Liberalization and Privatization

Literature Study Applied to Next Generation Access
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Abstract

Trends in the past have indicated growing patterns towards liberalization and privatization. However, many sectors remain under public control. In deciding between nationalization, liberalization, and privatization, the government faces certain trade-offs. An important issue as a result of privatization could be lower cost and possible lower quality. Privatization can be a trade-off between allocative and productive efficiency as well. The former being higher under public control and the latter under private control. Liberalization can reduce the need for regulation and increase efficiency. Both policies face problems if applied to natural monopolies, the first might give too much market power to a private party creating the need for strong regulation. Introducing competition might be complicated given the industry characteristics and they may also not enhance welfare due to high duplication costs. Although many sectors have been privatized and/or liberalized, the discussion about these policies remain important. Developments in Next Generation Access, renew the question of government participation.
3.1.2 The Costs and Benefits of Privatization ................................................................. 49
3.1.3 Regulation, Competition, and Liberalization ....................................................... 51
3.2 Research Questions ................................................................................................. 53
  3.2.1 Main Research Question .................................................................................... 53
  3.2.2 Sub Questions .................................................................................................... 55
3.3 Case Study - Next Generation Access ..................................................................... 58
Part 4: Conclusion ......................................................................................................... 63
Part 5: Appendices ......................................................................................................... 64
  Appendix 1 .................................................................................................................... 64
  Appendix 2 .................................................................................................................... 68
References ...................................................................................................................... 70
Introduction

“What kind of goods and services should be provided by government employees as opposed to private firms (Shleifer, 1998, pp. 133)?” Is a question that has been in the minds of economists and politicians for decades. Societies have flourished and failed as a result of a vision on this question. Slowly, the Western world has shown a trend of answering this question in favor of private firms and to allow competitors into the market (Megginson and Netter, 2001; Lee, 2008; Sheshinski and López-Calva, 2003). However, many sectors remain under government control and without competition. How come the transformation is a gradual one, still continuing today. Not only is the transformation gradual, there exist wide difference between countries in their view on the role of the government (Megginson and Netter, 2001). These differences and the slow transformation show that the answer to this question is not clear-cut. Governments must weigh the advantages and disadvantages of their decision. This thesis will try to answer the question:

What are the trade-offs in a liberalization and/or privatization process?

To illustrate the difficulties a government faces when it decides on the question which goods and services should be provided by the government. Once the trade-offs are clear, the criteria on which the government must decide need to be made clear. The sub-question:

When does it pay to liberalize and/or privatize?

tries to answer this question. Finally, the government should only decide to change its policy towards liberalization or privatization if it pays off. The second sub-question:

Why does it pay to liberalize and/or privatize?

tries to illustrate the reasons explaining liberalization and privatization.

In most Western countries the government has already liberalized and/or privatized sectors for which they concluded it to be the best policy. The sectors that remain controlled by the state are still being discussed or not considered eligible for either of these policies. Therefore the discussion of and academic research on liberalization and privatization might seem to be losing relevance. However, ongoing
developments might revitalize the relevance of this discussion. Next Generation Access (NGA)\(^1\) is one of such developments. In the Digital Agenda (European Commission (EC), 2010a) for 2020, NGA plays a crucial role. Until now, private investment in NGA is lacking and compared to other Western countries, penetration rates in Europe are low. The EC (2010a) believes strong public intervention is needed. In deciding on the role of governments in deploying the network, but especially after deployment, past experiences and the trade-offs of liberalization and privatization should be kept in mind to make these insights relevant again.

This thesis will be divided into four parts. Part one will discuss the literature on liberalization and privatization, natural monopolies, and regulation. The second part will discuss three papers in relation to the trade-offs faced by a government in deciding on liberalization and privatization. Part three will comment on these three papers and answers the research question. The final part will conclude.

\(^1\) “Next generation access (NGA) networks’ (NGAs) mean wired access networks which consist wholly or in part of optical elements and which are capable of delivering broadband access services with enhanced characteristics (such as higher throughout) as compared to those provided over already existing copper networks (EC, 2010b, pp.40).”
Part 1: Literature Review

The literature review will be divided into three sections. The first section will describe literature on privatization and liberalization. The second section will discuss characteristics of network industries. The final section will discuss regulation issues with regard to liberalization and privatization of network industries, telecommunications in particular.

Some terms will be used throughout this thesis, the definitions of these terms will be derived from those put forth by Saavedra (2000). “Nationalization corresponds to a situation in which the monopoly is state owned. Liberalization is the market structure in which any firm is free to enter the competitive market. Finally, privatization occurs when the monopoly is privately owned and regulated by the government.” One addition to privatization is that the monopoly was previously owned and controlled by the state.

1.1. Privatization and Liberalization

Liberalization and privatization has been widely discussed in academia. There are many ways to approach these topics and to explain the literature related to it. This thesis will approach the literature by distinguishing three broad approaches towards the issues related to privatization and liberalization. The first approach will focus on the role of competition. Secondly, the role of ownership will be explained. Finally, the theory presented will focus on government behavior.

1.1.1 The Role of Competition

The first question that need to be addressed: why should an industry or an enterprise be liberalized? By liberalizing an industry, the former monopolist is faced by competition. The reasoning behind this policy is that competition is believed to enhance industry performance. This part will discuss the literature on introducing competition.

Competition can impact efficiency in various ways. First of all, it might improve allocative efficiency. According to Shirley and Walsh (2000, pp. 5) “Competition in product markets is widely viewed to improve allocative efficiency.” Some theoretical evidence for this statement is provided by Oum and Zhang (1995, pp. 83), who state that “the introduction of competition reduces allocative inefficiency of the incumbent firm by inducing a more efficient use of capital”. In their model, they show that allocative inefficiency, caused by the Averch-Johnson effect, is reduced by competition. Their empirical model, based on annual data of the U.S. telephone services industry, supports this prediction. While allocative efficiency is important, however, one might assume that the behavior of a State Owned
Enterprise (SOE) is not that much different from a private enterprise with respect to the market structure. As Shirley and Walsh (2000, pp. 5) argue, “SOE behavior in this regard follows the well-understood patterns of private firms in various market structures”. In sum, in any market, independent on the owner of the firm, competition improves allocative efficiency.

Secondly, competition might affect productive efficiency by maximizing output from a given set of inputs. According to Machlup (1967), competition motivates an agent. He explains this by stating that in a noncompetitive environment managerial slack is not punished by the market, since it can only exist in the presence of supernormal profits. According to Winter (1971), competition is a natural selection in which the inefficient firms do not survive, and therefore a competitive market outperforms a noncompetitive market. Hart (1983) assumes that if there is a common component to enterprises costs, this cost will fall. A normal profit-maximizing firm will expand production and as a result prices will drop. A less performing firm, in this case explained by a shirking manager, will underperform relative to other firms. The owner will know that less performance derives not from the common cost, but from a poorly performing manager. More information makes it easier for the owner to monitor the manager, thereby allowing him to design a better incentive scheme.

The literature illustrates that competition can have a positive effect on allocative and productive efficiency. From this perspective, liberalization can be considered to positively influence the outcome of the market.

1.1.2 The Role of Ownership

The next issue is that of ownership; should the former monopoly in the liberalized sector be under public or private control? This can be explained using different perspectives; the objective of politicians, the objective of the firm, and the incentive and behavior of agents and governance.

The first issue concerning a SOE is the motivation of politicians. Boycko et al. (1996) argue that, even in a competitive environment, SOE are inefficient because they pursue the strategies of politicians to satisfy the politician’s political objectives (e.g. excess employment). These political strategies might not be in line with social welfare. The same strategy can be dictated to a private enterprise, but Boycko et al. (1996) state that such a strategy is more costly and possibly more transparent. Thus, it is unlikely for a politician to pursue the same agenda if the firm is privatized.

The second issue with respect to the role of ownership is the objective of the firm, discussed by Sappington and Sidak (2003). They find that “despite a reduced focus on profit, a public enterprise may have stronger incentives to pursue anticompetitive activities than does a private, profit-maximizing firm (pp. 183).” In particular, these authors show that a public firm is more likely to set “prices below marginal cost, raising the operating costs of existing rivals, erecting entry barriers to preclude the
operation of new competitors, and circumventing regulations designed to foster competition (pp. 183).” The reason for their behavior is that SOE may pursue other objectives than profit maximization.\(^2\) Sappington and Sidak (2003) claim that in a competitive market, a SOE may even hamper market performance.

The third issue concerning ownership is the principal-agent relationship and governance. Both public and private enterprises face principal-agent problems. Whitehead (1988) posits that both face the same principal-agent problems. Boardman and Vining (1992) challenge this assumption by outlining some differences between the public and private enterprise; political market failure, threat of takeovers, government monitors with self-serving interests, and a more distorted market for public managers. Hart et al. (1997) find that a private agent is more willing to invest in cost reduction, but will only preserve quality if it is contracted. Nevertheless, Hart et al. (1997) and Shleifer (1998) note that competition and reputation might induce private managers to maintain non-contractible quality. Willner and Parker (2007), on the other hand, find that privatization may increase managerial slack. With regards to governance, Chang and Singh (1997) claim that both SOE and large private enterprises have to deal with unwieldy bureaucracies and that both of the respective disciplinary mechanisms are not perfect. They conclude that public enterprises have no disadvantage in corporate governance. However, according to Shirley and Walsh (2000, pp.29) “they present no theoretical model or empirical evidence to show that public and private management problems are the same.” Vickers and Yarrow (1991) recommend a private firm to outperform the public, since the market provides information that can be used to monitor the manager. In addition their model shows a manager puts in more effort due to the threat of a takeover. Bankruptcy has the same outcome as a takeover.

Although the literature is not completely conclusive, most authors argue in favor of private ownership.

\subsection{Benevolent or Malevolent Government}

The assumption about a government being malevolent or benevolent might influence the outcome and relevance of the model. This section discusses literature on whether a government acts malevolently or benevolently.

In a democratic society, politicians need votes in order to stay in office. Therefore they are believed to act benevolently to align their policies with the interest of their voters. According to Vickers

\footnote{The United States Postal Service, for example, is required by statute to consider the fairness, equity, and simplicity of its rate structure as well as the relationships among prices, production costs, and the value of the service provided (39 U.S.C. § 3622). (Sappington and Sidak, 2003)}
and Yarrow (1986), politicians will try to maximize the sum of consumer and producer surplus. Shirley and Walsh (2000) comment that none of the articles present a framework to quantify the costs and benefits. In addition they state there to be no empirical literature to support the statement of a benevolent government, with the exception of a few case studies. Finally they state the literature to ignore other ways to achieve social goals, such as regulation.

Vickers and Yarrow (1986) claim that a government might not focus on total welfare, but focus on consumer welfare instead, given their voting power. As a result it could be that not total welfare but consumer welfare is maximized. Examining the principal-agent problems between voters and politicians, Vickers and Yarrow (1986) first note any information asymmetries between the two. Secondly, elections are a poor mechanism for reflecting voter’s preferences. Finally, the majority of voters might be in favor of an action that benefits them but is detrimental to the minority, which might result in lower total welfare. Therefore, the alignment of the voters preferences with the politician preferences might fail due to imperfections in the relationship between voters and politicians. Not only is the relationship between politicians and voters questionable, but also the behavior of politicians. Governments and politicians might want to maximize their own utility and act accordingly. Shapiro and Willig (1990) modeled a public manager’s utility as a function of both social welfare and private welfare. They argue that the weight placed on both kinds of welfare depends on whether or not the political market is efficient. With a more efficient market, more weight is placed on social welfare and vice versa. To conclude, given the literature it is more likely for a government to behave malevolently than benevolently.
1.2 Natural Monopolies

According to Ceriani et al. (2007), a network industry is characterized by the presence of a natural monopoly and competitive segments. Being a natural monopoly complicates the privatization process of the telecommunication sector, or network industries in general. This part will discuss the difference between public and private monopoly. As the literature will illustrate, the discussion actually is between a public monopoly and a regulated private monopoly.

In part 1.1.2 arguments are given in favor of private ownership. However things become more complicated in case of a monopoly. The best solution would be to create competition. Given the high fixed costs of a network, of which duplication can be considered undesirable, creating competition might be difficult. Vickers and Yarrow (1989) call this the trade-off between allocative efficiency and scale economics. In their model they find that the duplication of fixed costs for the network outweighs the benefits to consumers. Given that competition is not possible, at least in the network segment of the sector, the former state monopoly would remain a monopoly, even after privatization.

Kay and Thompson (1986) claim that there is no difference between public and private monopolies, if the threat of a take-over, bankruptcy, or entrance is small. They state that “the pressures of the market affect a private sector manager no more than his public sector counterpart.” Shirley and Walsh (2000, pp. 12) note, citing Shapiro and Willig (1990) “In the case of more autonomous agents, they find that public ownership and private ownership with regulation produce the same results when information about profits is revealed only after investment, or when the government is indifferent the amount of money spent to acquire that information ex ante. When these conditions do not apply, they find that the case for public ownership grows with the efficiency of political markets and diminishes with the "salience" of the agent's private agenda.” Laffont and Tirole (1991) find two insights, “The cost of private ownership in our model is that the firm's managers must respond to two masters-the regulators and the shareholders (pp. 85)” and “the cost of public ownership is a suboptimal investment by the firm's managers in those assets that can be redeployed to serve social goals pursued by the public owners (pp.84).” All these theories show that the decision between a public and a private provider often is a trade-off between various aspects. Laffont and Tirole (1991) conclude by stating that these insights have ambiguous implications and that theory is inconclusive.

The literature about privatization a monopoly is ambiguous. Another issue should be considered: regulation. If the regulator is not able or lacks the resources or knowledge to regulate the privatized monopoly, the monopoly should not be privatized.
1.3 Regulation

If a government decides to liberalize or privatize a sector, regulation can be of vital importance to the well-functioning of the market. In case of a natural monopoly, regulation is needed in four areas; cost of investment, access pricing, universal service obligation, and downstream market participation (Mason and Valletti, 2001). This part of the literature review will discuss three topics and briefly outline the future of regulation.

1.3.1 Cost of Investment

Before investing, an enterprise tries to determine the cost of investment as well as possible. This private information is not automatically shared with the regulator. The regulator needs this information to impose regulation on the sector. If the information is not shared or is not trustworthy, the regulator should determine the exact cost of investment itself. The cost of investment is especially important to set the correct access prices and the terms of access, both for existing networks as for possible future networks. Cost measurement can be complicated by various aspects summarized by Vogelsang (2003): “the forward-looking nature of economic costs, because of rapid technical progress and because of economies of scale and scope, resulting from the use of long-lived assets (pp. 839).”

1.3.2 Access Pricing

The second role of a regulator concerns the pricing of access. The correct pricing of access is important for various reasons. First, network access is an input in the downstream market. If not priced correctly, competition will not be fair. Secondly, an enterprise needs to be able to recoup its investment in the network to stimulate further investment (Vogelsang, 2003). Finally, an access price-setting regulator may want to promote particular entry modes (Mason and Valletti, 2001). Access prices could help to achieve a number of tasks according to Vogelsang (2003). These tasks are; right amount of downstream entry, efficient network investment, and network utilization, while being manageable. The problem with regulatory access pricing is that the regulator wants to achieve too many goals with one tool- a difficult or impossible task (Armstrong, 2004; Vogelsang, 2003). In general, a regulator has four broad kinds of pricing strategies at his disposal, Ramsey pricing, Efficient Component Pricing Rule (ECPR), cost-based access charges, and price caps for access. In the literature on access pricing, each of these policies are discussed and are believed to have advantages and disadvantages of their own. Cave and Vogelsang (2003) state that of these access pricing policies, cost based pricing is used most frequently. Specifically,
forward looking incremental costs are used, often incorporating a mark-up which makes allowance for costs made by the access provider that cannot be attributed to network services.

### 1.3.3 Participation in the Downstream Market

Regulation is important in the liberalization and privatization of the telecommunication sector, since the monopolist owns the so-called “bottleneck” and may wish to participate in the competitive downstream market, the bottleneck is the part of the network that has the characteristics of a natural monopoly. By liberalizing the sector, the monopolist faces competition in the downstream market and regulation is needed to prevent abuse of market power. Regulation might be considered only relevant if the sector is privatized as well, since a government monopoly can be considered to be self-regulating. Before liberalization, the government or regulator should decide about the role of the monopoly. Is it allowed to be active in the downstream market or should both activities be split up? In both options the regulator should regulate the monopolist so it will not abuse its market power to set access prices too high.

Vickers (1995) looked at the effect of a regulated monopolist competing in the downstream market by examining the relation between entrance and access prices, and found ambiguous results. If the number of entrants is sensitive to the access price, the price can best be set above marginal cost. Consequently a lower number of competitors will enter the market keeping the average cost lower (less duplication of fixed costs). As a result, the downstream market becomes less competitive and the price-cost margin will go up. If entrants are not access price sensitive, this effect will not work and access prices should set lower to get a more competitive downstream market. Vickers (1995) finds that if entrants are access price sensitive, which is the most realistic case, “The reduction in the duplication of fixed costs more than offsets the greater price-cost markup (p. 11).” This can only be the case if the monopoly competes in the downstream market. Given the model and the assumptions of entrants being access price sensitive, Vickers (1995) argues in favor of downstream integration.

Farrell (2003) looks at integration and the degree of innovation. A nonintegrated monopolist might be willing to pay some of the cost of downstream innovation. Lower prices for the final product might positively influence sales; as a result more of the input supplied by the monopolist might be sold. With vertical integration, innovation by the entrant might reduce the monopolist downstream market share. Cooperation between the entrant and the monopolist consequently depends on the balance between the lost market share in the downstream market and the rise in inputs sold. Concluding, without integration the monopolist will support innovation (if income is higher than the costs). An integrated monopolist will be less willing to support innovation.
The literature about participation in the downstream market remains ambiguous, as illustrated by these two papers.

