possibly restrict other firms to search for the most efficient technology.

Process innovation and -imitation of firms with diverging technologies

In more recent models, firms can build their own stock of knowledge related to the firm-specific technology and production methods (see e.g. Jovanovic and MacDonald, 1994a and 1994b, and Jovanovic and Nyarko, 1995). In order to strengthen their competitive position, firms can improve their technology by enlarging their knowledge through several types of research. More particularly, they can conduct applied research and improve their current technology, imitate better technologies of other firms or invent completely new technologies. The choice depends on the balance of early (sunk) investment in existing technologies and the expected profitability of adopting new, perhaps risky technologies.

First, (conservative) firms may conduct only applied research in order to optimize their current technology and to learn about the best practice or production method (organization of the work space, type of labor hired and task-assignment, etc.). The *expected* profits of upgrading to a better technology cannot outweigh the existing profits and an additional gain by conducting applied research. The sunk (capital) investment related the existing technology will be foregone, while upgrading involves too much risk. However, the gain in conducting applied research will diminish as the firm's experience increases and production converges to the best practice.

At the other extreme, pioneering firms may continuously invent new technologies on the basis of their knowledge on previous technologies. In this way they will show upward jumps in productivity levels or downward jumps in marginal cost. Whereas these firms do not invest in applied research or learning, they will never attain the best practice for each specific technology. As a result, profits realized using the current technology are no higher than the incremental (risky) benefit of research in a potentially better one. Nevertheless, since these firms can continuously decrease their marginal cost, they will

eventually have a larger market share, certainly compared to those firms that have not conducted any research.

Box 4 Shake-out in the US tire industry

Jovanovic and MacDonald explain the sudden shake-out of firms in the US automobile tire industry after a major invention in the production technology (see Jovanovic and MacDonald, 1994b). Their model distinguishes between an invention (the discovery of "something new" outside the industry) and an innovation (firms adapt inventions so that the finding can be applied commercially).Using this model, Jovanovic and MacDonald then describe the evolution of the tire industry, in which firms flourished by succeeding at innovation or exited due to missing new inventions.

After the invention of the rubber pneumatic tire in 1888, new firms entered the market by conducting some innovative research to get familiar with a low-tech technology. The number of producing firms rose from ten in 1906 to 275 in 1922. But, meanwhile, in 1916, a major invention and refinement in production technology occurred, raising the minimum efficient scale of firms but reducing the production cost. Firms that were able to adopt the new high-tech technology could survive. But many firms that could not adopt the new technology were forced to leave the market, viz. the sharp decrease in the number of firms to 132 in 1928 -- before the onset of the Depression. The (estimated) firm value of low-tech firms decreased after the refinement, but stayed above the average value of firms in other industries. The estimated firm value of high-tech firms are even nine or ten times larger than the firm value of low-tech firms. The actual wholesale market price for tires dropped from the first observation in 1913 until 1928 by more than 80%, but stabilized somewhat afterwards.

The third option can best be characterized as waiting to see in which way the cat jumps. Firms can imitate existing high-grade technologies of other firms, thus taking a relative low risk while conducting (low) imitative research. Initially, R&D will be restricted to applied research or inventing new technologies, because there are few firms to imitate. But when time passes, there will be more high-grade technologies. Then the return on imitative effort will rise and overall industry imitative research, particularly by low-tech firms with a low level of know-how, will replace the inventing research for developing new technologies. Although the initial market share of the imitating firms may be relatively low, they will grow at a faster rate than the innovative and pioneering firms.

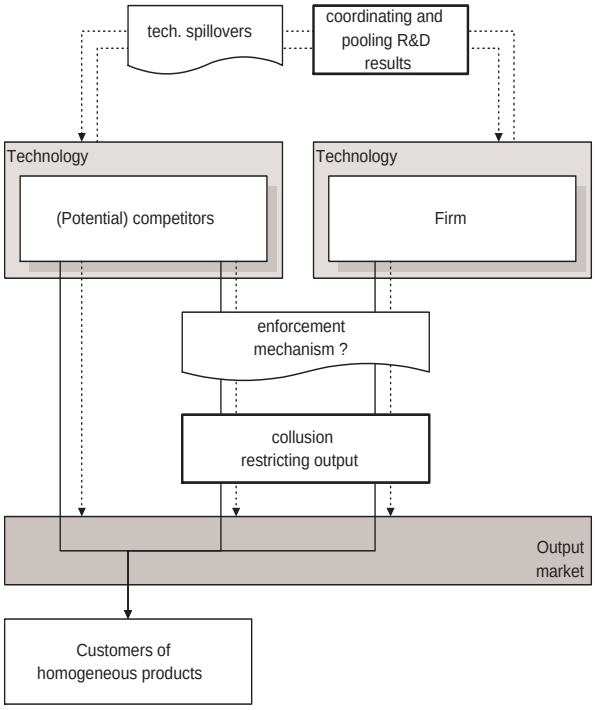
Indicator

The amount spent on R&D may be indicative of the opportunity for developing new technologies and reducing production costs. The difference in production costs among firms may point to the potential for inefficient firms to imitate better technologies, i.e. if there are no technological patents granted.

4.2.7 Horizontal collusion and cooperation in research

This section discusses horizontal collusion and cooperation in research. We will particularly consider output-restricting cartels on a homogeneous Cournot market, and R&D cartels and joint ventures. The admissibility of cartels and joint-ventures depends very much on their concerted behavior and purpose. Whereas output-restricting cartels try to increase prices at the expense of individual consumers, R&D cartels and joint-ventures try to reduce overall research costs and eliminate duplication of R&D effort.

Figure 2.7 Horizontal collusion and R&D cooperation



The essence of collusion is that two or more firms maximize their joint profits and redistribute some gains among one another if necessary (see Jacquemin and Slade, 1989). Several firms may lose some profits in favor of other

participants due to the consequences of the collusive agreement. Therefore, they will only consent to the agreement if they will be compensated. Only then will all firms gain from collusion.

Cartels and joint ventures are often plagued with coordination problems, and eventually with instability of the cooperative agreement. Firms may have an incentive to deviate from the collusive agreement in order to reap some additional profits at the expense of other colluding firms. The incentive to deviate may increase even further if non-colluding firms gain more than colluding firms (‘free-riding’ of non-colluding firms). In fact, the non-colluding firms have not committed themselves to the self disciplinary measures of the collusive agreement, but still gain from the market conditions caused by the agreement. Therefore each colluding participant may find it more profitable to sneak off from the agreement.

But if the loyal firms can detect deviation and cheating, they may punish the unloyal firm. The cheating problem would be more severe if colluding firms cannot directly observe the actual behavior of other participants, as in the case of legally prohibited, tacit collusion. Then, cheating would be hard to detect and is likely to go unpunished. However, some theoretical models[24] suggest several enforcement mechanisms to overcome the detection problem.

Now consider the specific case of a cartel on a Cournot market, attempting to restrict overall output and thus force up the market price. Each firm will then increase its profits, since the gain from a high market price will outweigh the loss from the output restriction. Participating firms may cheat by increasing their output and their market share above the level that is agreed upon, but will still gain from the high market price due to the remaining output restriction of the other participants. However, the other cartel members can credibly threaten to increase their output for a period of time to the competitive level and `punish' the defector with a lower market price if cheating is detected. But if the time lag of detection after cheating and/or the interest rate were to be sufficiently low,[25] firms will *not* deviate. If the cartel members cannot observe each others' output, they can still deter cheating by threatening to increase their output whenever the market price drops below a specified level (the so called `trigger price').