1.3.4 Future of Regulation

One of the goals of this thesis is to learn lessons from the privatization process of the telecommunications sector and from the regulation difficulties for future investment in telecommunications. According to Vareda (2010), creating competition in the short-run and facility-based competition is traditionally considered contradictory. Competition in the short-run involves lower access pricing in order for the entrant to gain some market share, since due to, for example, switching costs, it has a disadvantage compared to the incumbent. On the other hand, low access pricing gives no incentive to invest in a competing network and there will be no facility-based competition. Based on the Investment Ladder Theory (ILT) (Cave, 2004; Cave 2006) the EC only recently started to claim these objectives to be no longer contradictory.

In the ILT, Cave (2006) combines the two objectives. Initially, the entrant is allowed to enter the market at an access price that is too low to give the right make-or-buy incentive. This helps to start-up competition and let entrants gain a market share. Gradually the access price increase, thus inducing the incentive of the entrants to invest in their own network. Another option is to withdraw the access obligations where after a set time, the entrant must have invested in its own network before this time. The difficulty in the implementation of this policy lies in determining the starting height, timing, and duration of the policy. The final and very important step is to make the policy credible.

Since its introduction, ILT has gained strong influence in the telecommunications sector in Europe (Bourreau et al., 2010). On the other hand however, the theory is not without its critics. Oldale and Padilla (2004) discuss four propositions that must hold for the ILT to work. Bourreau et al. (2010) comment by stating that two key assumptions must hold for ILT to work.

This section showed that issues that seemed impossible to solve, can be overcome with development in regulation policies. A problem that a regulator continues to face is the difficulty in getting accurate information about the market, its players, and future developments.

To summarize the literature review. First liberalization and privatization were discussed, using three different approaches. Secondly, given the topic of the case study, natural monopolies were briefly discussed. Finally, given its importance in the successful implementation of liberalization and privatization policies, regulation was discussed. The next part will focus on three specific papers in which most of the topics of the literature review will be discussed as well.
Part 2: Body

In this part of the thesis three papers; The Proper Scope of Government: Theory and an Application to Prisons, The Costs and Benefits of Privatization: An Incomplete Contract Approach, and Regulation, Competition, and Liberalization, will be discussed respectively.

2.1 The Proper Scope of Government: Theory and an Application to Prisons

Hart, Shleifer, and Vishny (1997) attempt to answer the question “When should a government provide a service in-house, and when should it contract out provision (pp. 1127)?” In most cases, the government provides services paid by state revenue. Yet in other cases, the government can decide to contract out these services to private suppliers. The debate between contracting out and in-house provision is, as is the discussion whether to privatize or not, controversial. Some (Savas, 1982: Logan 1990) claim that private provision is cheaper. Others (AFSCME, 1985; Schichor 1995) claim public quality to be superior to private quality. Hart et al. develop a theory of government ownership and contracting that helps to solve this discussion. In addition they apply the outcome of the model to shed light on the discussion of private provision of several services.

The society, which is represented by a benevolent government, wants a certain good or service to be provided. The service is considered to be a public good that cannot be bought directly in the marketplace. The government has to decide between in-house provision or contracting out. An important perspective of this paper is that contracts are incomplete. Not all future events can be foreseen and contracted on and the quality of the service requested by the government cannot be fully specified. Another important aspect of the model is residual rights of control. The owner of the facility, the non-human assets used to provide the service, has the residual right of control and must approve cost and/or quality investment. In contrast to others who support private provision on the grounds of the benefits of competition, Hart et al. claim the residual right of control to be the fundamental difference. Competition can also be created between government-owned enterprises or management-teams within an enterprise. Competition might however strengthen the case for privatization.

2.1.1 The Model

In the model, government contracting focuses on quality issues. While the manager of the facility can invest his time in improving quality and/or in improving cost, the effort of the manager is non-contractible. In return he gets a fraction of the returns of this investment. Cost investment has an adverse
effect on quality and since contracts are incomplete, the manager can invest in cost reduction without breaching the contract. The difference between public and private provision is that the former requires government (holds the residual right of control) approval for investment, while the latter does not. On the other hand, the private owner will only invest in quality if he gets compensated.

Hart et al. model the difference between public and private provision. The crucial distinction between the two is who has the residual right of control of the facility (F). This right is of much importance because it determines who can approve a change. F is run by a single manager/worker (M), who in case of private provision is also the owner. With public provision, F is owned by a single bureaucrat or politician (G). If the service is contracted out, M and G write a long-term contract. In this contract, some of the aspects of the good or service are specified, yet it is impossible to specify all contingencies. The price \( P_0 \) of the contracted “basic” good is set. \( P_0 \) has different implications for public and private provision, respectively the wage that M receives and the price that M receives for providing the good. Since it is not possible to specify all contingencies of the good, the parties need to revise the contract ex post. The modified good is the basic good modified for all contingencies. To produce the modified good, the manager bears direct costs (C). The society yields a benefit (B) from the production of the good; this benefit cannot be measured or verified. Yet both C and B can be represented by a “dollar” amount.

By investing in quality and/or costs improvement, M can manipulate B and C through prior effort choices. The following functions represent this effect:

\[
B = B_0 - b(e) + \beta(i)
\]

\[
C = C_0 - c(e)
\]

\( B_0 \) and \( C_0 \) represent the basic benefit and cost, before investment by M. M can put effort \( e \) in cost reduction, which reduces cost in C by \( c(e) \geq 0 \) and lowers quality in B by \( b(e) \geq 0 \). M can also put effort \( i \) in quality improvement, which improves the quality by \( \beta(i) \). The quality improvement is the quality increase net of costs from the quality innovation, in contrast to the cost improvement where these two effects are separated. This distinction can be explained by the fact that quality improvement is only interesting if the net effect is positive, both for a private and a public party. A private firm however, might decide to reduce costs and as a consequence, the quality is lowered more. As long as they do not breach the contracted quality, they are indifferent about the quality deterioration. Hart et al. make the assumption that both the cost and the quality innovation can be introduced without triggering the breach of the original contract. Other standard assumptions about the convexity, concavity and monotonicity of \( b, c, \) and \( \beta \) are:
b: $b(0) = 0, b' \geq 0, b'' \geq 0, b$ is convex or a straight line starting in the origin.

c: $c(0) = 0, c'(0) = \infty, c' > 0, c'' < 0, c'(\infty) = 0, c$ is concave, starts straight in the origin, and ends straight.

$\beta$: $\beta(0) = 0, \beta'(0) = \infty, \beta' > 0, \beta'' < 0, \beta'(\infty) = 0, \beta$ is concave, starts straight in the origin, and ends straight.

c' - b' \geq 0, the quality reduction from a cost innovation does not offset the cost reduction.

$\beta'' > 0$, the cost increase from a quality innovation does not offset the quality increase.

Both e and i influence the managers ex ante overall costs, hence M’s overall costs are:

$$C + e + i = C_0 - c(e) + e + i$$

Hart et al. assume that i, e, b, and c are only observable to G and M, not to outsiders. As a result these variables cannot be a part of an enforceable contract. The same is true for G’s benefits and M’s costs, which means that both revenue and cost-sharing arrangements are infeasible. Once the relationship between G and M is under way, they are locked into each other and the good cannot be provided by another facility. Only M’s labor services may be partially substitutable. Both G and M are risk-neutral and there are no wealth constraints.

In the model, two options are possible; renegotiation between the manager and politician, or otherwise. If both parties negotiate, they are assumed to renegotiate according to Nash bargaining, where the surplus is split 50:50. With no renegotiation, it is assumed that the basic good is supplied, since changes made to cost and quality can be made without breaching the original contract. The timeline of the model is presented in Figure 1.

![Figure 1: Timeline](image-url)

Suppose M has an idea about how to innovate, the benefit of this innovation requires some of M’s participation. The remainder can be realized without M, because some of the aspects of M’s ideas are shared within the company, becoming “public” knowledge. If F is public, G can realize a fraction $0 \leq (1-$
\( \lambda \leq 1 \) of the net social gains \(-b(e) + c(e) + \beta(i)\) from innovation without M by hiring another manager and paying him at cost. Normally the manager would not innovate without renegotiation, since he gets no extra benefit and only extra costs \((e\text{ and } i)\). However, the politician observed the manager and now knows how to innovate. The politician will fire the old manager and hire a new one that will implement the innovations and will be paid at cost. As a result, the innovations are implemented, however not as good as what the old manager would have done. The parameter \( \lambda \) effectively measures the weakness of the incentives of government employees and therefore is an important variable. The more replicable the public manager is, the lower share of rents he gets and the less motivated he is. Only if the public manager is irreplaceable \( \lambda = 1 \), he gets the same share of benefits as the private manager.

Without renegotiation the outcome is as follows:

**Private ownership:** M will only implement the cost innovation, since he will not get compensated for any quality improvement or get punished for quality deterioration. The pay-offs will be:

- **G:** \( B_0 - P_0 - b(e) \), the government will get the benefits, minus the basic price, minus the quality deterioration.
- **M:** \( P_0 - C_0 + e - i \), the manager get its pay, minus the new cost (old cost minus cost innovation), minus his effort \( e \) and \( i \) \((i=0 \text{ without renegotiation})\).

**Public ownership:** M will implement both cost and quality innovation since the old M is fired and G can dictate the new M to implement these changes. The pay-offs will be:

- **G:** \( B_0 - P_0 + (1- \lambda)[ -b(e) + c(e) + \beta(i)] \) the government will get the benefits, minus the basic price, plus part of the quality and cost improvement minus the quality deterioration.
- **M:** \( P_0 - C_0 - e - i \), the manager get its pay, minus the costs, minus his effort \( e \) and \( i \).

In a more realistic case, G and M can renegotiate after date \( 1/2 \). Both G and M want to renegotiate if M is private because quality can be improved and the gains shared between G and M, since \( \beta^* > 0 \) the improved quality offsets the higher costs. If F is public, the government wants to renegotiate in order to extract some of \( \lambda \) that G cannot appropriate, and M wants to renegotiate to get some of the benefits of the quality and cost investment. Without renegotiation, M would only bear the cost \((e\text{ and } i)\).

The first best outcome of the model would be possible if G and M could write a complete contract, where \( e \) and \( i \) are contractible. G and M would choose \( e \) and \( i \) to maximize the total net surplus from their trading relationship and divide the surplus using lump-sum transfers. To get the maximum total surplus, G and M need to maximize:

\[
\text{(1)} \quad \max_{e,i} \{ -b(e) + c(e) + \beta(i) - e - i \}
\]
Given the assumptions about the convexity, concavity, and monotonicity of the model (1) has a unique solution \((e^* \text{ and } i^*)\), characterized by first-order conditions:

\[
\begin{align*}
(2) & \quad -b'(e^*) + c'(e^*) = 1 \\
(3) & \quad \beta'(i^*) = 1
\end{align*}
\]

To find the unique interior solution, (1) is differentiated with respect to \(e\) and \(i\) gives respectively formula (2) and (3).

In a non-first best solution with \(F\) under private control, the manager will choose \(e\) and \(i\) to maximize its own output and will renegotiate with \(G\) in order to get 50:50 in return for its quality investment. The parties’ pay-offs are:

\[
\begin{align*}
(4) & \quad U_G = B_0 - P_0 + \frac{1}{2} \beta(i) - b(e) \\
(5) & \quad U_M = P_0 - C_0 + \frac{1}{2} \beta(i) + c(e) - e - i
\end{align*}
\]

As with no renegotiation, \(M\) can reduce cost without \(G\)’s approval and get the full benefit of cost reduction, while \(G\) bears the full cost of quality deterioration. The manager will try to maximize its pay-off. His maximization problem is given by (6). Differentiating (6) with respect to \(e\) and \(i\) gives respectively (7) and (8),

\[
\begin{align*}
(6) & \quad \max_{e,i} \{1/2 \beta (i) + c(e) - e - i \} \\
(7) & \quad c'(e_M) = 1 \\
(8) & \quad \frac{1}{2} \beta'(i_M) = 1
\end{align*}
\]

The differences between the first-best solution and this solution is the fact that \(M\) ignores the quality deterioration, no \(-b'\) and \(M\) has to share half of the benefit of the quality improvement with \(G\), which reduces its incentive to innovate. Under private ownership, total surplus \((S_M)\) is given by,

\[
S_M = U_G + U_M = B_0 - C_0 - b(e_M) + c(e_M) + \beta(i_M) - e_M - i_M
\]

The second option is that \(F\) is owned by \(G\). \(G\) and \(M\) will renegotiate over the fraction \(\lambda\) of both cost and quality innovation that \(G\) cannot appropriate. Without renegotiation \(G\) gets \((1 - \lambda)\), now \(G\) will share the benefit \(\lambda\) 50:50 with the manager. The parties pay-offs are,
If $M$ is irreplaceable ($\lambda = 1$), the parties split the gain from innovation 50:50, in any other case $G$ gets more of the benefit from innovation than $M$. $M$ will choose $e$ and $i$ to maximize its personal benefit, this maximization problem is illustrated by (12). Differentiating (12) with respect to $e$ and $i$ gives the effort that maximizes his pay-off, given by formula (13) and (14).

The manager takes into account both the cost innovation as the resulting deterioration in quality, in contrast to the private manager. The difference can be explained by who holds the right of control. The public manager, cannot cost-innovate without the approval of $G$, thus need to negotiate the cost reduction and has to share the benefit $c(e)$ and the cost $-b(e)$. Second, (13) and (14) shows that if $\lambda < 1$, $M$ is replaceable, the incentive to innovate is reduced. Both aspects stunt a public $M$ to innovate. Under public ownership, total surplus ($S_G$) is given by,

\begin{align}
\text{(15)} & \quad S_G = U_G + U_M = B_0 - C_0 - b(e_G) + c(e_G) + \beta(i_G) - e_G - i_G \\
\end{align}

In both (9) and (15), $P_0$ is chosen at date 0, to allocate the surplus between the parties according to their relative bargaining positions at this date.

Given the different ownership structures, maximization problems, and innovation incentives, the optimal form of ownership is the one that produces the largest total surplus. Total surplus will remain the same, but by adjusting $P_0$, the surplus can be divided separately between the government and either the private or public manager. Public ownership is superior to private ownership if (15) $> (9)$, illustrated by (16). Hart et al. add that due to renegotiation both public and private owner yield ex post efficient outcomes. The only difference between the two is the ex-ante choice of $e$ and $i$.

\begin{align}
\text{(16)} & \quad S_G > S_M \\
& \quad - b(e_G) + c(e_G) + \beta(i_G) - e_G - i_G > - b(e_M) + c(e_M) + \beta(i_M) - e_M - i_M \\
\end{align}
2.1.2 Analysis of the Optimal Ownership Structure

Given the model, Hart et al. produce several propositions that can explain some of the differences between public and private ownership. Outcomes will be used later on to shed light on specific sectors.

Proposition 1: \( e_M > e^* \) and \( i_M < i^* \)

This outcome can be explained by the fact that the private manager does not take quality deterioration into account, illustrated by formula (7) and thus has a greater incentive to cost innovate (\( e_M > e^* \)). In addition, the private manager only places 50% weight, illustrated by formula (8), on the gains from a quality innovation. In the first best solution, the quality deterioration is taken into account and 100% weight is placed on gains from quality innovation. As a result \( i_M < i^* \).

Proposition 2: \( e_G < e^* \) and \( i_G \leq i_M < i^* \) (with \( i_G < i_M \) unless \( \lambda = 1 \))

In contrast to private ownership, the public manager takes the quality deterioration into account in deciding on the effort for cost innovation. The facility is owned by \( G \), thus \( M \) has to discuss any changes and bargain about the net surplus. \( M \) places weight \( \lambda/2 \) on both the cost and the quality innovation. In the first-best situation, 100% weight is placed on the cost innovation, concluding that cost innovation is lower under public ownership than under the first-best solution and under private ownership (\( e_G < e^* \)). Quality innovation is per definition lower under public ownership compared to the first best solution. Only if \( M \) is completely irreplaceable, would quality innovation under private and public ownership be the same; otherwise it is lower. This can be explained by the fact that the public manager can be replaced and is therefore less willing to put in extra effort, since he cannot reap all benefits.

Proposition 3:
1. Suppose that the function \( b(e) \) is replaced by \( \theta b(e) \), where \( \theta > 0 \). Then for \( \theta \) sufficiently small, private ownership is superior to public ownership.
2. Suppose that the function \( b(e) \) is replaced by \( \theta b(e) \) and the function \( c(e) \) is replaced by \( \phi c(e) \), where \( \theta, \phi > 0 \). Then, for \( 0, \phi \) sufficiently small and \( \lambda < 1 \), private ownership is superior to public ownership.

If quality deterioration of a cost innovation becomes sufficiently small or disappears (\( \theta = 0 \)), cost innovation will be preferred more. If it would disappear, the outcome of private ownership would resemble that of the first best solution (since \( c'(e) \approx -b'(e) + c'(e) \)). Because a private manager invests in
cost innovation, the outcome is superior to public ownership. Proposition 3(2) follows from the fact that if both $\theta$ and $\varphi$ move to 0, the cost innovation part of the model becomes irrelevant and only quality innovation matters. Since $i_G \leq i_M < i^*$, private ownership is closer to the first-best solution except for $\lambda = 1$ and therefore preferred.

**Proposition 4:**

(1) Suppose that $b(e) \equiv c(e) - \sigma d(e)$, where $\sigma > 0$. Then for $\sigma$ sufficiently small and $\lambda$ sufficiently close to 1, public ownership is superior to private ownership.

(2) Suppose that $b(e) \equiv c(e) - \sigma d(e)$, where $\sigma > 0$. Suppose also that the function $\beta(i)$ is replaced by $\tau \beta(i)$, where $\tau > 0$. Then for $\sigma, \tau$ sufficiently small public ownership is superior to private ownership.

In part (1) the social gains from cost reduction falls to zero if $\sigma = 0$, the reduction in costs is completely offset by the reduction in quality. Making weak incentives for a public manager to invest in cost reduction preferred to private ownership. If $\lambda$ is close to one, the public manager has a greater incentive to innovate in quality, strengthening the case for public ownership. Given proposition 4(2), quality innovation becomes irrelevant, making only the cost innovation relevant. Given the assumption of $\sigma$ close to or equal to zero, public ownership is preferred. Especially given the fact that the private manager will invest more in cost reduction, public ownership is preferred.

**Proposition 5:**

Costs ($C_0 - c(e)$) are always lower under private ownership. Quality ($B_0 - b(e) + \beta(i)$) may be higher or lower under private ownership.

The first claim by Hart et al. follows from Proposition 1 and 2, $e_M > e^* > e_G$. The degree of quality depends on characteristics of the model. If $b'(e)$ is small, cost innovation does not influence quality and quality depends on quality innovation, which is higher or equal under private ownership. If on the other hand $\beta'(i)$ is small, the reduced quality as a consequence of cost innovation plays an important role, making public ownership more preferred. Hart et al. summarize this outcome “namely that private contracting typically yields greater cost efficiency (pp. 1143).”

Hart et al. add some aspects to their model, namely competition and government behavior. In case of competition, the market replaces $G$, the buyer can assess the quality, and the suppliers are perfectly competitive at every quality level, resulting in the correct incentives for a first-best outcome. The manager does not have to bargain about the quality innovation with $G$ and since a lower quality will result in a lower price (buyer can assess the quality) he takes the quality deterioration of cost innovation into
account in deciding on the best level of $e$ and $i$. If competition can be introduced, these arguments pledge in favor of privatization.

Next government behavior is discussed. In the previous part, the government was modeled as benevolent. Two possible cases of imperfect government behavior are discussed.

Suppose the privatization decision is made at a higher political level, before date 0 (-1/2). After the decision is made, the responsibility for the operations of F is transferred to a bureaucrat, who is assumed to be honest. The politician at the higher level has two options. He can privatize the facility and sell the right to control the facility to a private manager at an artificially low price and extract a bribe from M. He can also produce in-house and extract a bribe from M in return for M’s future role as a manager. Hart et al. state that under reasonable assumptions the pay-off for the politician is higher under privatization. At date -1/2 the politician can offer to sell F to the party that pays the highest bribe (assuming the participation of multiple enterprises). This bribe equals the benefit that the private manager receives if participating in the privatization process. To illustrate this, we should look at date 0. At this date M and G are at a bilateral bargaining position about the terms of the contract. With Nash bargaining, both the parties get half of the surplus. The surplus is given by (9). Thus M receives $1/2 S_M$ through the bargaining price, $P_0$. $1/2 S_M$ is the private managers benefit and with enough parties competing for F, this will be the politicians bribe. In the case of in-house provision, the bribe M wants to pay G is the same as with contracting out, namely M’s future pay-off. However, M’s future pay-off is zero since at date 0 no relation-specific investment is made yet. No contract is written between the politician and M before date 0. If F is public, M can be replaced by the bureaucrat with another manager. By corrupting the politician, he will choose to privatize F even if this is socially inefficient.

In addition to the corruption problem described above, a politician can cater to special interest groups, for example, win elections. Catering to special interest groups can be done by creating jobs or by paying workers above market prices. Patronage is easier under public management, due to more direct control by the politician. In contrast to corruption, patronage leads to an excessive bias toward in-house provision.

### 2.1.3 Privatization of Prisons and Other Sectors

In the final part of their paper, Hart et al. apply their model to several sectors. One sector will be discussed to show how the model can be applied to a realistic case.

In the past years, more and more prisons have become private in the United States. Private prisons are about 10 percent cheaper than public prisons, though the question is how much this deteriorates the quality. In order to demand the same quality as a public prison, the government should write a contract
with the private party containing all relevant aspects. Hart et al. state that many aspects of quality can indeed be contracted, while some cannot. The main contracting quality issue is about the use of force and the quality of personnel. The risk of bad quality can be high for society as a whole. In case of an outbreak, the police incur costs; in case of riots, the police may have to restore order, and if the rehabilitation facilities of the prison are of poor quality, society eventually must pay the costs. The case of prisons fits the model reasonably well, since the costs of lowered quality are not paid by the private party, the cost innovation can be completely offset by the quality deterioration, and the scope for quality innovation is limited. Therefore Hart et al. conclude using Proposition (4), that public ownership is superior. Introducing competition to improve the outcome of privatization is no option. Finally, government behavior is discussed. Patronage does not appear to be a huge problem. Corruption appears to be of greater concern, judging from the political activity of private firms and anecdotal evidence. To summarize, due to contract incompleteness, quality deterioration as a consequence of cost innovation, importance of quality, limited scope for quality innovation, limited competition possibilities, and possible corruption, based on the model, prisons should be public.
2.2 The Costs and Benefits of Privatization: An Incomplete Contract Approach

In his article, Schmidt (1996) highlights the differences between a privatized and a nationalized enterprise by developing a model using an incomplete contracts approach. There would be no difference if complete contracts were feasible. The allocation of ownership determines who has the residual right of control. Schmidt claims the right to have access to inside information is not a specific but a residual right of control. In his model, the correct information of the cost structure plays an important role. By privatizing a firm, the government gives the managers a better cost-saving incentive (a “harder budget constraint”) and thereby improves the productive efficiency. The manager of the nationalized enterprise faces a “soft budget constraint”, resulting in better allocative efficiency. The purpose of this paper is to give a theoretical foundation for the difference between a privatized and a nationalized enterprise. Schmidt states “economic theory still finds it difficult to explain what makes the difference between a privatized and a nationalized firm (pp.1).” The question he tries to answer is why the ownership of the enterprise makes a difference. Schmidt’s analysis focuses on two efficiency arguments, used in the literature more often. First, it is believed that production is organized and carried out more efficiently in a private enterprise, leading to better productive efficiency. Secondly, it is believed that a public enterprise will choose a socially more efficient production level, since a government cares about social welfare and internalizes externalities, while a profit enterprise wants to maximize welfare.

2.2.1 The Model

In this model, an enterprise produces a good that yields social benefit of \( b(y) \), with \( y \) representing the quantity of the good, \( y \in \mathbb{R}_0^+ \). Social benefit can be explained in different ways; in sum, it is what the government cares about. The enterprise has a revenue of \( r(y) = p(y) \cdot y \), with \( p(y) \) being the market price and \( r(y) \) being the revenue. The cost function is denoted by \( c(y, \Theta) \), with parameter \( \Theta \) representing the state of the world, with \( i = 1, 2 \). A good state of the world is represented by 1 and a bad state by 2, with \( c(y, \Theta_1) < c(y, \Theta_2) \). The state of the world is drawn by nature at the end of period 1, with a probability of \( q(e) \) of state \( \Theta_1 \) and probability of \( (1 - q(e)) \) of state \( \Theta_2 \).

The government (G) can choose to nationalize the enterprise and affect the level of production directly or privatize and affect the production level using a sophisticated subsidy and regulation scheme. Schmidt models the government as a benevolent, fully rational, and unitary decision maker. The decision between the two industry designs need to be made at period 0, as the property rights are in the hands of the government at period 0. If the government decides to privatize, it auctions it to a private owner (P) in a competitive market. Schmidt assumes the auction price \( (z) \) to equal expected profits of the company. In
both settings, the owner cannot take care of the enterprise its production herself and employs a manager (M) at a wage indicated by w. The expected utility of the manager under this contract equals his reservation utility $U$.

At period 1, the manager has to choose an unobservable action $e$, $e \in \mathbb{R}_0^+$, which reduces the expected cost in period 2. The investment is measured in units of disutility caused to the manager, although $e$ will sometimes be called “effort”, it is an investment made by the manager. The investment by the manager affects the probability distribution of both states of the world, thereby impacting the expected costs of production.

In the beginning of period 2, the state of the world is observed. Only the manager and the owner can observe the state of the world and it cannot be verified by an outsider. If the enterprise is nationalized, the government has to decide on the level of production, $y_n(\Theta)$, given that revenue and the subsidy must cover production costs. If the enterprise is privatized, the government cannot observe the state of the world and have to depend on the owner reporting the state of the world. The government only knows the ex-ante probability function $q(\cdot)$. The government can however, influence the production decision, by offering a subsidy scheme and include regulation to make a more efficient production level privately profitable. Referring to the revelation principle, the subsidy offer is modeled as a direct mechanism, $M = \{y_p(\Theta), s_p(\Theta), \Theta \in \{\Theta_1, \Theta_2\}\}$. The revelation principle is explained by Myerson (2008) as follows; “The revelation principle tells us that, for any general coordination mechanism, any equilibrium of rational communication strategies for the economic agents can be simulated by an equivalent incentive-compatible direct-revelation mechanism, where a trustworthy mediator maximally centralizes communication and makes honesty and obedience rational equilibrium strategies for the agents.” The owner of the enterprise reports $\Theta$ to the government, resulting in production of $y_p(\Theta)$ and a subsidy of $s_p(\Theta)$, it is possible for the subsidy to be negative. The owner will only produce if the profits are non-negative, since the mechanism need to be accepted voluntarily.

At the end of period 2, pay-offs are realized. In Figure 2, a timeline is presented.

<table>
<thead>
<tr>
<th>Period 0</th>
<th>Period 1</th>
<th>Period 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Government decide between nationalization and privatization.</td>
<td>- Manager select $e$.</td>
<td>- Owner and manager observe state of the world.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Decide on level of production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pay-offs are realized</td>
</tr>
</tbody>
</table>

Figure 2: Timeline
Next Schmidt gives the pay-off of the different parties given the model and assumptions stated above.

(i) The government pay-off is, \( V = \)
\[
b(y_n) + r(y_n) - c(y_n, \Theta) - w_n \quad \text{after nationalization} \\
b(y_p) - s_p + z \quad \text{after privatization}
\]
If the enterprise is publicly owned, the government receives the social benefit of production plus the profits of the enterprise minus the cost given the production and the state of the world, and the wage of the manager. If the enterprise is privatized, the government receives the social benefit of production minus the subsidy paid, plus the auction price.

(ii) The private owner pay-off is, \( P = \)
\[
0 \quad \text{after nationalization} \\
r(y_p) + s_p - c(y_p, \Theta) - w_p - z \quad \text{after privatization}
\]
If the enterprise is nationalized the private owner gets no pay-off. If the enterprise is privatized, the pay-off is the revenue plus the subsidy minus the cost, the wage of the manager, and the auction price.

(iii) The manager pay-off, \( U = \)
\[
w_n - e_n + u(y_n) \quad \text{after nationalization} \\
w_p - e_p + u(y_p) \quad \text{after privatization}
\]
In both industry designs, the manager receives a wage, puts in effort that creates a disutility, and an additional term \( u \) represents the private benefits the manager receives from production. The private benefit of the manager reflects two empirical facts about managerial incentives that are important for the model. First, “consumption on the job” increases with the size of the enterprise, reflected by the level of production in this model. Second, a manager incurs substantial disutility if the enterprise is shut down.

Before analyzing the game in more detail, Schmidt makes some additional assumptions. The first assumption is that it is impossible to write complete contingent contracts.

**Assumption 1.** In period 0, no contracts can be written on contingent payments in the future. However, it is possible to choose a governance structure in period 0, that is, to either nationalize or privatize the firm.

Schmidt illustrates this assumption by stating which variables could be controlled at period 0. The effort of the manager cannot be contracted, since it is unobservable. Second, since the cost parameter, or any accounted cost, subsidies, or profits of the firm cannot be verified to outsiders, they cannot be contracted either. An enterprise might manipulate costs and profits, and since subsidies come in many different forms, not all of them can be identified. Finally, contracting \( y \) could get around these problems. However,
the relevant type of $y$ depends on the state of the world. The only variables that can and are set at period 0 are $z$ and $w$. Both variables do not depend on the state of the world.

Another assumption is that the government cannot get full information about the enterprise’s cost and profits. Schmidt states that the right of information is not a specific right which can be contracted on, but a residual right. The government could write a contract stating that the enterprise should hand over its information. However, the information is produced, collected, accounted, processed, and transmitted by the enterprise. The owner could always manipulate information or not share all information, leaving the government less informed. To overcome this problem, it could write a contract ex ante, stating that it may send its own auditors to monitor and control the enterprise. If such a contract is not written, it is impossible to become fully informed ex post. Schmidt states that “ex ante the government wants to commit itself not to become informed (pp.10)”. The model will show that because the government is not as well informed, it can credibly commit to a “hard budget constraint”.

Finally, Schmidt adds some technological assumptions to guarantee that the maximization problems of the players have unique solutions.

**Assumption 2.** For all $y > 0$, $e > 0$, and $\Theta \in \{\Theta_1, \Theta_2\}$, it is assumed that $b(y)$, $c(y, \Theta)$, $u(y)$, and $q(e)$ are twice continuously differentiable and

1. $b(y) + r(y)$ is concave and bounded above, $b(0) = r(0) = 0$.
2. $c(y, \Theta)$ is strictly increasing and convex in $y$ with $c(0, \Theta) = 0$, $\Theta \in \{\Theta_1, \Theta_2\}$. There may be a discontinuity at $y = 0$ due to fixed costs.

Furthermore, $\exists y > 0$ such that $b(y) + r(y) > c(y, \Theta_2)$.

3. $c_y(y, \Theta_1) < c_y(y, \Theta_2)$ and $c_{yy}(y, \Theta_1) \leq c_{yy}(y, \Theta_2)$.
4. $u(y)$ is strictly increasing and concave.
5. $q(e)$ is increasing and strictly concave with $\lim_{e \to 0} q(e) = \infty$ and $0 < q(e) < 1$.

Given assumption (2.1) and (2.2), an interior solution for the first best production level is possible in all states of the world. Furthermore, for at least one $y$, the revenue plus the social benefit is bigger than the cost of production in the bad state. The first part of (2.3) states that in $\Theta_1$ marginal cost is lower than in $\Theta_2$ and that marginal cost are increasing with $\Theta$, this is a “single crossing property”. The second part of (2.3) must hold for $c$ to be convex. Next, the manager prefers a higher production level, illustrated in (2.4). Finally, (2.5) illustrates that investment by the manager pays off in both states of the world.
2.2.2 Nationalization: Forgiving High Costs

In the next two parts, Schmidt shows that the choice between nationalization or liberalization leads to different subsidies and production levels, both affecting the manager’s optimal effort. First, nationalization is discussed. In this sub game, the government has to decide about y after it has observed the state of the world. The government wants to maximize its pay-off, this maximization problem is given in (1) where $y_i$ is the production level if the government observes $\Theta = \Theta_i$, $i \in \{1, 2\}$ and $y_n$ indicating nationalization. Given assumptions (2.1) and (2.2), (1) needs an interior solution that must satisfy (2).

\[
\begin{align*}
\text{Max } y_i \{V_n = b(y_i) + r(y_i) - c(y_i, \Theta_i) - w_n\} & \quad (1) \\
b_y(y_n) + r_y(y_n) = c_y(y_n, \Theta_i) & \quad (2)
\end{align*}
\]

With formula (2) being the derivative of (1) with respect to $y_i$ and set equal to 0. Assumption (2.3) implies that $y_{1n} > y_{2n}$, since costs are lower in the good state of the world and the government will thus produce more. The government’s maximization decision is not quite ex post efficient, since it does not take into account the managers private benefit. According to Schmidt $u(y)$ is negligible compared to $b(y)$, since $b(y)$ represents the benefit of all consumers, while $u(y)$ only represents the manager’s personal benefits. Naturally, the benefit of all consumers is much larger than that of a single manager. The government will thus choose $y_{in}$ almost efficiently. Given the governments’ production decision, the manager wants to maximize his personal benefit,

\[
U_n = q(e) \cdot u(y_{1n}) + (1-q(e)) \cdot u(y_{2n}) - e + w_n \tag{3}
\]

The manager has to choose his effort before he knows the state of the world, therefore he takes both states into account. The wage is determined before he decides on his effort and does not depend on the state of the world. Proposition 1 follows from this maximization problem:

**Proposition 1.** The optimal action of the manager in the nationalization sub game, $e_n$, is uniquely characterized by

\[
q_n(e_n) \cdot [u(y_{1n}) - u(y_{2n})] = 1 \tag{4}
\]

Formula (4) is the derivative of (3) with respect to $e$ and set equal to 0, the manager will try to maximize his personal benefit. The optimal level of effort from the manager’s perspective is $e_n$ which is too small from a social point of view, since the manager does not take into account the external effects of
production (b). Given assumption (2.4) and (2.5), (4) must have an unique interior solution. Finally, using the implicit function theorem, it is frank to show that \((\tfrac{de_i}{dy_1}) > 0\) and \((\tfrac{de_i}{dy_2}) < 0\). More effort by the manager results in a larger probability of the good state in which more is produced and a smaller probability of the bad state in which less is produced. The government anticipates the manager’s maximization problem with respect to its effort, setting the wage equal to his outside option utility \((U)\) plus his effort level \((e_i)\) minus the utility it gets from production. Which gives the manager a wage just his outside option utility given by (5). The government expected pay-off if it chooses to nationalize is given by (6),

\[ w_n = e_n - q(e_n) \cdot u(y_{1n}) - (1-q(e_n)) \cdot u(y_{2n}) + U \quad (5) \]
\[ V_n = q(e_n) \cdot W(y_{1n}, \Theta_1) + (1-q(e_n)) \cdot W(y_{2n}, \Theta_2) - U - e_n \quad (6) \]

See appendix 1(A)

Where \(W (y, \Theta) = b(y) + r(y) + u(y) - c(y, \Theta)\) denotes social welfare if \(y\) is produced in state \(\Theta\). With a nationalized enterprise, allocative efficiency is high because the government decides on the production level (almost)\(^3\) ex post efficiently. It first observes the state of the world and then decide on the level of production, given it maximization problem. On the other hand, productive efficiency is poor since the manager’s effort is too low. He lacks the correct incentive to invest in cost reduction. If the government would commit to a low and inefficient production level at period 0, punishing the manager for a bad state of the world, the manager’s incentive would increase. The result would be a small decrease in \(y_{2n}\) consequently a loss in allocative efficiency and a bigger gain in productive efficiency. By improving the pay-off of the government in the bad state, the good state yields the same outcome. However, since it is not possible to write a complete contingent contract at period 0, the punishment cannot be made credible. The government’s optimal reaction to a bad state of the world is to “forgive” the manager and choose \(y\) efficiently, maximizing (1). The manager foresees this reaction and will have little incentive to save cost. The manager faces a “soft budget constraint”. A possible solution to give the manager the correct incentive is to threaten to fire him. However, all managers are considered equal in the model, so firing him would make no difference. Taking switching costs into account, this strategy would only result in a lower government pay-off.