Finally, let's focus our attention on another, more specific type of cooperation, i.e. R&D cartels and joint ventures (see e.g. Kamien, Muller and Zang, 1992). In order to unite forces in searching for new technologies and lower production costs, firms can join a

[24] See e.g. Jacquemin and Slade, 1989.

[25] I.e. if firms are not short-sighted but put enough weight on future profits.

R&D cartel or establish a new R&D joint venture. In this way they can overcome a cost-of-development barrier and eliminate duplication of R&D effort. However, cooperation may be hindered by a combination of the cheating and the free-riding problem. Each firm will try to minimize its own effort and rely on the spillover effects of R&D results (and thus efforts) by other firms.

In many theoretical models the cooperation between firms is restricted from above to the stage of research, not to the final production stage. Still, there are several ways to cooperate. Firms can, for example, coordinate their R&D efforts in order to maximize the sum of overall *competitive* profits in the production stage (either in a Cournot or in a Bertrand market). A second option may be to pool the R&D efforts in a joint venture in order to avoid duplication of R&D activities and to internalize the spillover effects.[26] Then, pooling the R&D results still yields the highest prices because of the free-riding problem. However, if the participating firms not only pool their R&D results but also coordinate their efforts to maximize overall profits, they will actually attain the highest total profit *at the lowest product prices*.[27] Pooling and coordination takes full advantage of spill-over effects but keeps the free-riding problem within bounds.

[26] If we allow all types of combinations (joint profit maximization in a cartel or not, respectively sharing R&D results in a joint venture or not), we get four possible scenarios.

[27] This result yields for both a Cournot market and a Bertrand market whenever the substitutability of products is sufficiently low.

Indicator
Output restricting cartels: *Since cooperative agreements can be successful only if cheating can be detected and punished, the possibility to design enforcement systems to detect and punish cheating show to what extent cartels can arise. However, since most output restricting cartels are strictly forbidden, firms will keep such an enforcement mechanism secret. Therefore, analysts and policymakers will find it difficult to discover enforcement mechanisms and cartels (see Phlips, 1995).*
R&D cooperation: *The cooperation in research depends very much on the spillover effects of R&D results. Therefore, the opportunity to incorporate spillover effects and to reduce research costs may be indicative of the potential success of pooling R&D results.*

5. Policy questions

This section will focus on questions that may arise in three policy settings. First we will consider the concerns of the agency charged with enforcing the new law on antitrust and competition policy. Next, we review questions that are relevant to designers of industrial policy. Last but not least, we will review issues that may arise for policymakers entrusted with streamlining regulation and legislation in particular markets. We will use the analytical framework introduced above to identify policy questions, to specify and analyze available policy options, and to make welfare comparisons.

The policy questions are related to the objectives of each policy setting. Enforcement of competition policy entails both prevention of market concentration and evaluation of proposed mergers. The policy questions in competition policy are whether collusion has taken place, whether a firm has abused its dominant position, or whether the potential for both issues exists. Industrial policy entails pinpointing areas where measures aimed

at stimulation can alleviate dynamic market failure and setting conditions for the efficient functioning of markets. More particularly, it encourages (cooperative) research and development, but also aims to develop specific industries that support domestic firms in international markets, or to adjust the structure of mature or declining industries. The streamlining of regulation and legislation entails reviewing the economic basis for specific regulatory measures, such as their role in alleviating market imperfections. If the new law on competition policy cannot address specific imperfections, targeted regulation may be desired.

The analytical framework outlined in section 4 introduced economic models concerning firms' behavior that set their supply conditions and their market interactions. For each policy setting, we will now determine which models are relevant, and what the models imply about the dynamic performance of markets. Then we may determine the potential role for policy and thus the welfare implications of various policy options.

Section 6 presents a method to analyze the (potential) policy issues on a specific market. By using this method we may detect several market imperfections that cannot be relieved by competition and industrial policy, and thus require some additional, market-specific regulation.

5.1 Competition Policy

The new law on competition policy in the Netherlands harmonizes Dutch legislation with European laws and directives. EU competition policy aims at improving the allocative efficiency of markets (see Buigues, Jacquemin and Sapir, 1995, and Gual, 1995). More particularly, the competition policy attempts to enhance social welfare by prohibiting abusive strategical behavior or by removing inadmissible market structures. Art. 85 of the EEC treaty prohibits any agreement between firms that hinders competition, unless the agreements lead to `technological advances or economic prosperity'. Art. 86 restricts the abuse of unallowable dominant positions. However, Art. 90 sets specific conditions that allow firms to attain a dominant position. Still, the government may regulate these allowed dominant firms in order to increase social welfare. Finally, Art. 92 sets down some directives regarding government subsidies. In the Netherlands, a governmental competition authority (NMa) will enforce the prohibition of cartels and the abuse of dominant market position, will determine when exclusions on technological or prosperity grounds are warranted, and will monitor market concentration and evaluate merger proposals.

The analytical framework can provide guidance in locating abusive behavior, because it indicates which types of market interactions (see table 1, section 4.1) may lead to

welfare-reducing behavior. In the subsections below we will first indicate in which markets abusive behavior may emerge, the impact on market performance and welfare, and which policy options may provide relief.

Next, the framework can aid regulators by describing the characteristics of markets that may be susceptible to vertical integration. Further, it sheds light on the types of horizontal collusion or cross-firm agreements, which may theoretically be conducive to more rapid technological development or to increased economic prosperity.

Finally, the government may still have economic grounds on which to regulate firms, even if the firms do not collude, nor abuse their dominant position. For example, natural monopolies or oligopolies resulting from economies of scale or scope may still require regulation in order to, for example, ensure universal service at uniform prices. Section 5.3 mentions several problems that emerge with regulating firms.

Abuse of dominant positions

This section will consider the effects of the behavior of firms that abuse their dominant position and restrict competition. For example, firms may raise entry barriers in order to sustain their favorable market position.

Section 4.2.2 explored how advertising and image-building can raise an entry barrier. The issue of image-building can be perceived either as a positive or as a negative aspect. Whereas advertising involves extra sunk costs and reduces competition, customers may still enjoy the image of using a highly promoted product. The image associated with the product becomes an added value, thus making a clear statement on the allocative efficiency ambivalent.[28] Another option for incumbents is to commit themselves to excessive capacity or output. In this way they can lower the market price and make successive entry unprofitable. Although the market price will decrease slightly, it will never attain the minimal average cost level because free entry will be deterred. The market will therefore not be allocatively efficient.

Section 4.2.3 indicated that differentiating firms may exert some market power on a particular segment, especially when competition from adjacent segments is restricted. Incumbents on spatial markets, for example, have more incentives to operate on a new site than do entrants; incumbents will thus set up an establishment on the new site before entrants can. On markets with the potential for quality differentiation, firms will search

[28] If image-building is perceived as a negative aspect, e.g. when a strong brand-image does actually not imply high product quality as customers might think, high advertising will be allocatively inefficient.

for their own quality niche in order to overcome the threat of destructive (price) competition. For both types of markets reduced competition from adjacent segments will drive up prices in each separate segment at the expense of customers. Therefore, incumbents' foreclosing behavior will reduce the magnitude of allocative efficiency on each separated segment, i.e. if there are no economies of scope involved.

The general competition policy states clearly that all the above-mentioned types of abusive behavior are prohibited (art. 86 of the EEC treaty). However, the general law may be insufficient to provide specific directives for each typical market. Therefore, section 5.3 will consider additional regulation that may be required.

Vertical and horizontal collusion

This subsection treats several forms of vertical integration (i.e. integration of firms with their customers or suppliers) two types of horizontal collusion and some related policy issues.

First, a dominant upstream supplier may have an incentive to foreclose or control the downstream final markets. Section 4.2.4 indicated that the supplier will only integrate with downstream firms that have elastic demand for the intermediate product, because it can better squeeze inelastic downstream purchasers and ask them high intermediate prices. If final customers do not value product variety per se, they will experience no welfare loss by integration due to less variety in final products. In fact, integration will enhance more welfare: mark-ups of intermediate firms will be reduced and marginal cost will be lower for producing the final products by the integrated firm.

However, integration may tip the scales to monopolization of the overall industry if the integrated firm ceases delivery of intermediates to each non-integrated downstream firm. This will reduce the initial welfare gain of reduced mark-ups and lower production cost. Moreover, if final customers do benefit from product diversity, integration renders the market dynamic inefficient, and the resulting loss in consumer surplus will shrivel the initial welfare gain even further.

Section 4.2.4 also indicated that (competitive) intermediate firms may want to integrate with their capacity-constrained suppliers to ensure stable supply. But since the final outcome on firms' behavior depends on several conditions, the impact on total welfare is difficult to determine. Nevertheless, Bolton and Whinston have derived some results on the welfare effects of (potential) supply assurance in an industry with one upstream supplier and several competitive intermediate purchasers. Appendix A gives the results that are most important to our framework.

The next issue concerns horizontal collusion between competing firms on a single (homogeneous) market. One type of collusive action discussed in our framework (see section 4.2.7) is the restriction of output on a Cournot market, resulting in higher market prices. This behavior increases producer surplus, but reduces consumer surplus to a larger extent -- and thus total welfare.

Another type of collusion, collusion in R&D projects, may be welfare improving (i.e. as long as cooperation is restricted to the development stage and is not shifted to the final production stage). If firms avoid costly duplication in research efforts and internalize R&D spillovers, total welfare may rise. In particular, by coordinating the R&D efforts and pooling the R&D results, participating firms will actually attain the highest total combined profit, while providing the final product at the lowest price. Thus, pooling and coordination may yield the highest welfare.

As mentioned above, by art. 85 of the EEC treaty the competition policy prohibits any agreement between firms that hinders competition, unless the agreements will lead to technological or economic prosperity. This design implies that the regulatory authority (NMa) has to weigh the pros and cons of cooperative agreements in terms of (dynamic) social welfare. The decision may be relatively easy for horizontal cooperative agreements on research and development, since cooperation may only take place for research, not in the production stage. However, the balance appears to be more complicated for vertical agreements and mergers. Moreover, specific regulation (see section 5.3) may be required to prevent further misbehavior of integrated firms (monopolization of the whole industry).

5.2 Industrial policy

The second direction in EU policy, industrial policy, emphasizes the removal of dynamic market failures and the settings of conditions for the efficient functioning of markets (i.e. dynamic efficiency). Art. 130 of the EU treaty states that industrial policy should focus on `... ensuring that the conditions necessary for the competitiveness of Community's industry exist ...'. Industrial policy has traditionally been quite strong in the area of research and development. The EU and national governments support many R&D programmes in the `pre-competitive stage', i.e. the stage before production and marketing. However, industrial policy also aims at developing specific industries that support domestic firms in international markets,[29] or adjust the structure of mature or declining industries to ensure continuation of profitable business and employment. In

[29] E.g. international banking and business services.

that sense, the EU and national governments may promote the introduction of new products that better fit customers' preferences.

Although analysts and policymakers agree upon the necessity of innovation, they are still debating how to accomplish more innovation and technological progress. There are two conflicting views on the relation between innovation and competition (see e.g. Scherer and Ross, 1990). The first view emphasizes that more (potential) competition stimulates more rapid and intense support of R&D (i.e. the first-mover advantage drives firms to perform R&D as soon as possible). The second view, in line with Schumpeter's ideas, states that larger firms with market power are more appropriate for conducting risky research and development. Whereas small firms can raise only financial sources from risk-averse lenders, large firms have more internal and free available financial sources, and can better diminish the risk by engaging in different but uncorrelated research projects. Moreover, large firms can better reap from cost-saving innovations than can smaller firms (see also Klepper, 1996).

Next to the relation between competition and innovation, we may also consider the issue of under- or over-investment in R&D from a social point of view. On the one hand, as the benefits of R&D may not be fully appropriable to a single firm and spillover effects to other firms may emerge, we may observe under-investment in R&D (see Romer, 1990). On the other hand, rivalry and competition among firms in patent races may lead to excessive spending on R&D because overlapping or even duplication may arise. Therefore, the EU stimulates cooperation in research and development in order to reap as many R&D results as possible by avoiding duplication of research. However, section 4.2.6 denoted that firms can pick up new technological developments without excessive duplication of research activities.

The analytical framework contributes to this debate on the accomplishment of more and efficient innovation, and considers several aspects that fit into the scope of industrial policy. First, it highlights some aspects on research for improving technology and production methods. Technological innovation may then result in lower production costs and, if competition remains, in lower prices. Second, the framework indicates several effects that may emerge with product differentiation. Introducing more product variety contributes to the valuation of (intermediate) products, but may also lengthen the life cycle of a mature market by attracting new customers, or become a starting point for new product markets.

Process innovation

Firms that lower their production costs by applying innovative technologies may improve their competitive strength at the expense of conservative firms, eventually altering the market structure. Those firms that introduce new technologies and continuously upgrade their technology, can be considered as the pioneers in the market's evolution. They take the first step to improve the dynamic efficiency of the market. New firms are more likely to conduct risky innovation projects, because they have no safe and profitable market position to put at stake and thus are less risk averse.

Governments can stimulate upgrading research by granting a (temporary) patent or by allowing cooperation (see section 5.1). But although patents avoid duplication and offer the patented firm some secured profitability, they still hamper spillover effects and cut off any use of cost-saving R&D results by other firms. Moreover, patent races may provoke too much investments in research capacity from a social optimal point of view, because firms are eager to win the patent. The dynamic welfare will increase if imitation of high-grade technologies with lower production cost will be allowed (see Jovanovic and MacDonald, 1994a).

Furthermore, non-upgrading does not automatically imply that firms produce inefficiently. Some firms stick to the same technology but try to get the most out of their current technology. They will develop a better production method through learning effects and some additional grade-specific, applied research. In this way these firms try to minimize the extent of X-inefficiency.

Thus, in addition to exploration of upgrading technologies, imitation of new technologies and applied research to increase the return of existing technologies should be allowed. Firms have incentives to conduct different types of research (see section 4.2.6). Moreover, as indicated in section 5.1, pooling R&D results and coordinating R&D efforts may further increase dynamic welfare.

Product innovation and differentiation in product attributes and quality

Our analytical framework takes account of the fact that in many markets customers have different preferences towards variety in terms of product quality and product attributes. Customers benefit if they can find products that better fit their preferences (`love-of-variety' effect). Introduction of new product varieties increases overall demand, but also increases the substitutability between varieties which reduces mark-ups. The overall effect of a new variety on price is ambiguous. From a social point of view, however, more variety is not necessarily better if new varieties require sunk investments. Entrants will not take into account the effect of their investment on the profitability of incumbents (`busines-stealing' effect). Whether free entry leads to a socially optimal

outcome depends on the relative size of the love-of-variety effect versus the business-stealing effect (see e.g. Mankiw and Whinston, 1986).

However, there are two important caveats to be made on entry and introduction of new varieties. First, similar to the strong impetus of incumbents to penetrate new spatial segments (see sections 4.2.3 and 5.1), incumbents may have an incentive to forestall potential entrants and introduce new products at a faster rate. Second, whereas the (potentially) destructive price competition in a single (high quality) segment reduces profits, firms will try to stay out of the competitors' segments and find their own niche. As mentioned in section 5.1, both types of firm behavior may release overall competition and result in higher prices in separated segments.