\(^3\) The government does not take the utility of the manager into account in his maximization problem, therefore the level of production is “almost” efficient.
2.2.3 Privatization: Imposing a Harder Budget Constraint

With privatization, while the government cannot observe the realization of the cost parameter at the beginning of period 2, it does however know the probability function \( q(\cdot) \). Suppose the government believes the private manager took effort \( \hat{e} \) with probability 1, then the government will try to choose a regulation scheme that maximizes its pay-off by letting the private owner choose a socially more efficient production level. This regulation scheme might be quite complex. However Schmidt states that by the revelation principle, there exists a direct mechanism for any equilibrium of any mechanism. Under this, truth telling is an equilibrium strategy, such that the mechanism prompts the same action of the private owner and gives identical expected pay-off to the government. Thus, claiming that it is possible to implement a direct mechanism that induces the owner to announce its private information, is his best strategy. Without loss of generality, the government’s best option is to implement a direct mechanism \( M(\hat{e}) = \{ s_{ip}(\Theta', \hat{e}), y_{ip}(\Theta', \hat{e}), \Theta' \in \{ \Theta_1, \Theta_2 \} \} \). The direct mechanism is based on the owner report of \( \Theta' \) and the belief that the manager has taken \( \hat{e} \). The subsidy is given by \( s_{ip}(\hat{e}) \) and the production level by \( y_{ip}(\hat{e}) \), given that the private owner announces \( \Theta' = \Theta_i, i \in \{1, 2\} \). The government’s maximization problem is:

\[
\text{Max } y_{ip}(\hat{e}), s_{ip}(\hat{e}) \quad \{ q(\hat{e}) \cdot [b(y_{1p}(\hat{e}) - s_{1p}(\hat{e})] + (1-q(\hat{e})) \cdot [b(y_{2p}(\hat{e}) - s_{2p}(\hat{e})]\}
\]

\[ (7) \]

Subject to

\[
s_{ip}(\hat{e}) + r(y_{ip}(\hat{e})) - c(y_{ip}(\hat{e}), \Theta_i) \geq S_{ip}(\hat{e}) + r(y_{ip}(\hat{e})) - c(y_{ip}(\hat{e}), \Theta_i) \]
\[ \forall i, j \in \{1,2\} \]

\[ (8) \]

\[
s_{ip}(\hat{e}) + r(y_{ip}(\hat{e})) - c(y_{ip}(\hat{e}), \Theta) \geq 0 \]
\[ \forall i \in \{1,2\} \]

\[ (9) \]

\( z \) is not taken into account, since it is no longer relevant to any decision in period 2. Function (8) ensures that truth telling is the weakly dominant strategy for all possible states of the world. Function (9) has to be satisfied, since the private owner cannot be forced to produce unprofitable results.

The government can give the private owner the correct incentive to produce at the ex post efficient production level. To achieve this, it must set the subsidy equal to the social benefit, inducing the owner to internalize the positive external effect. As a result the private owner chooses the efficient production level. This mechanism is only optimal if the government is indifferent about transfer payments to the private owner. In the case of high transfer costs, or if the private owner’s rent does not count in the objective function, this mechanism is not optimal. If the government cannot offer this mechanism, it would like to implement the efficient production by offering a subsidy that pays only for the uncovered
cost and leaves the owner with his reservation pay-off. As a result, the private owner will always overstate its cost to make a bigger profit, since the government cannot check its cost state. This leaves the government with two options. First, pay a high subsidy if a low value of \( \Theta \) is reported, inducing the owner to honestly report low costs. Second, the government can distort \( y_p(\Theta) \) in a bad state of the world, making it less attractive to overstate costs. The government has to make a trade-off between costly subsidies and ex post efficiency.

**Proposition 2.** If the government believes the manager has taken the effort level \( \hat{e} \) with probability 1, then the optimal direct mechanism under privatization is given by:

\[
s_{1p}(\hat{e}) = c(y_{1p}(\hat{e}), \Theta_1) + c(y_{2p}(\hat{e}), \Theta_2) - c(y_{2p}(\hat{e}), \Theta_1) - r(y_{1p}(\hat{e}))
\]

\[
s_{2p}(\hat{e}) = c(y_{2p}(\hat{e}), \Theta_2) - r(y_{2p}(\hat{e}))
\]

\[
y_{1p}(\hat{e}) = \begin{cases} 
  y'_{2p} & \text{if there exists a } y'_{2p} \text{ as defined by (10) with } y'_{2p} \geq 0 \text{ and if} \\
  b(y'_{2p}) + r (y'_{2p}) - c(y'_{2p}, \Theta_2) - \frac{q(\hat{e})}{1-q(\hat{e})} \cdot [c(y'_{2p}, \Theta_2) - c(y'_{2p}, \Theta_1)] & \geq 0 \\
  0 & \text{otherwise}
\end{cases}
\]

where \( y'_{2p}(\hat{e}) \) is implicitly defined by

\[
b(y'_{2p}) + r (y'_{2p}) = c(y'_{2p}, \Theta_2) + \frac{q(\hat{e})}{1-q(\hat{e})} \cdot [c(y'_{2p}, \Theta_2) - c(y'_{2p}, \Theta_1)]
\]

\[(10)\]

See appendix 1(B)

The subsidy offered to the enterprise in the good state of the world equals its costs minus its revenue, covering the losses made or extracting the profits. Next, the government transfers the profit the enterprise would make if it was to report a high cost state, if it would face a low cost state, inducing truth telling. The subsidy in the bad state of the world only covers the possible losses or extract the possible profits. The production level in the bad state of the world depends on function (10). With \( y_{2p}(\hat{e}) = y'_{2p} \) if (7) would have an interior solution and \( y_{2p}(\hat{e}) = 0 \) if it would have a corner solution. Anticipating the mechanism in period 2, the manager has to decide on his effort level in period 1 to influence the outcome of the world. Optimally, the subsidy scheme distorts production below ex-post efficiency if costs are high to create the right incentive for the manager to put more effort in trying to influence the outcome of the world.
When comparing the optimal production schemes under nationalization and privatization, three observations can be made

1. \( y_p(\Theta | \hat{e}) = y_n(\Theta) \) if and only if \( \Theta = \Theta_1 \). Both industry designs have the same production in the good state of the world.

2. \( y_p(\Theta | \hat{e}) < y_n(\Theta) \) if \( \Theta = \Theta_2 \), because \( q(\hat{e}) > 0 \). The government expects the private manager to put in at least a little effort to enhance the probability of the good state of the world. Since \( (de_n/dy_{1n}) > 0 \) and \( (de_n/dy_{2n}) < 0 \), more effort by the manager thus reduces the \( y \) in the bad state of the world. As a result \( y \) is lower in the bad state of the world if the enterprise would be privatized. Although \( y_{2p}(\hat{e}) \) is decreasing in \( \hat{e} \), it not depend on \( e \). Since the first is the governments’ expectation of the effort and the second the real effort. But in equilibrium \( \hat{e} \) and \( e \) must be equal.

3. Schmidt states that in the high cost state, the private owner is held down to his outside option utility. In the low cost state he gets a positive information rent if \( y_{2p} > 0 \):

\[
\pi_p(\Theta_1 | \hat{e}) = s_{1p}(\hat{e}) + r(y_{1p}(\hat{e})) - c(y_{1p}(\hat{e}), \Theta_1) = c(y_{2p}(\hat{e}), \Theta_2) - c(y_{2p}(\hat{e}), \Theta_1) > 0
\]

(11)

See appendix 1(C)

where \( \pi_p \) is the profit of the private owner in the sub game starting in period 2, thus not taking the wage of the manager and the auction price into account. \( \pi \) is increasing with \( y_{2p}(\hat{e}) \), the smaller the difference between \( y_{1p} \) and \( y_{2p} \), the bigger the information rent. The difference in cost of production in the good and the bad state of the world is multiplied times a higher \( y_{2p} \), thus becoming bigger. The economic purpose of \( \pi \) is for the private owner to honestly reveal its low cost state. Without it the manager would always report a bad state of the world.

Proposition 3. Under privatization, the manager chooses with probability 1 an effort level \( e_p \) that is characterized by

\[
q_e(e_p) \cdot [u(y_{1p}(\hat{e})) - u(y_{2p}(\hat{e}))]
\]

(12)

For any \( \hat{e} > 0, e_p > e_n \). There exists an \( e_p \) that satisfies (12) with \( \hat{e} = e_p \).

Schmidt proves this proposition by stating that assumption (2.4) and (2.5) and \( y_{1p}(\hat{e}) - y_{2p}(\hat{e}) > 0 \) imply that the managers’ maximization problem has an unique interior solution characterized by (12). The maximization problem of the manager of the nationalized enterprise (4) and of the privatized enterprise (12) is compared, given the fact that \( y_{1p}(\hat{e}) - y_{2p}(\hat{e}) = y_{1n} - y_{2n} > y_{1n} - y_{2n} \) for all \( \hat{e} \geq 0 \), consequently \( e_p > e_n \). Thus \( y_{2p} < y_{2n} \) is negatively influenced by the effort of the manager, a lower \( y_2 \) implies higher effort by the manager. To show that there exists an \( e_p \) that ensures that formula (12) is satisfied with \( \hat{e} = e_p \), the
The implicit function theorem can be applied. This shows $y_{2p}(\hat{e})$ to be the continuous function of $\hat{e}$. Let $e_p(\hat{e})$ be the unique solution to (12). By Berge’s maximum theorem, $e_p(\hat{e})$ is a continuous function. Note that $e_p(0) \geq e_n > 0$. Besides, since $y_{2p} (\hat{e}) \geq 0$, $e_p(\hat{e})$ is bounded above $\epsilon < \infty$, where $\epsilon$ is defined by:

$$q_p(e_p) \cdot [u(y_{1n}) - u(0)] = 1$$

(13)

Therefore, Schmidt states that by the intermediate value theorem, there exists an $\hat{e}$ such that $e_p(\hat{e}) - \hat{e} = 0$.

In period 0, the private owner offers the manager a wage characterized by:

$$w_p = e_p - q(e_p) \cdot u(y_{1p} (e_p)) - (1-q(e_p) \cdot u(y_{2p} (e_p))) + U$$

(14)

The manager of the private enterprise gets a higher wage than the public manager for two reasons. First, the private manager puts more effort in trying to influence the outcome of the world, $e_p > e_n$. The second reason is that the output in the bad state is lower under privatization. Since his expected utility should always equal his reservation utility, he needs to be compensated for the lower production in the bad state of the world.

Next the government needs to auction the right of production to the private party, where the price of the auction is determined by the zero expected profit condition, so

$$z = q(e_p) \cdot [c(y_{2p} (e_p), \Theta_2) - c(y_{2p} (e_p), \Theta_1)] - w_p$$

(15)

See appendix 1(D)

The government extracts all the information rent ex ante through the auction. It extracts formula (11) times the expectation of this outcome, minus the wage of the manager. By substituting this expression into the governments pay-off and using $y_{1p} = y_{1n}$ results in,

$$V_p = q(e_p) \cdot W(y_{1n}, \Theta_1) + (1-q(e_p)) \cdot W(y_{2p} (e_p), \Theta_2) - e_p - U$$

(16)

See appendix 1(E)

where $W (y, \Theta) = b(y) + r(y) + u(y) - c(y, \Theta)$. 
2.2.4 Nationalization versus Privatization

In his article, Schmidt clearly showed the trade-off between nationalization and privatization. If the enterprise is under public control, the government will choose an (almost) efficient level of production, so allocative efficiency is high. The manager knows that even in the bad state of the world the government will produce an efficient level, letting his utility from production remain intact. This result gives the manager little incentive to put effort in cost reduction, resulting in a poor productive efficiency. The manager of the private firm knows that the government will cut back subsidies and so, puts in more effort than the public manager to reduce costs. The subsidies are cut in the bad state of the world, in order to limit the information rent of the owner in the good state. This reduces allocative efficiency in the bad state of the world, but enhances productive efficiency since the manager puts in more effort. The government imposes a “hard budget constraint” on the private manager.

By comparing the expected pay-off of the government under public, (6), and private, (16), ownership, Schmidt state his main result as follows:

Theorem 1. The government prefers privatization to nationalization if, and only if, the welfare gain through the more efficient investment decisions of the manager outweighs the welfare loss due to the ex post inefficient low production under privatization, that is, if and only if:

\[
q(e_p) \cdot W(y_{1n}, \Theta_1) + (1-q(e_p))W (y_{2p}(e_p), \Theta_2) - e_p \geq \\
q(e_n) \cdot W(y_{1n}, \Theta_1) + (1-q(e_n))W (y_{2n}(e_n), \Theta_2) - e_n
\]

The theorem suggests that the difference between the two industry designs become more significant whenever the government is more willing to distort the ex post production level, a harder budget constraint. If it does this, the difference between the outcome in the bad state increases and the effort of the private manager increases. While if \(y_{2p} \approx y_{2n}\), there is neither ex post inefficiency nor a harder budget constraint for the manager, eliminating differences between the two. This would also be the case if an enterprise would have high fixed costs, which are sunk, and if marginal costs are not strongly affected by the state of the world. Then it would not be possible for the government to credibly threaten the enterprise to reduce its subsidies or let it go bankrupt, reducing the effect of privatization.

Schmidt added three points when the comparative advantage of privatization goes up:

(a) if the cost-reducing investment of the manager becomes more important,

(b) if the manager's utility is more strongly affected by the distortion of production in the high cost state, and
(c) if the social benefit of production becomes smaller.

The first point suggests that if the effort of the manager becomes more effective, the probability of the good state of the world is more heavily influenced by the effort, so the advantage of privatization increases. The second point creates a greater incentive for the private manager to put in more effort. The last point can be illustrated by two points. First of all, a distortion in the production by the government in the bad state becomes less costly the smaller the social benefit of production. Allocative efficiency becomes less important to the government. Secondly, a smaller social benefit reduces the willingness of the government to pay for the information rent and instead will motivate the manager by increasing the likelihood of closing down the firm or distorting production.

According to Schmidt, point (a) and (b) are plausible but difficult to prove with empirical observations. Point (c) however, seems consistent with two stylized facts from empirical research (Atkinson and Halvorson, 1986; Boardman and Vining, 1989; Vickers and Yarrow, 1988, 1991). First, in most developed countries, sectors with high social benefits are under public control. The second point, summarized by Vickers and Yarrow (1991, pp. 113) state, “Private ownership has efficiency advantages in competitive conditions, but does not show either public or private ownership to be generally superior when market power is present.” This relates to point (c) in the sense that when a private enterprise faces competition, the termination of its production influences social benefit less, since the competitor still produces the good. Enforcing the “hard budget constraint” of the government and the model predicts that the comparative advantage of privatization goes up.

Finally, Schmidt elaborates on some of the assumptions made in the model. The government is modeled as a benevolent, fully rational, and unitary one. While these assumptions are not very realistic, they however strengthen the model. If a private enterprise outperforms a public one, given this assumption, a stronger case is made for privatization. The regulator however, might have some deficiencies as well, weakening the case for privatization. A second assumption that Schmidt made is that of a very simple production process. The owner orders the manager to produce, while in reality, principal-agent problems might occur. This assumption does however, not affect the outcome of the model, since both under public and private control, principal-agent problems can occur. Another assumption is that the owner, the holder of the residual right of control, can directly observe $\Theta$. If this assumption is relaxed and the owner cannot directly observe $\Theta$ while the manager can, the owner needs a new mechanism for the manager to report $\Theta$ honestly. Although the owner does not know $\Theta$ precisely, it is realistic to assume that if the enterprise is privately owned, the owner is still better informed than an outsider. Relaxing this assumption would not influence the outcome of the model with respect to the difference between a private and a public owner.
2.3 Regulation, Competition, and Liberalization

Armstrong and Sappington (2006) discuss two issues in relation to liberalization. First, the differences between regulated monopoly supply and unregulated competition and under what conditions one or the other is preferable. Second, they discuss optimal liberalization policies; an issue, Armstrong and Sappington claim, that we know relatively little about. According to the authors, both issues are of substantial practical importance and apply throughout the world. These topics are particularly important in network industries, where the presence of too many firms may be uneconomic due to scale economies, but where competition might be a tool to discipline the incumbent. Their analysis emphasizes the problems that imperfect institutions and imperfect information pose for the right design of the industry policy.

2.3.1 Recent Experience with Liberalization

Armstrong and Sappington start by looking at recent liberalization experiences in network industries. They discuss the liberalization of Chile’s telecommunications industry, the United Kingdom’s natural gas industry, and California’s electricity industry. The first two experiences showed that liberalization alone is not sufficient to reap the benefits of competition. The regulator is needed to impose additional regulation. Chile’s experience showed some issues common to liberalization of telecommunication industries; the importance of regulation, granting access to the network, urban and rural presence, and the role of competition. California’s experience showed that liberalization policies could result in a worse situation than before.

2.3.2 Regulated Monopoly and Unregulated Competition

In a Utopian world where a regulator is omniscient, benevolent, and able to fulfill any promise he makes, competition cannot improve upon regulated monopoly. In reality, regulators lack important information about the regulated enterprises and therefore are not able to control and direct the monopoly the way they would like to. Armstrong and Sappington point out that the information asymmetry between the regulator and the monopoly is an important argument to liberalize a sector. The information asymmetry gives rise to a trade-off between rent and efficiency. The enterprise will be more efficient if it is rewarded rent. Armstrong and Sappington present a model to illustrate the differences between regulated monopoly and unregulated competition decision of liberalization and conclude by comparing the different outcomes.
Armstrong and Sappington assume the regulator to pursue the social goal of maximizing the expected value of $V + \alpha U$, where $V$ is consumers surplus and $U$ is the firm’s rent, and $\alpha \in [0,1]$ is a parameter. Because $\alpha \leq 1$ society values shareholders’ welfare lower or equal to consumer welfare. In order for the monopoly to produce, the regulator transfers a payment ($T$) to the firm. This payment by the consumers reduces their surplus by $(1+\lambda)$. The parameter $\lambda \geq 0$ represents the cost of public funds. If the profits of the firm are taxed, they yield a benefit of $1+\lambda$, since it reduces the tax that have to be paid by consumers. In this model, the regulator sets both the unit price $p \geq 0$ and the transfer payment ($T$), the firm is obliged to serve all customers’ demands at price $p$. The demand curve for the good $q(p)$, is supposed to be common knowledge. The enterprise has both fixed cost ($F$) and marginal cost ($c$), $c$ can take two values; $c_L$ and $c_H$, respectively the low and the high cost state. The difference between these two is $\Delta = c_H - c_L > 0$. Only the enterprise knows its marginal cost, while the regulator has to speculate about the likelihood of the marginal costs. Both cost realizations are assumed to be equally likely. In contrast to the marginal cost, $F$ is assumed to be common knowledge. The goal of the firm is to maximize its rent ($U$), which is the sum of the profit $\pi = q(p)[p-c]$ and the transfer payment it receives from the regulator.

The regulator sets the unit price at $p_i$ and the transfer payment at $T_i$ after the firm has reported $c_i$ for $i \equiv L, H$. This results in the rent of the firm $U_i \equiv q(p_i)[p_i-c_i] - F + T_i$ and the social welfare when the firm’s marginal cost is $c_i$:

$$v(p_i) - [1+\lambda] T_i + \alpha[q(p_i)[p_i-c_i] - F + T_i] = w_i(p_i) - [1+\lambda-\alpha]U_i$$

See appendix 2(A)

where $w_i(p_i) = v(p_i) + [1+\lambda][q(p_i)[p_i-c_i]-F]$. The authors separate social welfare into two parts, with $w_i$ representing the surplus for the consumer and the second part representing the cost for the consumer and the surplus for the enterprise. With $v(p_i)$, consumer surplus is represented when $p$ is established, and the second part of the formula is the public funds secured by positive rents of the firm. The other part - $[1+\lambda-\alpha]U_i$ is the negative effect of taxing and the valuation of firms rent as a part of social goals.

If the marginal cost of the firm were observable by the regulator, they would implement a pricing scheme that maximizes $w_i(\cdot)$. Maximizing $w_i(\cdot)$, $\lambda$ plays an important role, since payment from the firm to the government can overcome the distortive effects of tax. When $\lambda$ is large, the regulator, knowing $c_i$, would try to maximize the profit of the enterprise and set $p_i$ equal to the price set by an unregulated profit-maximizing monopolist. If $\lambda$ is zero, enterprise its rent will not affect $w_i(\cdot)$ and the regulator will set the price equal to marginal cost ($p_i=c_i$).

When the firms’ marginal cost are not observable, the authors state that:
\[ q(p_L)[p_L - c_L] - F + T_L \geq q(p_H)[p_H - c_L] - F + T_H \]

\[ U_L \geq U_H + \Delta q(p_H) \] (1)

Meaning that the profit with low reported marginal cost must be equal or bigger than that with high reported cost, while having the low cost. By stating (1) the authors create an incentive for the firm to truthfully report \( c_L \). The regulator will induce the enterprise to report its marginal cost truthfully by adjusting \( p_i \) and \( T_i \). The firm must also find it profitable to operate when its marginal cost is high, therefore \( U_H \geq 0 \). Since social welfare declines if the firm makes more profit (when \( \alpha < 1 \) and/or \( \lambda > 0 \)), the regulator will set the price and transfer payment such that \( U_H = 0 \). In an optimal regulatory situation, the regulator will set \( U_L = \Delta q(p_H) \). In this situation, the enterprise makes the same profit if it truthfully reports the low cost state and if it overstate its costs and have a production level of \( q(p_H) \). The enterprise will be indifferent and will report the true state. Therefore, total expected welfare if price \( p_i \) is set when marginal cost \( c_i \) is realized (for \( i = L, H \)), will be:

\[ \frac{1}{2} [w_L(p_L) - [1 + \lambda - \alpha] \Delta q(p_H)] + \frac{1}{2} w_H(p_H) - [1 + \lambda]G \] (2)

Both cost structures are perceived to be equally likely, therefore the expected welfare is \( \frac{1}{2} \) for both situations. The expected welfare is calculated using \( w_i(p_i) - [1 + \lambda - \alpha]U_i \). With the low cost structure, \( U_L = \Delta q(p_H) \) and \( i = L \). If the marginal cost is high, \( U_H \) is set equal to zero by the regulator (social welfare declines as the firm’s equilibrium rent increase) so the second part of \( w_i(p_i) - [1 + \lambda - \alpha]U_i \) becomes zero and \( i = H \). The authors add \( G \) to this equation, representing the cost of regulation. Since this cost is paid by using public funds, \( 1 + \lambda \). When (2) is differentiated with respect to \( p_H \), \( p_H \) is optimally chosen to maximize,

\[ w_H(\cdot) - [1 + \lambda - \alpha] \Delta q(\cdot) = v(p_H) - [1 + \lambda] T_i + \alpha[\Delta q(\cdot)] \]

it shows that when a regulator cannot observe the marginal cost, he is able to achieve the same level of expected welfare as when he could observe the marginal cost, but the high marginal cost was \( \hat{c}_H \):

\[ \hat{c}_H = c_H + \left[ 1 - \frac{\alpha}{1 + \lambda} \right] \Delta > c_H \] (3)
The regulator sets \( c_H \) above \( c_L \), to ensure the firm reports its true cost. By inflating the costs, the price will be inflated as well, reducing the quantity of goods sold on which the firm can exercise its costs advantage when \( c_L \) is realized. The higher \( p_H \) and the lower \( T_H \) will limit the rent if the firm overstates its cost. As a result, the enterprise has no incentive to overstate its production costs.

This model presents three features of optimal regulatory policy that also applies to more general settings of a monopoly supplier that is better informed than the regulator. The first feature is that a firm generally commands rent from its superior information. With \( c_L \) the extra profit as a consequence of an information advantage is \( \Delta q(p_H) \). Second, the regulator will try to limit the “abuse” of the enterprise by creating a menu of options, using both \( p \) and \( T \), of which the firm can make a binding choice. A good menu can induce the enterprise to share its information and result in an outcome better for both the firm and the consumers. Finally, “the optimal regulatory policy generally induces inefficient performance to limit the firm’s rent (pp. 333).” The regulator sets a policy such that the enterprise will report its true cost, by for example inflating the price in the bad state of the world, which might not be the best level for production for the enterprise or the country as a whole.

Next the authors discuss the features of unregulated competition. They present a model in which two firms compete in Bertrand price competition. With Bertrand competition, the prices will equal marginal cost of the least efficient producer. Both firms are aware of each other’s marginal cost, \( c \in \{c_L, c_H\} \), when they set their price. The social cost of public funding, \( \lambda \), does not play a role in this model, since no transfer payment is made and the firm’s profit cannot be appropriated by the government. The social welfare is \( v(p) + \alpha \pi \), where \( \pi \) is the industry profit. Each firm has a probability of \( \frac{1}{2} \) of low marginal cost, \( c_L \). The firm’s cost may be correlated, \( \rho \in [\frac{1}{2}, 1] \) represent the probability of cost correlation, with \( \rho = 1 \) representing perfectly correlated cost and \( \rho = \frac{1}{2} \) representing uncorrelated costs. Bertrand competition will ensure price \( c_H \) except if both firms have cost structure \( c_L \). In any other case, the firm with \( c_L \) will set prices equal to \( c_H \), since he knows that the other firm will not produce below cost. Competition would drive down a price above \( c_H \). Adding to their model, the authors state that the same cost structure occurs with probability \( \rho/2 \). A firm makes zero profit if both firms have the same cost structure. If one firm has \( c_L \), he will make a profit of \( \Delta q(c_H) \), with \( \Delta \) being the difference between \( c_L \) and \( c_H \). A firm will achieve this profit with a probability of \( (1-\rho)/2 \). As a result, the industry-expected profit is \( [1-\rho]\Delta q(c_H) \), and the profits decline as the firms’ cost structure becomes more highly correlated. The probability of low marginal cost is \( [1- \rho/2] \) and the probability that the industry price is \( c_L \), thus both firms having low marginal cost, is \( \rho/2 \).
Ignoring fixed cost $F$, social welfare in this model is:

$$\frac{p}{2}v(c_L) + \left[1 - \frac{p}{2}\right]v(c_H) + \alpha[1-\rho]\Delta q(c_H)$$ \hspace{1cm} (4)

With a probability of $\rho/2$ of social welfare with a low cost state, $[1 - \rho/2]$ of social welfare with a high cost state, and finally if one of the two firms has low marginal cost, this firm will make a profit, represented in the final part of the formula. If this is the case, social welfare will be $[1 - \frac{p}{2}]v(c_H) + \alpha[1-\rho]\Delta q(c_H)$. While with both firms having the high marginal cost function, welfare will be $[1 - \frac{p}{2}]v(c_H)$.

Armstrong and Sappington point out four potential advantages of regulated monopoly over unregulated competition. First, industry prices are under direct control. Next, the regulator can transfer payments to provide the desired incentives. Third, taxing the profits of the firm can generate public funds without disturbance. Finally, an aspect that can be of importance in the telecom sector, duplication of fixed cost, can be avoided. On the other hand, unregulated competition has three advantages over regulated monopoly. First, there is a higher chance of one of the firms having the lower marginal costs. This advantage is known as the “sampling benefit of competition”. Second, a rival firm with correlated cost reduces the information advantage, the so-called “rent-reducing benefit of competition”. Finally, regulation costs are avoided.

To know the difference between the two industry designs that can be drawn using the model, the expected welfare of both should be compared. First it is assumed that $\lambda = 0$, $F = 0$, and $G = 0$, so there is no social costs of public funds, there are no fixed costs of production, and regulation costs are zero. Taking together (2) and (3) it shows that the maximum expected welfare under monopoly regulation is:

$$\frac{1}{2}v(c_L) + \frac{1}{2}v(c_H+ [1-\alpha]\Delta)$$ \hspace{1cm} (5)

Both states of the world are assumed to be equally likely. The consumer surplus depends on $p$, since the regulator created the correct regulation scheme the firm reports the correct value of $c$ and $p$ is set equal to cost or the inflated cost.

When comparing function (4) and (5), four conclusions can be drawn regarding the relative performance of regulated monopoly and unregulated duopoly. First, if the costs of a duopoly are perfectly correlated ($\rho=1$), the unregulated duopoly delivers a higher level of expected welfare for two reasons. First, none of the two enterprises will have a costs advantage, consequently no rent is made. Second, competition will drive the price to the level of realized cost and price will equal marginal cost. Under a regulated monopoly, the regulator will set prices above marginal cost to limit the information rent. With
perfect correlation, the advantage of the duopoly does not come from the sampling benefit, but from the rent reduction and competition reduces or takes away the information rent. Second, with perfect inelasticity, only the probability of obtaining a low cost supplier affects welfare. The probability of a low cost supplier is higher under a monopoly (sampling benefit op competition), thus again duopoly is preferred. The explanation is that with inelastic demand, price distortions do not affect output levels, therefore, serving to limit rent. Thus the only factor that affects welfare is the probability of a low cost producer, since a low cost producer makes a profit that is valued by society. Third, with elastic demand (and $p<1$), regulated monopoly outperforms the unregulated duopoly. When prices are elastic it is important that they closely track costs, otherwise you will get substantial losses in surplus (see appendix 2 (B)). The regulated monopoly tracks costs better than the unregulated monopoly. Finally, the unregulated duopoly will generate a higher level of expected welfare if the difference between the low and high marginal cost ($\Delta$) is sufficiently close to zero. A small $\Delta$ makes monopoly rent and duopoly profit negligible; making the probability of a producer with low marginal cost an important factor in comparing both industry designs, making the duopoly the preferred industry design. Another conclusion that can be drawn from the model especially relevant to network industries is that a regulated monopoly outperforms competition if $F$ is sufficiently large. With one supplier the duplication of fixed cost is avoided, a monopoly will minimize industry costs in the presence of economies of scale. On the other hand, if regulatory costs are sufficiently large, unregulated competition is preferred. Finally, if raising public funds by taxing consumers is relatively costly, $\lambda$ is high, a regulated monopoly is preferred. By taxing the monopoly, the government can, without costs ($\lambda$), raise public funds.

The authors comment on their model by stating that Bertrand competition is not the most likely form of competition. This form of competition ensures production at the marginal cost of the most expensive producer (in case of a duopoly), a result not obtained in other forms of competition. A different form of competition could result in different conclusions about the difference between a regulated monopoly and unregulated competition. Sticking with Bertrand competition, the model shows that the choice between the two industry designs depend on industry characteristics. In the following section, additional considerations are discussed.

2.3.3 Additional Considerations

By modeling regulated monopoly and unregulated competition, Armstrong and Sappington abstracted several important institutional factors. First the regulator might be less informed than the regulator in the model. This could be the result of limited physical and/or financial resources. If the regulator lacks the ability to transfer a payment and wishes the monopolist to produce under both pricing schemes, the regulator could do no better than to set $p = c_H$. Resulting in the expected welfare:
\[ v(c_{HL}) + \frac{1}{2} \alpha \Delta q(c_{HL}) \quad (6) \]

The expected welfare in (6) is lower than with unregulated competition, (4). Since formula (4) minus (6) is,

\[
[v(c_L) - v(c_{HL})] \rho/2 + \alpha \Delta q(c_{HL})[ \frac{1}{2} - \rho ]
\]

*See appendix 2(C)*

which is a nonnegative formula at \( \rho = 1 \). Therefore the expected welfare is lower than under a duopoly. Consequently, if the regulator lacks the ability to transfer a payment, a duopoly is always preferred. More general, if the regulator lacks the ability to reward or penalize a monopolist, it might be unable to achieve the desired outcome. Another issue might arise if the regulator has limited powers to gain information from the monopolist, information needed to act as a regulator. Regulation might play a role in a liberalized sector as well. If the regulator has no mandate to control entrants, the entrant might act in a way that harms total welfare. It might engage in cream-skimming, creating a situation in which the incumbent can no longer provide the service to all customers. The regulator could also be dependent on the enterprise (e.g. for information and funding) and as a result, the enterprise has a say in the regulatory activities. Another issue that might arise is the regulator pushing down prices for short-term gains, forcing the producers out of business or reducing the incentive to invest. Possible solutions to overcome the problem of a not properly functioning regulator are: strong legal institutions, certain degree of independence (government appointment instead of direct voting), regulatory transparency, clear mandate and objective, and a long tenure.

2.3.4 Franchise Bidding

If competition does not positively influence total welfare because, for example when duplication of fixed cost negatively impacts welfare, bidding for the right to serve as a regulated monopoly suppliers, might capture some of the potential benefits of competition. Armstrong and Sappington assume two firms, aware of their own marginal cost of production (\( c \in \{c_L, c_{HL}\} \)), to bid for the right to serve as the sole provider. \( c_L \) and \( c_{HL} \) are equally likely for each firm and for simplicity the firms’ cost realizations are uncorrelated. In the bidding process, the firms have to report their cost realizations simultaneously. The firm with the lowest cost realization is selected to be the supplier. If both firms report the same cost realization, one firm is selected at random. The selected firm receives \( p_i \) and \( T_i \) with \( i = L, H \), depending
on the reported cost structure. If a firm has the low marginal cost, it is likely to be selected with probability $\frac{3}{4}$.