The models for product differentiation thus point out that stimulating (the research for) product variety induces a gain in dynamic efficiency, i.e. only if incumbent firms do not forestall entrants and build their own niche to restrict overall competition. If product differentiation restricts competition on each segment, customers may pay high prices for each product. This issue puts some burden on the policy to encourage product differentiation.

5.3 Regulation in particular markets

Next to the use of general competition and industrial policy, several specific policy instruments exist that focus on typical markets or industries. In recent years, the Dutch government has taken considerable action to improve (existing) industry-specific directives, and eliminate excessive regulation that restricts competition (MDW operation). The new law on competition will cover some part of existing specific regulation that aims at removing anti-competitive behavior. Similarly, the government has also liberalized several markets that were previously (semi-) public sectors in order to allow more competition.

Bos points to several types of regulation on firm's conduct and market structure (see Bos, 1996) that have a direct impact on competition. More specifically, the regulation of conduct may focus on the price and output level of firms, firms' capacity, product quality and, finally, contracts between mutual suppliers, or between suppliers and customers. The regulation of market structure may be related to the entry and exit of firms.

It should be obvious that these types of regulation should fit into the framework of the general directives set by the EU or national government. But if the general policy cannot offer a remedy for existing market failures, or if government still has some

economic grounds to regulate firms (even if firms act according to the general policy measures), the government may apply these types of market specific regulation.

Next to economic regulation, the government may also find some non-economic grounds to regulate firms. These types of regulation mainly concern clerical and managerial obligations, environmental issues, health and product safety, labor conditions and wage systems. Although an extensive elaboration of non-economic regulation will be beyond the scope of our analysis,[30] we can still observe that sunk investments that are used in order to meet the firm's obligations with respect to non-economic regulation may burden the entry of new firms and competition (see section 4.2.2).

Suggestions for additional regulation

Sections 5.1 and 5.2 pointed out several issues that result in market imperfections and for which the government may find some further market-specific regulation appropriate. These issues concern large stock building and capacity building beyond the minimum efficient scale, segment- and quality differentiation that restrict competition, misbehavior after vertical integration (monopolization of the complete industry) and possibly high advertising and image-building.[31]

The most obvious measure to remove excessive capacity- or stock building is to impose capacity or stock constraints. However, the upper bounds for capacity should be related to the minimum efficient scale, because prices on competitive markets will attain their lowest levels if firms set their output level at the minimum efficient scale (see section 4.2.1). But, whereas the most efficient cost structure is difficult to observe, the minimum efficient scale -- related to the cost function -- is even more difficult to determine. Indeed, the continuous effort to improve technologies, to enhance efficient use of inputs and to bargain for low input prices will shuffle the minimum efficient scale.

Regarding the strong incentive of incumbents to enlarge their activities to new spatial or product segments, the government may consider giving entrants an advantage and providing them the only license to operate on a new segment.

[30] For an extended list of various types of economic and non-economic regulation see Research voor Beleid, 1994.

[31] E.g. when a strong brand-image actually does not sufficiently imply high product quality, as customers might think.

The misbehavior of a vertically integrated firm owning a bottleneck facility in industry (e.g. the upstream stage with scarce capacity) may be prevented by imposing a condition of non-exclusionary (intermediate) supply at reasonable prices. The open-network provision in network-related industries (such as telecommunications) shows some similarity with the condition of non-exclusionary supply.

If the government suspects that firms abuse a dominant position attained by advertising and differentiation, it can set standards on product quality and/or product attributes, and make customers aware of these standards. In this way government may equally tackle the problem of asymmetric information on product quality between suppliers and customers (see e.g. Hendrikse, 1995). However, firms may (again) use advertising in order to make customers familiar with some standards, and to indicate that their products satisfy these standards.

Regulation of firms with allowable dominant positions

To conclude this section, we will consider the dominant positions of firms that take advantage of several types of economies, but that may still be regulated to further increase total welfare or to prevent the firm from misbehaving. Section 4.2.1 we have learned that firms on a contestable market with no entry barriers may still sustain a dominant position. These natural monopolists or natural oligopolists take full advantage of the economies of scale or economies of scope. The integrated monopolist reduces the marginal cost of producing total final output and limits excessive mark-ups of formerly intermediate purchasers (see section 4.2.4). The government may allow the dominant positions of these firms in order to gain from the respective economies. However, it should also protect the customers from firm behavior in capturing high surpluses. In that sense, the government can, for example, regulate the market price and increase the total surplus in favor of customers.

But suppose that the regulated price will be composed of some variable or marginal costs and a mark-up for rewarding fixed capital. When this mark-up is related to some allowed rate of return exceeding the marketed cost of capital, each regulated firm will allocate too much capital and too low a level of labor from that which is optimal. This effect, known as the Averch-Johnson effect, has been recognized by regulators. Therefore regulating authorities now more often use price caps instead of marginal-cost-plus-margin price regulation.

Box 5 Costs and benefits of (de)regulation

Hahn and Hird have calculated the annual costs and benefits of economic and social regulation in the US (see Hahn and Hird, 1990). First they provide an overview of the calculated costs of economic regulation for international trade, the labor market and specific industries in agriculture, energy, transport and communications, and the financial sector. They not only consider the welfare or `efficiency' costs (dead-weight loss), but also transfers in surplus between customers and suppliers. The authors simply add up the costs of regulation calculated by other economic analysts to an overall amount, neglecting the impact of industry-specific regulation to other related industries.

Then Hahn and Hird calculate the total cost and benefits of non-economic regulation, such as regulation on environmental issues, health and product safety. Whereas the costs can be measured in terms of related investments, the benefits can at best be calculated as the projected amount individuals are willing to pay for changes enforced by regulation.

The next table summarizes the results of Hahn and Hird.

Calculated annual costs and benefits of regulation in the US (in billions of 1988 dollars resp. % of GDP in 1988)

	Economic regulation	Social regulation
Efficiency cost	45.3- 46.5 (0.9% GDP)	
Welfare transfer	172.1-209.5 (3.5-4.2% GDP)	
Total costs		78.0-107.1 (1.6-2.2% GDP)
Total benefits		41.9-181.5 (0.8-3.7% GDP)

Winston states that the actual annual benefits of economic deregulation range from 35.8 to 46.2 billion (1990) dollars (see Winston, 1993). Most of the benefits contribute to consumers' welfare. He also emphasized that regulation actually not only resulted in price changes, but also in unforecasted price differentiation and

The effectiveness of price regulation may be reversed if we consider some external effects on adjacent segments. Price regulation therefore requires an intensive monitoring of the structure in the overall industry. We will give two examples in which price regulation is difficult to apply (see Viscusi, 1992).

First, if prices of several product segments will be regulated and set to a single price level (for example, the high marginal cost of a high quality product), customers will only buy the high quality product at the regulated price. But those customers that consider only price and not product quality, will incur a loss because they are not able to buy a low quality product at a lower price.

Second, the government may decide to subsidize a high-cost product segment by regulating the price of a segment for products of low marginal cost. But if the subsidized segment has only a low but inelastic demand, while the regulated segment has a high but elastic demand, regulation and subsidization will reduce total welfare.