<table>
<thead>
<tr>
<th>Producer 1</th>
<th>c_L</th>
<th>c_L</th>
<th>c_H</th>
<th>c_H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer 2</td>
<td>c_L</td>
<td>c_H</td>
<td>c_L</td>
<td>c_H</td>
</tr>
<tr>
<td>Expected pay-off 1</td>
<td>$\frac{1}{2} U_L$</td>
<td>$U_L$</td>
<td>0</td>
<td>$\frac{1}{2} U_H$</td>
</tr>
</tbody>
</table>

Table 1

Table 1 illustrates the expected pay-off for a producer. Truthfully reporting would be a best reaction if the expected pay-off of $U_H$ would be at least three times the expected pay-off of $U_L$, given the expected outcome of the game. However, the possible profit of not truthfully reporting and having the low cost realization should be taken into account. The producer will therefore truthfully report their marginal cost if,

$$\frac{3}{4} U_L \geq \frac{1}{4} [U_L + \Delta q(p_H)]$$

(7)

with $U \equiv [p_i - c_i]q(p_i) - F + T$, for $i = L, H$. The binding participation constraint will be that of the firm with the high marginal cost. Optimally, $U_H$ is set equal to zero. The firm will produce if it has the high cost structure, but will make no profit. If $U_H$ would be negative, the producers would not enter the bidding. Consequently, expected welfare under optimal pricing policy is:

$$\frac{3}{4}w_L(p_L) - \frac{1}{3} [1+\lambda - \alpha] \Delta q(p_H) + \frac{1}{4} w_H(p_H)$$

(8)

Differentiating (8) shows that $p_H$ is optimally chosen to maximize $w_H(\cdot) - [1+\lambda - \alpha] \Delta q(\cdot)$ and $p_L$ is optimally chosen to maximize $w_L(\cdot)$, resulting in the same prices as with a regulated monopoly. Because cost exaggeration entails a substantial risk of being excluded from the industry (by losing the bidding process), the firm will reveal its possible cost advantage more easily. As a result, $T_L$ is lower in case of the franchise bidding setting compared to the regulated monopoly.

Given the fact that both franchise bidding and a regulated monopoly implement the same prices for a given cost realization, total expected welfare is the same under both regimes. Only the likelihood of a certain outcome is different in the both settings ($\frac{3}{4}$ instead of $\frac{1}{2}$ for the low cost scenario). Resulting in the following expected welfare, given that the cost of social funds is zero:

$$\frac{3}{4} v(c_L) + \frac{1}{4} v(c_H + [1-\alpha] \Delta)$$

(9)
Expression (9) not only exceeds (5), but expression (4) as well if $\rho = \frac{1}{2}$. In conclusion, in this model, franchise-bidding outperforms both unregulated competition and regulated monopoly. Due to the bidding process, it can secure the sampling benefit of competition as well as the rent-reducing benefit of competition and the benefit of scale economies, since only one producer is active. Franchise bidding does however have some drawbacks, some of which will be briefly discussed below.

First, the bidding process might not be intense enough to reach the best outcome. Reasons for this might be; not enough parties involved in the bidding process, non-accurate or lack of information, insufficient financial resources, and non-comparable skills between the bidding parties. A problem that might arise after the bidding process is that the winning party wants to renegotiate the terms of the contract. Although not efficient, the government might renegotiate in order to avoid the appearance of failure in the procurement process or to avoid costs with re-auctioning the franchise. An important downside of franchise bidding is the length of the contract. Short contract duration might not create the right incentive for investment. The longer the contract, the more uncertainties, and the harder it is to write a contract incorporating all contingencies. As a result, the length of a contract often is not long enough for the right investment incentives.

2.3.4 Anti- and Pro-Competitive Liberalization Policies

Given the experience in the liberalization of Chile’s telecommunications market and the British gas market, sometimes liberalization in itself is insufficient for competition to flourish. Entrants might face economic barriers like; customer inertia due to switching cost or ignorance, incumbent control of key inputs that entrants require for profitable operation, and the prospect of aggressive pricing by incumbent suppliers. As a response, the government or a regulator might decide to impose additional measures or liberalization policies to promote competition. According to Armstrong and Sappington the government should consider the following policies carefully because they might influence the outcome negatively; providing a temporary monopoly or oligopoly, specifying market share targets, and implement vague or excessively generous network access policies.

In contrast to anti-competitive liberalization policies, Armstrong and Sappington discuss pro-competitive policies that promote “vigorous long-term industry competition (pp. 350).” By removing entry barriers and unleashing the full force of competition, these policies provide potential for ultimately relying on market forces to achieve the desired outcome. The policies discussed are the following; reduce customer switching and search costs, ensure adequate monitoring and data reporting, privatize SOE, rebalance retail tariffs to better reflect costs, allow adequate pricing flexibility, prevent disadvantaging of downstream competitors, establish appropriate access prices, and limit cost shifting.
Part 3: Opinion

This part of the thesis will try to combine the insights gained from the papers discussed in the previous chapter and the literature review to answer the research question and to illuminate on the issue of NGA. It will start by discussing and commenting on the papers discussed in the previous chapter. Next, using the insights gained from the three papers in the previous chapter and the literature discussed in the literature review, the research questions will be answered. Finally, the results will be used to discuss the role of the government in NGA.

3.1 Main papers

3.1.1 The Proper Scope of Government

Hart, Shleifer, and Vishny (1997) created a model to illustrate one of the trade-offs the government has to decide on if it is to liberalize a sector. The public manager will have both a greater incentive to cost innovate as to improve quality. However, Hart et al. assume that cost innovation would deter quality and the government thus has to make a trade-off between the more innovative private manager and the less innovative public manager. The next part will discuss the assumptions, the model, and some points of discussion of the paper by Hart et al.

In order to make a workable economic model, some assumptions and simplifications need to be made. The most important assumption of the model is that complete contracts are not feasible, an assumption, given the scope of most government projects, that can be considered fairly realistic. Most projects are long term and complex, which makes the creation of a complete contract virtually impossible. What the paper misses, but something that can be easily assumed given the model, is that better quality can be incorporated in a contract, the more private provision would be preferred. If quality can be better contracted on, the impact of \( b \) will be smaller and thus less damaging. One other omission of the model is that the government will most likely incur regulation or oversight costs once the provision is made private; the more detailed the contract, the higher these costs. Hart et al. do not incorporate regulation, something of vital importance in the privatization process, especially with monopolistic supply. Regulation could increase the cost of privatization.

Secondly, competition plays no role in the model. Hart et al. assume that competition is possible between several government owned enterprises or several management teams and is therefore not the main argument for privatization. They do note that competition could create the right incentive for the private producer if the consumer can assess the quality. In most real life cases, privatization often follows
liberalization, or both policies are implemented at the same time, to reduce the private party’s market power or regulation costs. Given that the private party sells directly to the government and regulation is left out of the model, the omission of competition does not matter much for the outcome of the model. If the good would be sold directly on the market place, competition would be of more importance. However, adding competition by, for example, auctioning the right to produce, could give a higher pay-off to the government.

The model assumes that the holder of the residual right of control must approve all changes. In real life, a manager must make many decisions that might change the course of the enterprise. Most of these decisions are relatively small, but might have an impact on quality or cost. It is inefficient for both the owner and the manager to discuss all decisions. Realistically, some changes can be made without the approval of the owner. For big changes however, this assumption holds. Applying this to the model could result in a cost innovation by the public manager, without the approval of the owner. This gives the public manager greater incentives to cost innovate, since he reaps the benefits and is not affected by the quality deterioration. As a result, the difference between a public and private manager diminishes.

Hart et al. assume that the owner manages the private enterprise. In most industries or enterprises, these roles are separated. Relaxing this assumption could change the outcome to the model. In the new situation, the manager and owner need to split the benefits of the innovations. The deterioration in quality as a result of cost innovation is still not taken into account and there will still be an excessive tendency to reduce costs. The effect on quality innovation is more complicated, Hart et al. state that the manager might be less replaceable, resulting in a higher incentive to innovate. Then again, the gains of the innovation need to be divided between three parties, resulting in a lower incentive to innovate. All in all, the impact of this assumption on the outcome with respect to the quality innovation is ambiguous.

Finally it is assumed that the manager of the public enterprise can be replaced- an assumption not necessarily realistic. By relaxing this assumption, the incentive to innovate in quality would equal that of the private manager. However, the assumption that a manager knows he can be replaced and with what certainty, is less realistic, although again it would not change the outcome of the model much, but would only make the outcome of formula (12), (13), and (14) less predictable since $\lambda$ is more uncertain.

Hart et al. also omitted some important aspects of the privatization process in their model. Regulation, a very important aspect of the liberalization process, was already mentioned. Another issue not mentioned is the utility a manager gets from production. As Schmidt (1996) notes, a manager might get utility from “empire building” or disutility if the enterprise is liquidated. Hart et al do not mention this point explicitly. Adding such an assumption could change for example the effort put into the quality innovation. If the government must pay a higher price for the good as a consequence of a higher quality, it might demand less of the good, resulting in a lower incentive for the manager to quality innovate.
Finally, the government is believed to have a long-term vision. It takes the quality deterioration into account. With a more malevolent government or a more short-sighted government, the influence of the lowered quality might be less important. Take for example education. The quality deterioration as a result of cost innovation is something of which the pain is felt in the future and indirectly, lower economic growth, while the reduction in cost is instant. Consequently, a malevolent or short-sighted government might not take the quality deterioration into account and only look at the cost of production. One could assume that the government knows the private owner to invest in cost reduction, while it still has to pay the manager $P_0$ (since it cannot be contracted on). It gets none of the cost reduction if $F$ is privately owned. If the government is short sighted (quality less important) it would have a lower incentive to privatize and would invest more in cost innovation.

3.1.2 The Costs and Benefits of Privatization

In the model by Schmidt (1996) the holder of the residual right of control has an informational advantage. If the enterprise is under public control, the government cannot credibly commit to a budget, but it can if the sector is privatized. The model illustrates that the government has to trade-off allocative and productive efficiency. The next part will discuss the assumptions, the model, and some points of contention.

As with any model, Schmidt made some assumption and simplifications. Some of these are relaxed in the final part of the paper, which strengthens the model and the paper. However some comments can be made. One of the key assumptions in the model is only the holder of the residual right of control can observe the state of the world. Schmidt assumes that the government can only observe the probability function of a certain state of the world. It is assumed impossible for the manager or the owner to convince the government of a certain state of the world. In real life, one might assume the owner or manager to be able to convince the government of a certain state of the world, especially given the fact that it knows the probability function. The manager might have the incentive to do so, in order for the government to give a higher subsidy and the enterprise to produce more, thus resulting in a less stringent budget constraint and less difference between public and private control.

Another assumption is that contracts are incomplete. If contracts were complete, there would be no difference between public and private provision. Schmidt states that conditioning the contract on the output could circumvent some of the issues in relation to incomplete contracts. However, the type of output depends on the state of the world, making it impossible to condition the contract on output. One can easily think of some sectors in which the type of output will not differ (much) in different states of the world. Schmidt only discusses an example in which the type of product does depend heavily on the state.
of the world, leaving this issue unresolved. Being able to write a more complete contract would result in less difference between nationalization and privatization.

Some additional comments on the paper can be made. First of all, the paper is only about privatization, thus competition is not discussed. Schmidt only states that competition reduces the social benefit of production. Introducing an auction or competition could strengthen the model. If the manager knows that he might lose production to a competitor, he has more incentive to put in effort. Competition or an auction might replace the lower production in the bad state of the world and induce the manager to report the good state of the world truthfully. The former might not be necessary any longer since the threat of competition and the latter might be the best response to the presence of a competitor that has to report its state of the world as well.

A second point of discussion is about the type of good produced and the relevance of the model. No example of a service or sector that is relevant for the model is given. Clearly, the product is one that is not provided sufficiently by the market or considered too important to be left over to the market; otherwise government intervention would not be needed. Second, the government is better able to determine the correct supply of the good, since it needs to intervene to achieve allocative efficiency. Combining both points makes it difficult to come up with a realistic product or service. In the model, the government induces a lower production in the bad state of the world. However, if a good needs government intervention to be produced, be it too important or yielding external benefits, the threat of lower production in the bad state is not a credible one. This action would be realistic in a situation in which the government does not care about production that much, but since the government wants the good to be produced, this is not a credible threat. Given this contradiction, it is difficult to apply the model to vital industries or industries that still need to be privatized (e.g. education, health care). The one example given in footnote (21), which might be relevant, is the aviation sector. This sector used to be publicly owned and not of vital importance, so the threat of a cutback in production is a vital one. However, most enterprises that were publicly owned and not considered of vital importance or yielding high enough external benefits are already privatized. In conclusion, this paper is only relevant for industries in which government intervention was not necessary in the first place.

An omission of the model that might affect the outcome is investment. Only the manager is assumed to invest. In most sectors, especially natural monopolies, investment plays an important role. Logically not all real-life aspects can be incorporated in the model, but the omission of investment weakens the model as follows. The government is believed to be able to reach allocative efficiency as it observes the state of the world, after the manager has made its investment. But if it had to make an investment before period 1, which is of importance to the production process, it might be impossible to reach allocative efficiency after it observes the state of the world, since the initial investment might not be
perfectly in line with the state of the world. This decreases the impact of the subsidy on allocative efficiency, resulting in less difference between public and private control.

3.1.3 Regulation, Competition, and Liberalization

In the paper by Armstrong and Sappington (2006) different issues in relation to liberalization and privatization are discussed. They describe three experiences, create a model to show the difference between a regulated monopoly and an unregulated, and discuss some liberalization/privatization policies. Their general conclusion can be summarized by stating that the decision of liberalization and/or privatization is not a straightforward one and if competition is preferred, the roads towards it are long and winding. The next part will outline the assumptions, the model, and some points of discussion of the paper by Armstrong and Sappington.

In order to make a workable economic model, some assumptions and simplifications need to be made. The first assumption is that the regulator faithfully pursues the social goal of maximizing the consumer’s surplus and the enterprise, its rent (assuming a benevolent government might not be a credible assumption). In addition, Armstrong and Sappington assume the regulator to be able to perceive the parameter of society’s valuation of the enterprise its rent, something that might prove to be very difficult in real life. If the government would act malevolently, a duopoly would be favored sooner. The visibility of the parameter does not affect the outcome of the model.

A second assumption is that the duopoly cannot be taxed; a relatively unrealistic assumption, since there is no difference between profit made by a duopoly or a monopoly. This assumption does not alter the outcome of the paper, since in comparing the different industry designs, the social cost of public funds are set equal to zero. Furthermore, Armstrong and Sappington assume Bertrand competition. It would strengthen their model if they had relaxed this assumption, since this might alter the outcome of the model. With other forms of competition, prices might have been higher and benefits of unregulated competition lower. This is especially so given the assumption that the duopoly needs no regulation, which simplifies price arrangements. The assumption that the duopoly needs no regulation and the monopoly does, does not alter the model because regulation costs are set equal to zero. However, a note or more discussion on the assumption of no regulation could have strengthened the paper.

Besides the model, some liberalization policies are discussed. Some of these policies are not recommended, while others are. They relax their recommendations by stating that under some circumstances a certain policy might have a contrary effect from what they claim to have. Therefore, these recommendations are hard to comment on, except for one. Armstrong and Sappington assert that, “Rebalance retail tariffs to better reflect costs (pp. 352)” to be a recommended policy. Sometimes the
price of a good or service is set above incremental cost. The price should be rebalanced before liberalization to communicate the correct signals to potential entrants. The question that arises is; how can the government let loose a policy that is set for a certain reason before? Letting loose the pricing policy implies having another solution that could have been used before, since price distortion is in most situations not an appropriate policy. If no such method is on hand, there is no possibility to rebalance retail tariffs. It could be a temporary measure, if competition would replace the need for intervention. However, the regulator or government could achieve the same result not by rebalancing, but by providing the correct information to potential entrants, which is probably a more credible solution. Stating that this policy is a good liberalization policy is not very credible. The final issue with respect to this policy is the difficulty in determining the correct price, if the retail tariff is to be rebalanced.
3.2 Research Questions

3.2.1. Main Research Question

The main research question of this thesis is “What are the trade-offs in a liberalization and/or privatization process?” In deciding between public or private provision the government needs to deliberate upon many trade-offs, some of which might not even be considered in the initial political process. This thesis tries to illustrate the difficulties faced by the government and summarize some of these trade-offs.

Hart et al. discuss probably the most important trade-off a government faces in deciding between public and private provision; the trade-off between lower cost and possibly lower quality. As was discussed in the introduction, trends in past decades have shown a clear pattern towards liberalization and privatization. Given the trade-off illustrated by Hart et al., one should assume that either governments cared less about quality, cost reduction became more important, or the quality less deteriorated. The former is a less persuasive argument. The second argument is discussed by Sheshinski and López-Calva (2003) who state that improving public sector’s financial health was indeed an important reason for privatization. Finally Armstrong and Sappington (2006) discussed some policies that could improve the outcome of liberalization and/or privatization that might explain this shift. If the government is able to privatize a sector, thereby reducing costs but keeping quality intact or eventually improving quality, privatization could be the preferred policy. Given the important role of regulation in liberalization and privatization, it can play an important role in reducing the quality deterioration. Through developments in academic research, granting more authorities to the regulator, and technological development, regulation has become more effective. Another development that might reduce the negative impact is competition. As both Hart et al., as well as Schmidt state, competition might strengthen the case for liberalization. By facing competition, the quality deterioration reduces the price consumers are willing to pay and the lowered production in the bad state can be compensated by a competitor. With the introduction of the European Union, or more generally, a more globalized world, foreign competitors could enter the market, reducing the negative impact of privatization. These arguments together can explain the shift towards liberalization and privatization.

To answer the research question some trade-offs will be discussed. Hart et al. discuss the trade-off between lowered cost and lowered quality. Public provision would be preferred if formula (16) would apply. If the private producers takes quality into account more, the government could better regulate the enterprise, or competition ensures the right incentive, making privatization possibly the best policy. Only
industries in which quality assessment is rather difficult (e.g. education, health) or in which the goods cannot be sold on the marketplace (e.g. safety), would the trade-off not automatically favor privatization.

The second trade-off illustrated by Schmidt is between allocative and productive efficiency - the former being higher under public provision and the latter, under private provision. Given this trade-off, why was there a shift towards privatization? Did allocative efficiency become less important, or did productive efficiency gain more importance? First of all, allocative efficiency might be accomplished by ways other than public provision. As Schmidt states, if by means of competition, the social benefit of provision becomes smaller, there is less reason for public provision. Competition can even be achieved on a network, by means of right access pricing. Thus, through developments in access pricing, competition can be introduced to reduce the social benefit of production and increase the scope for privatization. Another reason for allocative efficiency to become less of an issue is through the introduction of a comparable good or service (e.g. mobile phones). Finally, improvements in regulation or contracts might ensure a certain degree of provision that satisfies the desired allocative efficiency. Achieving higher productive efficiency, without lowered allocative efficiency is something a government would always opt for.

Schmidt illustrates another trade-off that the government faces once the production is privatized. To induce truth-telling, the government must decide between paying a higher subsidy if a good state of the world is reported or it can distort the production in the bad state of the world. It trades off ex post efficiency and costly subsidies. Improvements in monitoring by the regulator would lower the information rent of the enterprise and make privatization more attractive given the incentive of the private manager to invest in cot innovation.

Armstrong and Sappington show a trade-off between different industry designs, by comparing the expected pay-offs. Depending on characteristics of the industry, one is preferred above the other. The monopoly is preferred if prices are sufficiently elastic and if correlation between two enterprises in a hypothetical duopoly is not perfect. The duopoly is preferred if correlation between the two parties in the duopoly is perfect, if demand is inelastic, and if the difference between the high and low cost is sufficiently close to zero. Franchise bidding outperforms a regulated monopoly in all situations in the model and outperforms the duopoly if the correlation is equal to \( \frac{1}{2} \). Armstrong and Sappington note that the outcome of the trade-off depends on the strength of the regulator and the form of competition between the two enterprises, but franchise bidding does have potential drawbacks. Another trade-off discussed in their paper is that between rent and efficiency. The enterprise will operate efficiently, operating at minimum costs and satisfying the need and desires of all customers, if it is awarded substantial rent. The reward for operating efficiently would most likely be too generous and provide the enterprise with significant rent and thereby reduce the consumers’ net benefit.
3.2.2 Sub Questions

In line with the main research question, some additional sub questions need to be answered. The previous part showed that the government has to decide on certain trade-offs. Having trade-offs implies that given certain characteristics of an industry or sector, nationalization, liberalization or privatization is preferred. The sub-question “When does it pay to liberalize and/or privatize?” tries to identify these characteristics. The final sub-question, “Why does it pay to liberalize and/or privatize?” tries to align the main arguments in favor of liberalization and/or privatization.

When does it pay to liberalize and/or privatize? In other words, what characteristics should the production process, the government, and the regulator have in order for the liberalization and/or privatization policy to be successful? By “successful”, it refers to achieving a better outcome than that was realized before liberalization and/or privatization policy, considering that not all characteristics need to hold for the liberalization or privatization policy to be a success. This part will independently discuss certain characteristics, taking the others as given.

First, the production process must have certain characteristics for liberalization or privatization to be affective. Hart et al. assumed some of these characteristics that influence the success of privatization. Privatization pays off if quality improvements play an important role in the sector. It is also preferred if the negative effect of a cost innovation on quality is low. According to Schmidt, privatization pays-off if the cost-reducing investment plays a more important role. Next, privatization pays off if a manager's utility is more strongly affected by the distortion of production in the high cost state, since incentives are created with less distortion to the allocative efficiency. If distortion to the social benefit of production becomes smaller, in other words, allocative efficiency becomes less important. With respect to liberalization, (the duplication of) fixed costs play an important role. Liberalization will pay off according to Schmidt if fixed costs are low and marginal costs are high. Armstrong and Sappington claim that it pays off if industry scale economies are limited relative to consumer demand. Since liberalization introduces competition into a sector, liberalization pays off if competition pays off. As was discussed in the literature review, especially in industries without a natural monopoly, competition might enhance both allocative and productive efficiency. Hart et al. add that competition can reduce the negative effect of cost innovation on quality and might thus help privatization pay off.

Second, the government plays an important role in the success of liberalization and/or privatization. Hart et al. state that it is good to privatize a sector if the chance of patronage by the government is high. In addition, the more replaceable the public manager is, the more privatization pays off. If the government can more credibly threat to reduce production in the bad state of the world, privatization is effective according to Schmidt. Armstrong and Sappington state privatization pays off
more if the former SOE does not have a real task to redistribute wealth. Finally, as was discussed in the literature review, the objective of the government influences the pay-off of liberalization and/or privatization. If the government uses its power in SOE for its own interest, the introduction of competition by means of liberalization or privatizing might pay off. By introducing competition, the power of the government becomes limited. A privatized enterprise is more difficult or costly to abuse by the government. However a note to consider is that a government that abuses its power might not be very willing to let go of its power.

Finally, in order for liberalization and/or privatization policies to pay off, the quality of the regulator plays a crucial role. Armstrong and Sappington state that liberalization is a desired policy if the regulator is not a very strong one, for example due to limited resources, information, and/or instruments. On the other hand, privatization without liberalization asks for strong regulation. It would pay off to privatize if the regulator has the resources, information, and instruments to regulate. Another issue in relation to regulation illustrated by the model by Armstrong and Sappington is that if regulation is expensive, liberalization becomes more attractive.

The second sub question is “Why does it pay to liberalize and/or privatize?” In other words, what is the reason for and the desired outcome of a liberalization and/or privatization policy?

First, one should ask why it would pay for a society or a government to privatize a former SOE. Hart et al. show two reasons why it might pay to privatize an industry. The private manager is believed to put more effort into cost innovation, lowering the cost of production. If the quality deterioration does not offset the cost reduction, total welfare will increase. In addition, the private manager is believed to put more effort in quality innovation if it is compensated for this. Again, if the increase of quality is not offset by extra costs, total welfare is increased. The model by Schmidt shows that privatization pays off, since the private manager will put more effort in affecting the state of the world. In the better state of the world, costs are lower. Armstrong and Sappington show that after liberalization or auctioning the right to produce, the likelihood of a low cost producer is higher, increasing the expected welfare. In addition, selling the right to produce using franchise bidding (Armstrong and Sappington) or an auction (Schmidt) can increase government revenue. Since it is the government who decides on privatization, this might be a reason why it pays for them. Finally, the model by Schmidt shows that besides government revenue, privatization might be a cost-saving policy. If the industry is privatized, the government can apply a hard budget constraint.

There are other reasons why liberalization might pay off. First of all, the introduction of competition might induce higher productive and allocative efficiency. Next to this, although bearing ambiguous results, Armstrong and Sappington state that competition might give producers a greater incentive to reduce operating costs. Innovation might also be a way to become more competitive, and
liberalization might induce producers to innovate as well. The model by Armstrong and Sappington also show that the need for regulation is reduced by competition. In a competitive industry, enterprises cannot abuse their market power to set prices too high. The final reason why liberalization pays off, as illustrated by Armstrong and Sappington, is higher expected welfare, compared to a regulated monopoly.
Developments in telecommunications are believed to have had a positive impact on economic growth and development in past decades. The development of the Internet has especially added to productivity growth in the past two decades. The OECD (2002) stated that one-third of the increase in productivity in France, Germany, and the United Kingdom from 2001 to 2011 will be due to the introduction of broadband technologies, thus illustrating the importance of (fast) internet. Newer technologies developed depend on high-speed Internet, and the EU believes this trend will continue in the coming years. In March 2010, the EU launched the Europe 2020 strategy, a strategy to exit the crisis and prepare the EU for the challenges of the next decade. Part of this strategy was the Digital Agenda, whose overall aim “is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications (EC, 2010, pp.3).” Successful implementation of this strategy is believed to spur innovation, economic growth, and improvements in daily life for both citizens and businesses. The Internet, especially at fast and ultrafast speeds, plays a central role in this strategy. The role of the Internet is summarized by the EC (2010a) as “We need very fast internet for the economy to grow strongly and to create jobs and prosperity, and to ensure citizens can access the content and services they want (pp. 19).” The strategy seeks to ensure that by 2020 the following two objectives are achieved. First, all Europeans have access to Internet of speeds of 30 Mbps or above. Second, 50% or more of European households subscribe to Internet connections above 100 Mbps. For the latter to be achieved, NGA networks need to be deployed. In 2009, only 1% of European citizens had “Fiber to the Home (FTTH)”, compared to 12% in Japan and 15% in South Korea (EC, 2010a). In the Digital Agenda for Europe, the EC mentions that without strong public intervention, there is a risk of sub-optimal outcomes. Spillovers created by NGA justify intervention according to the EC. In this case study, government intervention in NGA will be discussed.

All four characteristics identified by Mason and Valletti (2001) of natural monopolies apply to NGA. Like telecommunications and Broadband Internet, investment costs are high and marginal cost of operation is low. Each component of NGA should be able to deliver the high speed Internet, components dependence. Positive externalities also apply to NGA. Although slower Internet is already available, the value of NGA is also determined by its content, which depends on the number of users. The final point is the social obligation of providing access to all. This point is illustrated by the objective set by the EC. The fact that NGA is a natural monopoly complicates the role of the government and private parties in the

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5 Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions – A Digital Agenda for Europe - COM(2010) 245.
6 “FTTH of fibre-to-the-home is an access network consisting of optical fibre lines in both the feeder and the drop segments of the access network (EC; 2010b; 41).”
provision of NGA. Some issues in relation to being a natural monopoly and the role of the government and private parties will be discussed below. First, the role of the government will be discussed.

According to Gómez-Barroso and Martínez (2005), a government should intervene in a market if there are “market failures” that justify this intervention. The authors looked at market failures in advanced telecommunications services and found several arguments for intervention. First Gómez-Barroso and Martínez (2005) conclude that NGA can be considered a mixed good and the Internet can indeed be considered a merit good, whether or not NGA is depends on application development. Second, high-speed Internet provides positive externalities not taken into account by the market. Third, given that duplication of the network is not welfare enhancing under most circumstances and the prominent role of regulation, failure of competition can be concluded. Another market failure would be that the market for NGA is considered incomplete, not restrained to the impossibility of choosing the suppliers, but by not providing the service at all for a given set of customers. The final argument relates to income redistribution or equity. Some goods are considered to be accessible to all on equity grounds. Gómez-Barroso and Martínez (2005) conclude, “Their importance seems to be sufficient to reach everyone based on an equity criterion (pp. 498).” Given these arguments, if the market fails to provide the good, there is ample room for government intervention. According to the EC (2010b) the benefits of a society appear to be greater than the incentives of the private suppliers of the Internet. Stimulating investment beyond the current market-driven development is needed to achieve the broadband target.

Taken together, the current development of NGA, the strategy of the European Union, and the arguments illustrated by Gómez-Barroso and Martínez (2005), government intervention in the deployment of NGA seems necessary. Given issues on public ownership or control illustrated throughout this thesis and the ambiguous outcome discussed in the literature review between a public monopoly or a regulated private monopoly, the role of the government after the deployment is unclear. Given its active role in the promotion of NGA, one could assume that the EC tackles some of the issues in relation to government involvement in NGA. In the next section, EC policy and recommendations are discussed.

The EC published three documents in relation to the deployment of NGA and possible issues arising from state intervention. It published a communication on the guidelines of state aid (EC, 2009), a communication on investing in broadband (EC, 2010c), and recommendations on access to NGA (EC, 2010b). The first issue the EC had to tackle was the problem created by article 87 on state aid of the European Treaty. This article forbids state aid or allocating resources in any form whatsoever that distorts or threatens to distort the well-functioning of the market. In its communication (2009) the EC relaxed some of its requirements with respect to state aid for NGA. In its communication (2010c) on investing in broadband, it outlined some arguments for state intervention in the broadband and/or NGA market. The recommendation also discussed different issues in relation to investment in the Internet. The final
recommendation tackles the issue of access regulation, an issue that becomes relevant after the deployment of the network. However, before initial investment, National Regulatory Authorities (NRA) should communicate clear access policies. When making an investment decision, the party involved should be able to determine the cost of investment as well as the future benefits. Access pricing plays an important role in future benefits, making regulation one of the most important aspects of a policy that promotes the deployment of a NGA network. One important aspect not discussed by the EC is the role of the government after investment if it participates in the deployment process. At the end of this part some recommendations about the role of the government based on the literature review and the papers discussed will be given. Given its importance, regulation will be discussed in more detail below, using the four issues of regulation discussed in the literature review.

First, it is important for a government or an NRA to decide on how to determine the cost of investment if a private party participates or invests in NGA, since according to the EC “Investment risk should be rewarded by means of a risk premium incorporated in the cost of capital (EC, 2010b, pp. 45).” The EC (2010b) proposes an NRA to estimate investment risk by taking into account various factors of uncertainty. In addition, the NRAs should review the situation at regular intervals and if necessary adjust the risk premium. This view by the EC illustrates the difficulty of determining the cost of investment, as discussed in the literature review, complicating the investment decision of private parties and being a possible explanation for the lack of investment in NGA thus far. The second issue discussed in the literature review was access pricing. The EC simply states “access prices reflect the costs effectively borne by the Significant Market Power operator, including the consideration of the level of investment risk (EC 2010b, pp. 36),” the Significant Market Power is the investing party. This recommendation seems to overlook different aspects of access pricing. For example, the point made by advocates of the ECPR that the access price should incorporate the lost profits; otherwise less efficient firms may enter the market. The lack of clarity by the EC might again reduce the incentive of private parties to invest. The next issue faced by an NRA is that of participation in the downstream market. The owner of the network might abuse its monopoly power to gain market share in the downstream market. The owner of the network might abuse its monopoly power to gain market share in the downstream market. There is a considerable chance that the investing party will become active after investment or is already active in the telecommunications market, thus having the possibility to abuse its upstream market power. The EC did not mention this issue. Given the importance and implications for the investing party, it should have communicated this issue. The final issue discussed in the literature review was the future of regulation. Development in regulation like ILT could be a part of a policy towards the creation of a NGA network. If an enterprise is given the incentive by ILT to invest in its own network, it should be stimulated by the government to invest in NGA. It can support this by direct public investment or public financing (2010c). By not considering this option, the EC might leave an opportunity unused. Given the important role of
regulation in the discussed issues, the EC should have more clearly stated possible solutions and its opinion on these issues, in order for the investors to have the correct investment incentives and to take away uncertainties.

If the government decides to invest in an NGA, after completion, it must decide between public or private ownership and/or management. The role of ownership might play a role in the well-functioning of an enterprise. Under public control a politician might use its powers to pursue political objectives (Boycko et al., 1996). While under private management, the manager might want to abuse its market power (e.g. set monopoly prices). The problem of government ownership can be complicated if a government is malevolent, which is implied by most literature. It could contract out the deployment of the network to a friendly and expensive enterprise in return for bribes. It could also, after completion, decide on cross-subsidization, from producers to consumers, given the latter’s voting power. Both are possible examples of a government not acting in line with total welfare. However, in the case of NGA, the decision is between no NGA at all or NGA deployed by a malevolent government. After completion, the optimal decision for a government would be to get as many buyers as possible, in line with total welfare. In addition, as illustrated by Hart et al. (1999), the ease of quality assessment can influence the choice of the consumer. If voters can assess the price and quality of the Internet, given the characteristics of and the knowledge about the good reasonable assumptions, acting malevolently could affect voting decisions and have detrimental consequences on the government. The room for a government to behave malevolently is thus limited by its optimal decision and transparency of the market. With respect to governance, the difference between public and private control are ambiguous, especially given the fact that takeovers and bankruptcy are not credible threats even if the enterprise is privatized. The former could be an option, but possibly blocked by the government that did the initial investment. Given the high investment costs and the external benefits, the government will not allow a provider of NGA to go bankrupt. Schmidt (1996) illustrates this in his model by stating that the higher the social benefit of a good, the less likely a cut back in subsidy. Another model that could illuminate this issue between a public monopoly and a regulated private monopoly is that by Hart et al. (1999). They claim a public manager to be more willing to invest in quality and cost innovation. If quality innovation is important, private management is preferred. However if cost innovation deteriorates quality too much, public control is preferred. Internet quality can be assessed by speed and reliability, both visible to consumers. As Hart et al. (1999) claim, if the good is sold directly to the market and the consumers can assess the quality, the producer will take the quality deterioration into account in its objective function. Given the market characteristics, based on the model by Hart et al. (1999), private control outperforms public control. Based on Schmidt’s (1996) model, the conclusion would not automatically favor private control. Given that marginal costs are low and the government cannot credibly threat a cutback in subsidies, there is less of a difference between public and
private control. Even if the monetary impact of a cutback could be made more severe, the threat of lowered subsidy would not be credible since the government wants the good to be provided. Otherwise it would not have invested in the network. Armstrong and Sappington (2006) advise on liberalization policies and state that entry assistance is generally not recommended, since it is difficult to determine the appropriate level of entry assistance.

Given the literature on privatization, the role of the government after the deployment of the NGA network is ambiguous. What is made clear by the literature review and partly by recommendations by the EC is that the correct investment incentives should be created by means of clear regulation and communication. The EC discussed some issues in relation to investment and regulation; however it failed to cover all relevant aspects.
Part 4: Conclusion

Liberalization and privatization have been a topic of discussion for decades now. The track record shows a move towards liberalization and privatization in ever more sectors (Megginson and Netter, 2001). However, some sectors remain (partly) under state control.