6. Using the analytical framework for determining the effectiveness of regulation

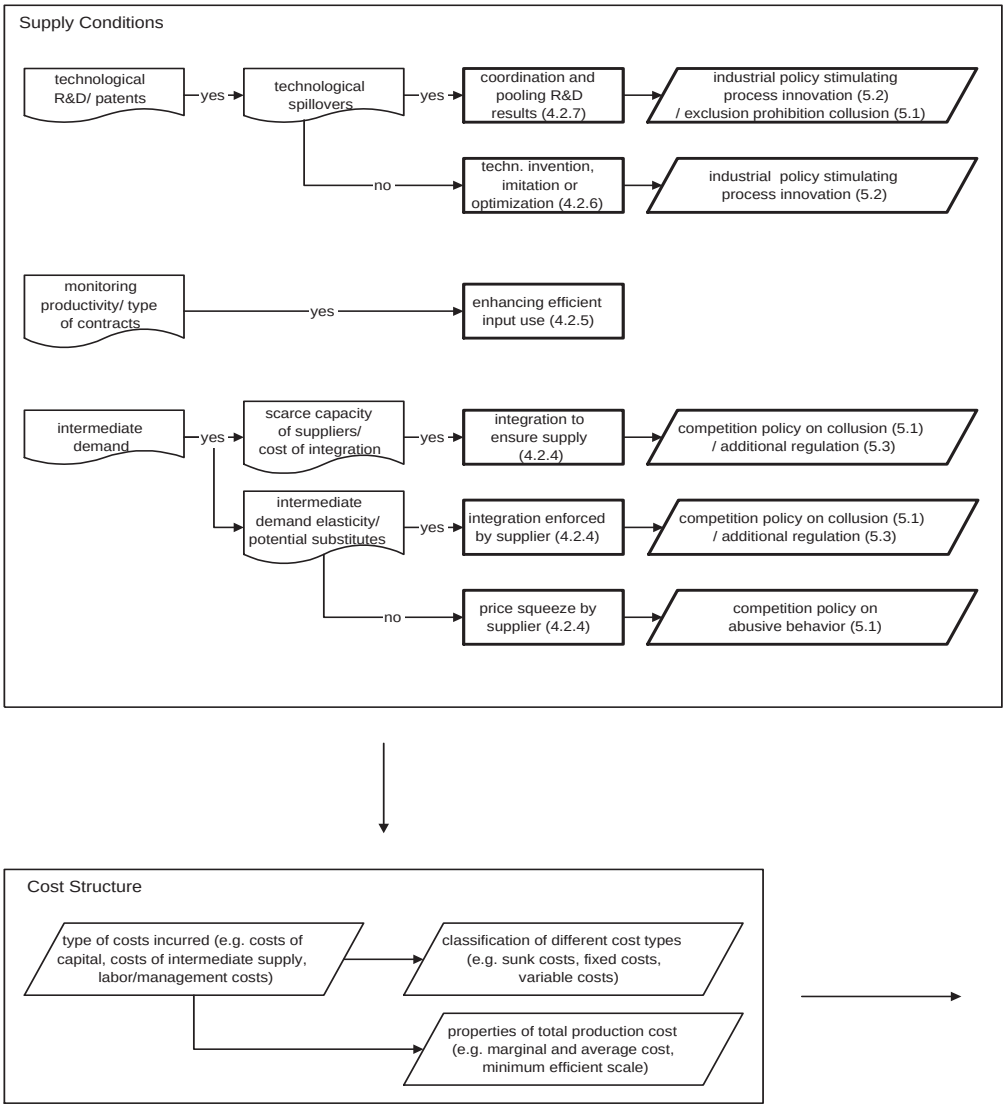
One of the underlying objectives of the analytical framework is to aid in cost-benfit analysis of regulatory reform. The basic method of cost-benefit analysis is simple: calculate the difference between total welfare before and after reform. However, this calculation requires knowing future market situations, which are quite difficult to predict.

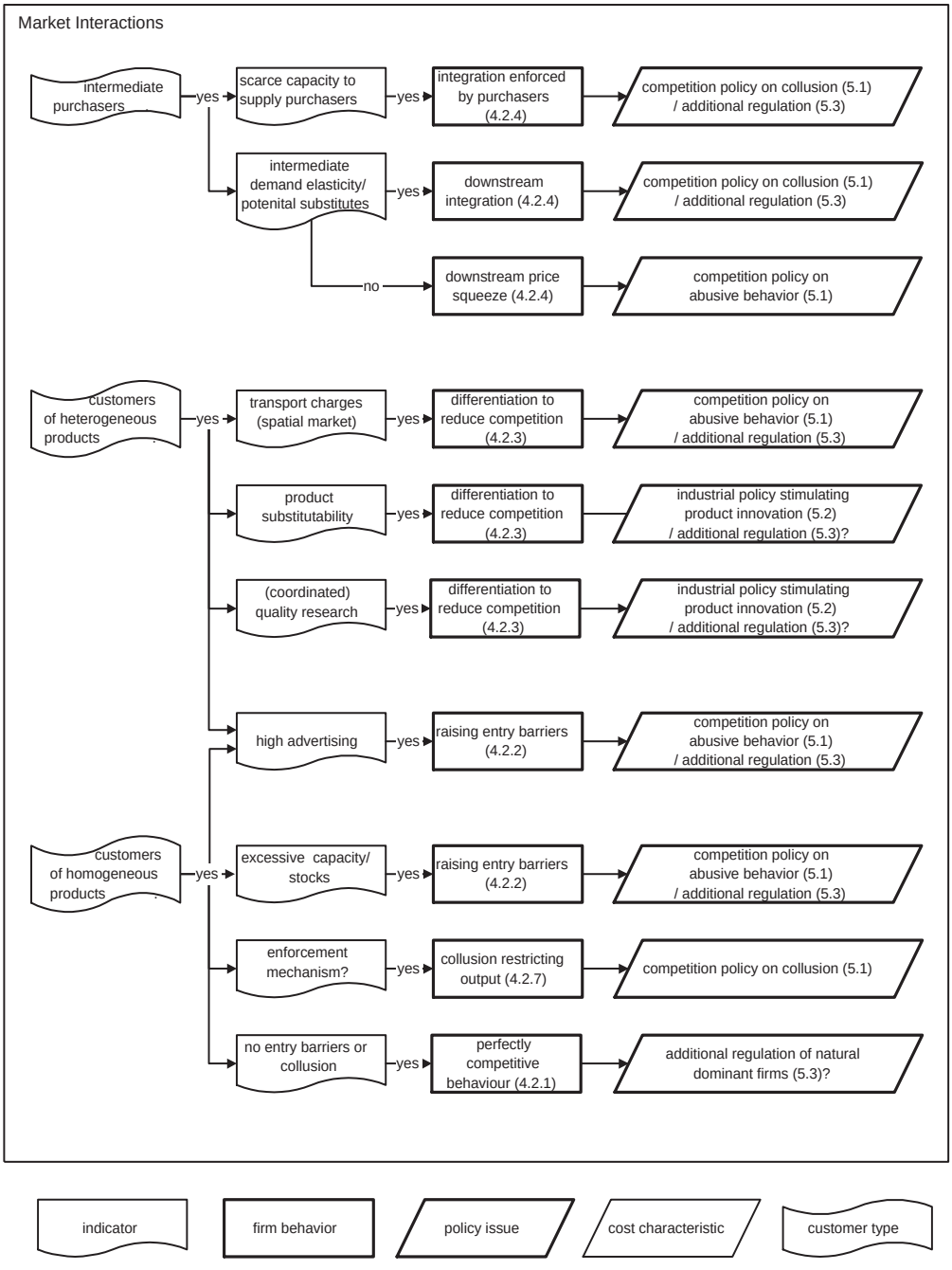
Three kinds of effects that hamper simple analysis should be considered. First, the effects of the new competition policy legislation on the market situation must be taken into account. Next, the static effects of the regulatory reform, such as price reductions following removal of entry barriers, need to be considered. Finally, important dynamic effects, such as increased product differentiation or the creation of new entry barriers by incumbents, may induce changes in market situations and thereby alter the final outcome of regulatory reform.

The analytical framework provides a tool for describing firm behavior that determine the market structure and the extent of competition. It also depicts the impact of firm behavior on total welfare. In this way we can find out whether such firm behavior becomes an issue for government policy and regulation, taking account of the renewed legislation of competition policy.

The next subsection will present a working procedure to handle the analytical framework. Subsection 6.2 will apply this procedure to the Dutch mobile telecommunications market and show how to use the analytical framework as a guide for policy analysis.

6.1 A checklist for investigating markets




Market Interactions
intermediate purchasers
yes
scarce capacity to supply purchasers
yes
integration enforced by purchasers (4.2.4)
competition policy on collusion (5.1) / additional regulation (5.3)
intermediate demand elasticity/ potenital substitutes
yes
downstream integration (4.2.4)
competition policy on collusion (5.1) / additional regulation (5.3)
no
downstream price squeeze (4.2.4)
competition policy on abusive behavior (5.1)
customers of heterogeneous products
yes
transport charges (spatial market)
yes
differentiation to reduce competition (4.2.3)
competition policy on abusive behavior (5.1) / additional regulation (5.3)
product substitutability
yes
differentiation to reduce competition (4.2.3)
industrial policy stimulating product innovation (5.2) / additional regulation (5.3)?
(coordinated) quality research
yes
differentiation to reduce competition (4.2.3)
industrial policy stimulating product innovation (5.2) / additional regulation (5.3)?
high advertising
yes
raising entry barriers (4.2.2)
competition policy on abusive behavior (5.1) / additional regulation (5.3)
customers of homogeneous products
yes
excessive capacity/ stocks
yes
raising entry barriers (4.2.2)
competition policy on abusive behavior (5.1) / additional regulation (5.3)
enforcement mechanism?
yes
collusion restricting output (4.2.7)
competition policy on collusion (5.1)
no entry barriers or collusion
yes
perfectly competitive behaviour (4.2.1)
additional regulation of natural dominant firms (5.3)?
indicator
firm behavior
policy issue
cost characteristic
customer type

Although many topics of the framework may be relevant to a specific market, not all topics are equally important. To highlight the most important market characteristics and potential market imperfections, policy analysts can use a checklist or decision tree for investigating a particular market. Van Cayseele, for example, developed two simple checklists for signalling dominant positions and entry barriers, and which are regularly used by the Belgian agency enforcing competition policy (see van Cayseele, 1994). Similarly, in the figure below we will define a checklist of indicators that directs the analyst to the related models on firm behavior and policy issues. Each indicator and the related type of firm behavior are extensively treated in subsection 4.2, while the related policy issues are developed in section 5.

Our checklist contains three parts, each represented by a separate box in the figure above. The indicators in the upper left box detect several types of firm behavior that determine the supply conditions, and locate policy issues that result from these types of behavior on input markets. Note that each of these types can be used as complementary options. By the lower left box we may describe the production cost structure by classifying several types of costs incurred and deriving some properties of total production cost. The indicators in the right box point to firms' market interactions on output markets and highlight market failures and policy issues that ensue from these interactions. These indicators are classified according to different types of markets with different kinds of customers. Finally, note that the representations of indicators and firm behavior in the checklist exactly match the similar representations in the graphical illustrations of firm behavior and the impact on industry structure in section 4.2.

6.2 Application to the Dutch mobile telecommunications market

In this subsection we will use the analytical framework to describe the current situation of the fast growing Dutch mobile telecommunications market. We will abstain from many technical and organizational details that complicate a thoroughly analysis. Moreover, rapid evolutions in this market make final judgements rather ambiguous. For an extended analysis we therefore refer to the CPB study on competition in the communication and information sector (see Bernardt and Canoy, 1997). Nevertheless, the mobile telecommunications market is a challenging case for testing the analytical framework.

Before we apply the checklist to detect typical firm behavior and relevant policy issues, we will first describe the industry structure to get a clear picture of the mobile communications market as a part of the telecommunications industry.

The structure of the telecommunications industry

We will start this section with some technological explanations that make describing the industry easier. Then we will provide a graphical representation similar to figure 2 in section 4.1 that summarizes the industry structure.

The operators offering mobile communication services use different technologies of radiographic transmission on several frequencies or networks. PTT-Telecom operates an analog NMT network and a digital GSM network, while Libertel only operates an own GSM network. However, these existing networks will have insufficient capacity to supply the fast growing demand. Therefore, this year two new firms will be allowed to operate respectively a new *extended* GSM network and a new DCS network, and entry of more firms is expected to be allowed within a few years.

Box 6 Network externalities

Normally customers do not gain from increased demand by other customers, unless economies of scale in production are present. However, the customers in the telecommunications industry may benefit if more customers are connected to a network. In particular, when network connections increase, each subscriber can reach more individuals and is thus prepared to pay more for a subscription fee. This effect is known as the network externality (see Economides, 1996), and clearly applies to interconnection in telecom.

The mobile operators still use the fixed wire network for transmitting messages over a longer distance or for (inter)connecting their customers with subscribers on the fixed wire network. Since PTT-Telecom operates both the fixed wire network[32] and (two) mobile networks, interconnection takes place in-home. For other mobile operators the fixed network is a bottleneck facility, because most calls originating from mobile subscribers are completed to customers on the fixed network. The fixed telephony division of PTT-Telecom offers a `service' of access to its network, *conditional* on equal access to the mobile communication networks.[33]

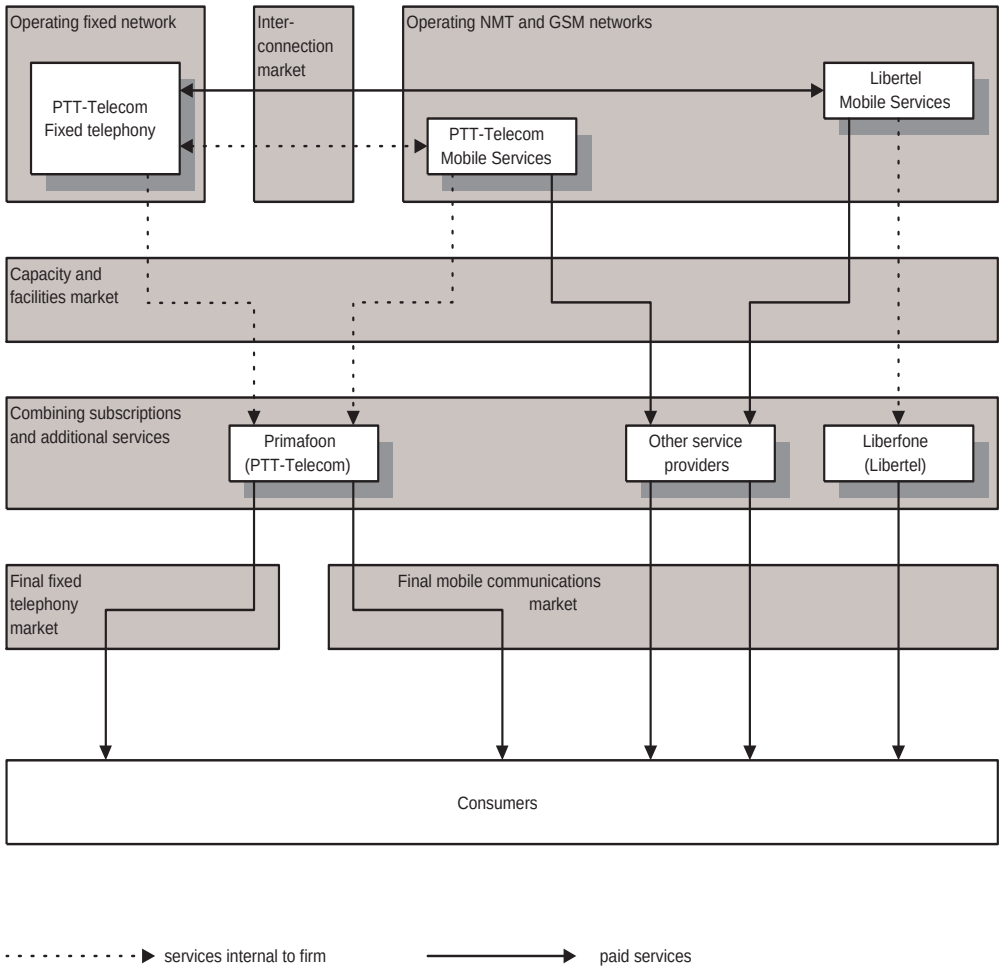
Both mobile operators own a dedicated retailer or `service provider' to distribute subscriptions and other services to final customers. Other independent providers distribute services of both operators.

The next figure represents a part of the structure of the telecommunications industry, and positions the market for mobile communication services.

[32] But in the near future other new operators may also place their fixed wire networks at disposal.

[33] Actually, Libertel and PTT-Telecom both pay the same interconnection price for the mutual access and interconnection to each others' networks. They probably even pay the same amount of interconnection charges if each subscriber has as many outgoing calls as incoming calls. However, PTT-Telecom mostly offers internal connection services on the fixed wire network or between its own mobile network and the fixed wire network. Then, since the interconnection charges are less important for PTT-Telecom, it suffers less from a high interconnection price than Libertel. As a result, Libertel will bargain for low interconnection prices, but PTT-Telecom may bargain for higher interconnection prices in order to diminish the profitability and thus to weaken the competitive position of Libertel.

Figure 3 Structure of telecommunications industry



Application of the checklist

In this section we will apply the checklist of section 6.1. More specifically, we will consider the indicators for firm behavior and find out whether the indicated behavior requires policy attention. We will first look at the supply conditions in which the mobile communication companies can offer their services.

Supply conditions

technological R&D/ patents

Do the mobile operators conduct research in order to improve their technology, and if so does their research result in technological spill overs?

The technologies of the NMT, the (extended) GSM and the future DCS network are based on international standard technologies (see Min. of Econ. Affairs, 1996). Therefore, new entrants have to conduct some imitative research to build a DCS network in the Netherlands, as PTT-Telecom and Libertel have done in the past for establishing their NMT and GSM networks. By adopting a standard technology the entrant is subject to low and predictable development costs, and may recover R&D investments rapidly (see sections 4.2.6 and 5.2). The incumbent NMT and GSM operators, instead, can only conduct further applied research to improve operational practices (such as compression of encoded messages etc.) and thus reduce X-inefficiency.

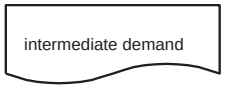
In order to alleviate the high fixed cost of the DCS network, the Min. of Transport recently suggested a technology that combines a DCS network in dense populated areas and an extended GSM network in less populated areas.[34] However, this technology demands more intense and risky research. The new technology is more likely to be developed by entrants because incumbents are too risk averse (see section 4.2.6). If the technology is patented in order to protect the innovating firm, other (incumbent) operators will be cut-off from cost-saving R&D results.

monitoring productivity/ type of wage contracts

Can firms monitor the effort and productivity of managers and empolyees, and if not, are they able to offer incentive compatible wage contracts?

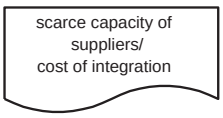
The capital-labor ratio of mobile networks is rather high, increasing the likelyhood that managers and employees try to to appropriate quasi rents through low effort or high wages. Operators may have difficulty to observe the productivity of managers and employees, particular of researchers and salesmanagers. By lack of information on payment schemes we cannot determine whether operators offer incentive compatible wage contracts. But if operators cannot offer such proper wage contracts, X-inefficiency may exist. In a competitive market X-inefficiency is unlikely to exist; operators must then exert some market power to be able to preserve their market share.

[34] See e.g. Algemeen Dagblad d.d. May 3rd, 1997.



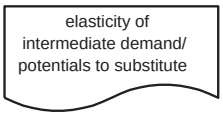
Do the operators use intermediate products or services of other firms or divisions that are indispensable in offering mobile communication services?

Yes, as outlined in the section on the industry structure, the mobile operators often demand access to the fixed wire network of PTT-Telecom or other network owners in the near future. Then consider the next two issues:



Does the fixed telephone operator (PTT-Telecom) have scarce capacity on its network to which the mobile operators desire acces?

No, the fixed telephone operator has sufficient capacity on its network to (inter)connect the relatively small number of phone calls from and to mobile subscribers.[35] Therefore it can supply all mobile operators, giving the mobile operators less incentives to integrate to ensure access. However, the fixed telephone operator could theoretically still abuse its dominant position and cut access of a few mobile operators to its network for strategical reasons (see next issue).



Can the mobile operators easily substitute their need of PTT-Telecom's fixed network and use other fixed networks for long distance transmission or interconnection to fixed subscribers?

The answer to this question is twofold. Since July the 1st, 1997, future mobile operators may use fixed wire networks of other firms for long distance transmission. However, since most customers still have a fixed telephony subscription at PTT-Telecom, most interconnections will be to the PTT-Telecom fixed network.

Then since PTT-Telecom owns a bottleneck facility (i.e. (subsriptions of) the fixed network), it has a dominant position in the overall telecommunications industry. According to the results of section 4.2.4, it will capture the mark ups on the mobile communications segment by bargaining for high interconnection prices. High interconnection prices will reduce the competi-

[35] Remember that the mobile communication segment has only a small share in overall telephony industry.

tiveness of Libertel, and will eventually lead to higher final customer prices and welfare losses on the mobile communications market (allocative inefficiency).

PTT-Telecom has no incentive to integrate with independent mobile operators (see section 4.2.4), nor does it have to disintegrate.[36] Independent mobile operators do not intend to integrate either (see above), so that the current market structure (i.e. one integrated firm and several independent mobile operators) can be expected to remain in tact.

Cost structure

From the industry structure and supply conditions we can get some insight in the cost structure for offering mobile communication services. The next table represents the different types of costs incurred (capital and labor costs, etc.) and their classification (sunk costs, fixed costs, variable costs, etc.). Actual data would show fixed costs to be a large proportion of total cost.

Table 2 Overview cost structure

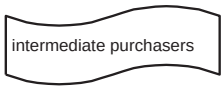
Cost incurred	Type of cost	Classification of type
Investment in mobile transmission equipment[37]	capital cost	exogenous sunk cost
Interconnection costs	intermediate cost	variable cost
Additional operating costs (energy, etc.)	intermediate and labor costs	variable cost
Marketing and advertising (see below)	intermediate and labor costs	endogenous sunk costs
Overhead costs (buildings, maintenance, management, etc.)	capital and labor cost	(non-sunk) fixed cost

Market interactions

[36] In that case both divisions with respectively a fixed network or two mobile networks would receive less profits due to increased competition on the competitive (mobile) segment (see Economides, 1996).

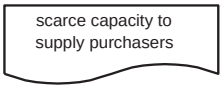
[37] I.e. tangible assets such as radio stations, provisions for interconnection, and intangible assets such as (specific) software.

In this part we will consider the market interactions of the mobile operators. Although the mobile operators sell their products directly to the service providers, they develop their products according to the preferences of final customers. In fact, they determine the technical characteristics of the final product.



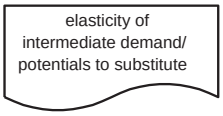
Do the core firms deliver to intermediate purchasers on downstream markets?

The mobile operators sell their capacity to the service providers. The service providers then distribute the capacity among subscribers of several types, and furnish the subscribers with a mobile apparatus and extra services. Then consider the next two issues:



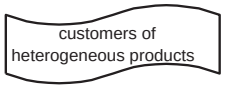
Do the mobile operators have scarce capacity to supply the service providers (and eventually final customers)?

In the future incumbent mobile operators may have insufficient capacity on the existing networks because the demand for mobile communication services is sharply growing. However, the government will release new frequencies so that incumbent and new operators will likely have sufficient joint capacity to satisfy the growing demand, for some time.



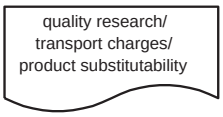
Can service providers choose between different operators to supply their capacity of calling time, and thus gain some bargaining power to reduce intermediate prices?

Yes, but only to a very limited extent. Since there are only two mobile operators, the service providers have few substitution possibilities between supplies of mobile communications capacity. In fact, they cannot alter their main business activity from distributing subscriptions to providing additional services without changing the firm's mission. Therefore, the mobile operators with dominant positions can easily squeeze the service providers and charge high intermediate prices (see section 4.2.4), and use the gain from the price squeeze to subsidize their own subsidiary. Obviously, higher intermediate prices will further increase the final customer prices and reduce consumer surplus.



Do the tastes of final customers vary? Do the mobile operators attempt to diversify their products to better meet customers needs?

Yes, then consider the next two issues:



Can the mobile operators (or service providers) increase the customers' willingness to pay by developing and introducing new product attributes or qualities, or by improving customer service?

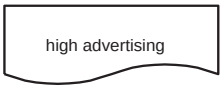
Yes, some customers, e.g. business users, may prefer specific products with various attributes (e.g. facilities for connection to internet and e-mail) for which they are willing to pay higher prices. Other customers, e.g. consumers, may only want the standard product and opt for standard subscriptions, but still demand high quality services with high reliability. Finally, customers can benefit from improved customer services, such as convenient location and business hours of retailers.

Since customers are willing to pay more if the available services better fit their preferences, the mobile operators and service providers have an incentive to differentiate their products (see section 4.2.3). The mobile operators, for example, offer supplementary technical facilities that make provision of additional services possible. The service providers then combine communication services and additional services to various packages that fit into customer-specific segments, and offer these packages at several shops or establishments of chain stores. In this way both the mobile operators and the service providers can overcome destructive price competition and zero profits in a single homogeneous segment. In fact, separation to segments will drive up prices on each particular segment (see section 5.1).

Entry of new mobile operators or service providers, stimulated by government, may increase competition because customers can find more substitutes. But entry and increased product variety may also increase customers' willingness to pay and attract new customers to the market (see section 4.2.3). Therefore, entry of new firms and introduction of new products have an ambiguous impact on the level of subscription fees, but will raise the customers' valuation of products. But if both incumbents and entrants have to

incur high sunk costs, the business stealing effect may outweigh the welfare gain from customers' valuation of increased variety.

Nevertheless, incumbent firms have an incentive to restrict competition and forestall new firms to enter the market. In fact, if the incumbent mobile operators had access to the auction of the single licence to operate the DCS network, they would make a higher bid and win the licence. Similarly, the incumbent service providers may forestall entrants in opening new establishments. All these actions of incumbent firms would remove any potential gain from increased competition.



Do the (incumbent) mobile operators conduct a lot of advertising?

Yes, the mobile operators may use advertising to build a brand image in order to bind customers (see section 4.2.2). In particular, they may provide an image of high quality products. Customers may value this image and are willing to pay for this intangible value-added. Therefore, advertising has an ambiguous effect on the extent of dynamic efficiency, even if it restricts entry of new firms, in particular operators.

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Appendix A Some welfare effects of vertical integration

This appendix is based on the work of Bolton and Whinston on vertical integration and supply assurance (see Bolton and Whinston, 1993). Their model combines several aspects of supply assurance with managerial effort to enhance efficient input use or to increase consumer valuation.

Suppose that the downstream firms can only increase the value of an (intermediate) base product by providing sufficient effort to improve the product according to customers' preferences. Assuming that firms can capture all consumer surplus, each non-integrated downstream firm has to bargain with the upstream firm for sharing the total surplus from offering the final product. Also assume that the managers of each downstream firm will commit themselves to provide some effort before upstream capacity will be known. Section 4.2.5 showed that managers who do not own a downstream firm but receive a fixed fee provide no effort. Since managerial skills are still required, the owner of an integrated firm will manage (one of) the downstream subsidiary (subsidiaries) himself, and only hire a manager for possibly other downstream subsidiaries.

Any non-integrated downstream firm will provide insufficient effort to what is socially optimal. In fact, a proportional fraction in the gain from incremental effort will be lost to the upstream firm through bargaining, so the downstream firm has less incentive to provide sufficient effort.[38]

On the other hand, any integrated downstream subsidiary will provide too much effort compared to the socially optimal level, since the integrated firm is assured of gaining its own (intended) surplus if it would actually supply. If the upstream firm can only supply to one downstream firm or subsidiary, it will supply to the downstream firm or subsidiary providing the highest surplus. In fact, the integrated firm can always extort the surplus that its own downstream subsidiary intended to offer because if even it would supply the non-integrated firm, it can still threaten to supply its own subsidiary. In that case, the downstream subsidiary has an incentive to raise its effort, although this effort may not be covered by more surplus on the overall market and the cost will be foregone.

Now, suppose that there will be certainly no scarce upstream capacity. Then vertical integration with a single downstream firm will be socially optimal. Particularly, the

[38] This argument is similar to the argument that the manger receiving only a part of overall profits, will provide less effort than is optimal to the owner of the firm.

manager/owner of a downstream firm will increase its effort if it becomes integrated, because the gain of an incremental effort will not be shared with some other firm but remains intact for the integrated firm.[39] Integration of the upstream firms with more downstream firms requires the use of hired managers who provide no effort at all.[40]

Next, suppose that there is certainly scarce upstream supply. Then, non-integration will be socially optimal. Whereas the integrated downstream subsidiary will provide too much effort, the argument of providing too little effort does not hold for non-integration.[41] However, this suggests a divergence between the social and private incentives to integrate.

Finally, suppose that there is only one downstream firm that can increase customer surplus. Then complete integration of the upstream firm and *all* downstream firms will be socially optimal. The owner can manage the downstream subsidiary (providing effort by himself) and optimize the overall surplus, while leaving the other downstream firms to the hired managers. Nevertheless, vertical integration of only the upstream firm and the single downstream firm able to increase surplus may result in too much effort.[42]

[39] The argument of providing too much effort does not hold, because there is no scarce capacity.

[40] Although the non-integrated downstream firms will provide too little effort, a non-zero effort is still better than providing no effort at all.

[41] If the upstream firm threatens to integrate with a downstream firm offering the second highest surplus, the downstream firm offering the highest surplus will gain the difference between its own surplus and the (intended) second highest surplus lost to the upstream firm. But since the incremental gain of effort does not depend on the second highest surplus, the effort provided by the supplying downstream firm will be socially efficient.

[42] I.e. when in the case of scarce capacity, this downstream subsidiary will not receive intermediate supply but still invests to guarantee a gain equal to its own "intended" supply.

Abstract

This paper discusses an analytical framework of industrial organization and a guide for policy analysis. It is mainly addressed to policy makers entrusted with competition policy, industrial policy and regulatory reform in particular markets (MDW project). The analytical framework contains a taxonomy of several IO-theories that consider relations between competitors, suppliers and customers on a market. It highlights firm behavior that results from or induce market imperfections. The guide for policy analysis then points to the potential role for policy to remove these market distortions and improve dynamic welfare.