Liberalization, the introduction of competition, can reduce, or even replace, the need for regulation. Abuse of market power will be punished by consumers and will result in less market share. In addition, competition might influence the incentives of the owner or the manager positively. However, even if competition is introduced, many obstacles remain. Consumers might face switching costs or lack the correct information about prices and quality. Goods might not be homogenous enough. Entrants might lack the knowledge to effectively compete with the incumbent. Competition is not severe and competing enterprises might form a cartel, reintroducing the need for regulation. In some industries which are, for example, natural monopolies, introducing competition might be a difficult task. By letting a competitor use the incumbent network, competition can be created. However, the need for strict regulation remains. Taken together, liberalization is a good policy. If there is ample room for competition, the regulator is able to regulate the market, switching and search costs are reduced, and access can be priced correctly.

Privatization of certain sectors remains a discussion between opponents and proponents. Reasons for this ongoing discussion are mainly about quality and equality. Hart et al. (1999) best illustrate the possible danger of privatization, an increased incentive to cost innovate without taking quality deterioration into account. Given that the government wants to maximize social welfare, the public manager does take quality deterioration into account. The second issue is about equality. Certain goods are considered to be of such importance that they should be available to all. If the market fails to provide the “basic” service, the government should intervene. Developments in regulation created possibilities to let the market provide the good, regulated by the government. However, some services remain to be provided publicly. Finally, certain sectors are not considered suitable for privatization, given the power that ownership brings.
Part 5: Appendices

Appendix 1

(A) Expected pay-off of the government (nationalization)

The pay-off of the government is given by,
\[ V_n = b(y_n) + r(y_n) - c(y_n, \Theta) - w_n \]

Putting all variables and expectations about the state of the world in this pay-off you get:
\[ V_n = q(e_n) \cdot [ b(y_1n) + r(y_1n) - c(y_1n, \Theta_1) ] + (1-q(e_n)) \cdot [ b(y_2n) + r(y_2n) - c(y_2n, \Theta_2) ] - e_n \cdot u(y_1n) - (1-q(e_n)) \cdot u(y_2n) + U \]

By bundling all \( q(e_n) \) and \( 1-q(e_n) \) and removing all brackets you get:
\[ V_n = q(e_n) \cdot W(y_1n, \Theta_1) + (1-q(e_n)) \cdot W(y_2n, \Theta_2) - U - e_n \]

With \( W(y, \Theta) = b(y) + r(y) - c(y, \Theta) \) you get
\[ V_n = q(e_n) \cdot W(y_1n, \Theta_1) + (1-q(e_n)) \cdot W(y_2n, \Theta_2) - U - e_n \]  \hspace{1cm} (6)

(B) Proposition 2:

To simplify notation, denote \( y_i = y_{ip} (\hat{e}), s_i = s_{ip} (\hat{e}) \) and \( q = q(\hat{e}), i \in \{ 1, 2 \} \).

Formula (7) need to be solved

\[ \text{Max } y_{ip}, s_{ip} \{ q \cdot [b(y_1) - s_1] + (1-q) \cdot [b(y) - s_2] \} \]

Subject to \( y_1, y_2, s_1, s_2, \geq 0 \)

For the private manager to have the correct incentives to report the true state of the world the following incentive constraints need to hold,
\[ s_1 + r(y_1) - c(y_1, \Theta_1) \geq s_2 + r(y_2) - c(y_2, \Theta_1) \] \hspace{1cm} (IC1)
\[ s_2 + r(y_2) - c(y_2, \Theta_2) \geq s_1 + r(y_1) - c(y_1, \Theta_2) \] \hspace{1cm} (IC2)

The private manager will only produce is the profit is non-negative, the following participation constraints must hold,
\[ s_1 + r(y_1) - c(y_1, \Theta_1) \geq 0 \] \hspace{1cm} (PC1)
\[ s_2 + r(y_2) - c(y_2, \Theta_2) \geq 0 \] \hspace{1cm} (PC2)
(a) If $y_2 > 0$, given (2.3) PC1 is implied by IC1 and PC2. PC2 is positive, so the right sight of IC1 must be bigger than zero (since $\Theta_2$ is replaced by $\Theta_1$) and therefore PC1 must hold.

(b) PC2 must hold with equality, $s_2 + r(y_2) - c(y_2, \Theta_2) = 0$. Otherwise there exists an $\varepsilon > 0$ such that $s_1 = s_1 - \varepsilon$ and $s_2 = s_2 - \varepsilon$ satisfy all constraints and have a strictly higher pay-off for the government. Then the government could lower the subsidy with PC2 still holding. Thus,

$$s_2 = c(y_2, \Theta_2) - r(y_2) \quad \text{(A1)}$$

(c) First, if $y_2 > 0$, PC1 is not binding since the right hand side of IC1 is not equal to zero. Then there is an $\varepsilon > 0$ such that $s_1 = s_1 - \varepsilon$ that satisfies IC1 and PC1. Second, if $y_2 = 0$, $c(y_2, \Theta_2) = c(y_2, \Theta_1) = r(y_2) = 0$. As a result $s_2 = 0$ (given A1) reducing IC1 to PC1, which must be binding, if not there is an $\varepsilon > 0$ such that $s_1 = s_1 - \varepsilon$.

Replacing $s_2$ with A1 in IC1 gives,

$$s_1 + r(y_1) - c(y_1, \Theta_1) \geq c(y_2, \Theta_2) - r(y_2) + r(y_2) - c(y_2, \Theta_1)$$

Rearranging gives

$$s_1 = c(y_2, \Theta_2) - c(y_2, \Theta_1) + c(y_1, \Theta_1) - r(y_1) \quad \text{(A2)}$$

Replacing $s_1$ and $s_2$ in the simplified version of (7) gives,

$$\max y_1 \quad \{q \cdot [b(y_1) - c(y_2, \Theta_2) - c(y_2, \Theta_1) + c(y_1, \Theta_1) - r(y_1)] + (1-q) \cdot [b(y_2) - c(y_2, \Theta_2) - r(y_2)]\}$$

$$= \{q \cdot [b(y_1) - c(y_2, \Theta_2) + c(y_2, \Theta_1) - c(y_1, \Theta_1) + r(y_1)] + (1-q) \cdot [b(y_2) - c(y_2, \Theta_2) + r(y_2)]\}$$

Taken the derivative of this function with respect to $y_1$ and $y_2$ and set this equal to zero gives,

$$q b_y(y_1) - q c_y(y_1, \Theta_1) + q r_y(y_1) = 0$$

$$b_y(y_1) - c_y(y_1, \Theta_1) + r_y(y_1) = 0 \quad \text{(A3)}$$

and

$$- q c_y(y_2, \Theta_2) + q c_y(y_2, \Theta_1) + (1-q)b_y(y_2) - (1-q)c_y(y_2, \Theta_2) + (1-q)r_y(y_2) = 0$$

$$b_y(y_2) + r_y(y_2) - c_y(y_2, \Theta_2) - \frac{q}{1-q} [c_y(y_2, \Theta_2) - c_y(y_2, \Theta_1)] = 0 \quad \text{(A4)}$$

The maximization problem could have a corner solution if there is no $y_2 > 0$ that satisfies A4. Given that $y_1 = y_{1n}$, $s_1 = c(y_{1n}, \Theta_1) - r(y_{1n})$, $y_2 = s_2 = 0$ satisfies all constrains and have a positive outcome. The only candidate for a corner solution is $y_2 = s_2 = 0$ and $y_1, s_1 > 0$. This corner solution would outperform the
interior solution if the outcome is greater than that of the interior solution. The interior solution is given by the maximization problem (given that both y_1, s_1, y_2, and s_2 > 0) and the corner solution by the maximization problem with y_2 and s_2 equal to zero. The latter would be a better outcome if it would be greater than the former, illustrated below.

\[
q \cdot [b(y_1) - c(y_2, \Theta_2) + c(y_2, \Theta_1) - c(y_1, \Theta_1) + r(y_1)] + (1-q) \cdot [b(y_2) - c(y_2, \Theta_2) + r(y_2)] \leq q \cdot [b(y_1) - c(y_1, \Theta_1) + r(y_1)]
\]

Rearranging gives:

\[
b_y(y_2) + r_y(y_2) - c_y(y_2, \Theta_2) - \frac{s}{1-q} [c_y(y_2, \Theta_2) - c_y(y_2, \Theta_1)] \leq 0 \tag{A5}
\]

Thus the corner solution would outperform an interior solution if A5 holds.

To prove IC2 holds, A1 and A2 are put into IC2 resulting in:

\[
c(y_2, \Theta_2) - c(y_2, \Theta_1) + c(y_1, \Theta_1) - r(y_2) + r(y_1) - c(y_1, \Theta_2) > 0
\]

\[
0 > c(y_2, \Theta_2) - c(y_2, \Theta_1) + c(y_1, \Theta_1) - c(y_1, \Theta_2)
\]

\[
0 > [c(y_1, \Theta_1) - c(y_2, \Theta_1)] - [c(y_1, \Theta_2) - c(y_2, \Theta_2)]
\]

Given that y_1 > y_2 and that the marginal costs are higher in the bad state, this equation must hold.

(C) Outside option utility:

\[
\pi_p(\Theta_1 \mid \hat{\epsilon}) = s_{1p}(\hat{\epsilon}) + r(y_{1p}(\hat{\epsilon})) - c(y_{1p}(\hat{\epsilon}), \Theta_1)
\]

Given the subsidy given in proposition two, this formula can be rewritten as:

\[
\pi_p(\Theta_1 \mid \hat{\epsilon}) = [c(y_{1p}(\hat{\epsilon}), \Theta_1) + c(y_{2p}(\hat{\epsilon}), \Theta_2) - c(y_{1p}(\hat{\epsilon}), \Theta_1) - r(y_{1p}(\hat{\epsilon}))] + r(y_{1p}(\hat{\epsilon})) - c(y_{1p}(\hat{\epsilon}), \Theta_1)
\]

\[
= c(y_{2p}(\hat{\epsilon}), \Theta_2) - c(y_{2p}(\hat{\epsilon}), \Theta_1) > 0 \tag{11}
\]

(D) Expected pay-off of the private owner:

The expected pay-off of the private owner is set equal to zero by the government. In order to find z (15), the expected pay-off should be calculated. The pay-off of the private owner is given by,

\[
P = r(y_p) + s_p - c(y_p, \Theta) - w_p - z
\]

The expected pay-off is the probability of a revenue and a subsidy in either the good or the bad state of the world. Below the expected pay-off is given by the probability times the revenue minus the subsidy and the cost, the wage and the auction price are extracted as well. Given that \(\hat{\epsilon} = e_p\),

\[
P = q(e_p) \cdot \{ r(y_{1p}(e_p)) + [c(y_{1p}(e_p), \Theta_1) + c(y_{2p}(e_p), \Theta_2) - c(y_{1p}(e_p), \Theta_1) - r(y_{1p}(e_p))] - c(y_{1p}(e_p), \Theta_1) \} + (1 - q(e_p)) \cdot \{ r(y_{2p}(e_p)) + [c(y_{2p}(e_p), \Theta_2) - r(y_{2p}(e_p))] - c(y_{2p}(e_p), \Theta_2) - w_p - z
\]
P = q(e_p) \cdot \{ r(y_{1p}(e_p)) + c(y_{1p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_2) + c(y_{2p}(e_p), \Theta_1) - r(y_{1p}(e_p)) - c(y_{1p}(e_p), \Theta_1) \} + (1 - q(e_p)) \cdot \{ r(y_{2p}(e_p)) + c(y_{2p}(e_p), \Theta_2) - r(y_{2p}(e_p)) \} - w_p - z

P = q(e_p) \cdot \{ c(y_{2p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_1) \} - w_p - z

Setting profits equal to zero, gives a z of

z = q(e_p) \cdot \{ c(y_{2p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_1) \} - w_p \quad (15)

(E) Expected pay-off of the government (privatization)

Formula (16) gives the pay-off function of the government, this formula can be found by putting in the relevant variables in the formula that gives the pay-off of the government,

V_p = b(y_p) - s_p + z

Putting all variables in this pay-off you get:

V_p = q(e_p) \cdot \{ b(y_{1n}) - [ c(y_{1p}(e_p), \Theta_1) + c(y_{2p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_1) - r(y_{1p}(e_p)) ] + (1-q(e_p))[b(y_{2p}) - \{ c(y_{2p}(e_p), \Theta_2) - r(y_{2p}(e_p)) \} + \{ q(e_p) \cdot \{ c(y_{2p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_1) \} - \{ e_p - q(e_p) \cdot u(y_{1p}(e_p)) - (1-q(e_p) \cdot u(y_{2p}(e_p)) + U) \}

Rearranging gives:

V_p = q(e_p) \cdot \{ b(y_{1n}) - [ c(y_{1p}(e_p), \Theta_1) + c(y_{2p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_1) - r(y_{1p}(e_p)) ] + (1-q(e_p))[b(y_{2p}) - \{ c(y_{2p}(e_p), \Theta_2) - r(y_{2p}(e_p)) \} + \{ q(e_p) \cdot \{ c(y_{2p}(e_p), \Theta_2) - c(y_{2p}(e_p), \Theta_1) \} - \{ e_p - q(e_p) \cdot u(y_{1p}(e_p)) - (1-q(e_p) \cdot u(y_{2p}(e_p)) + U) \}

By bundling all q(e_p) and (1-q(e_p) and removing all brackets you get:

V_p = q(e_p) \cdot \{ b(y_{1n}) - c(y_{1p}(e_p), \Theta_1) + r(y_{1p}(e_p)) + u(y_{1p}(e_p)) + (1-q(e_p))[b(y_{2p}) - c(y_{2p}(e_p), \Theta_2) + r(y_{2p}(e_p)) + u(y_{2p}(e_p))] - e_p - U

With W(y, \Theta) = b(y) + r(y) + u(y) - c(y, \Theta) you get
\[ V_p = q(e_p) \cdot W(y_{1p}, \Theta_1) + (1-q(e_p))W(y_{2p}(e_p), \Theta_2) - c_p - U \]  

(16)

**Appendix 2**

(A) **Social welfare (pp. 332)**

\[ v(p_i) - \left[ 1 + \lambda \right] T_i + \alpha q(p_i)p_i - c_i - F + T_i \]

= \[ w_i(p_i) - \left[ 1 + \lambda - \alpha \right] U_i \]

\[ w_i(p_i) - \left[ 1 + \lambda - \alpha \right] U_i \]

\{v(p_i) + \left[ 1 + \lambda \right] [q(p_i)p_i - c_i - F] \} - \{ \left[ 1 + \lambda - \alpha \right] [q(p_i)p_i - c_i - F + T_i] \}

\{v(p_i) + \left[ 1 + \lambda \right] [q(p_i)p_i - c_i - F] \} - \{ \left[ 1 + \lambda - \alpha \right] [q(p_i)p_i - c_i - F + T_i] + \lambda [q(p_i)p_i - c_i - F + T_i] - \alpha [q(p_i)p_i - c_i - F + T_i] \}

By removing the brackets and extracting both formulas you get

\[ v(p_i) - \lambda T_i + \alpha [q(p_i)p_i - c_i - F + T_i] \]

= \[ v(p_i) - \left[ 1 + \lambda \right] T_i + \alpha [q(p_i)p_i - c_i - F + T_i] \]

(B) **Footnote 22**

\[ \frac{1}{2}v(c_L) + \frac{1}{2}v(c_H) + [1 - \alpha] \Delta \]

= \[ \left[ v(c_L) + v(c_H) + [1 - \alpha] \Delta \right] / 2 \]

The convexity of \( v(\cdot) \) implies that (5) is at least,

\[ v(c_L) + v(c_H) + [1 - \alpha] \Delta q(c_H) / 2 \]

Formula (5) minus (4) gives,

\{ \left[ v(c_L) + v(c_H) - [1 - \alpha] \Delta q(c_H) / 2 \right] - \left[ v(c_L) + [1 - \rho] v(c_H) + \alpha [1 - \rho] \Delta q(c_H) \right] \}

= \{ -\frac{1}{2} v(c_L) + [1 - \rho] v(c_H) + [1 - \alpha] / 2 - \alpha [1 - \rho] \Delta q(c_H) \}

= \{ [1 - \rho] [v(c_L) + [1 - \rho] v(c_H)] / 2 - [1 - \alpha] / 2 - \alpha [1 - \rho] \Delta q(c_H) \}

\{ [1 - \rho] [v(c_L) - v(c_H)] / 2 - [1 - \alpha] / 2 + \alpha [1 - \rho] \Delta q(c_H) \}

Because this expression is non-decreasing in \( \alpha \), it is at least

\[ [1 - \rho] [v(c_L) - v(c_H)] / 2 - \Delta q(c_H) / 2 \]

This term is positive when demand is sufficiently elastic.

(C) **Footnote 30**

The difference between (4) and (6) is,

\[ \frac{\rho}{2} v(c_L) + [1 - \rho / 2] v(c_H) + \alpha [1 - \rho] \Delta q(c_H) - [v(c_H) + \frac{1}{2} \alpha \Delta q(c_H)] \]

\[ \frac{\rho}{2} v(c_L) + [1 - \rho / 2] v(c_H) + \frac{1}{2} \alpha \Delta q(c_H) \]
\[ \frac{\rho}{2} v(c_L) + [-p/2]v(c_H) + [\frac{1}{2} - p] \alpha \Delta q(c_H) \]
\[ [v(c_L) - v(c_H)] \frac{\rho}{2} + [\frac{1}{2} - p] \alpha \Delta q(c_H) \]

Given the convexity of \( v(\cdot) \), \( v \) is higher in a low cost state, implies \( [v(c_L) - v(c_H)] \) to be positive and the expression is at least,
\[ \frac{\rho}{2} - \alpha [p - \frac{1}{2}] \Delta q(c_H) \]

This function is nonnegative at \( \rho = 1 \) and this expression is nonnegative because it is a decreasing function of \( \rho \).
References

Books:


Articles:


