WPS 1698

POLICY RESEARCH WORKING PAPER 1698

Regulatory Structure and Risk and Infrastructure Firms

An International Comparison

Ian Alexander
Colin Mayer
Helen Weeds

How does choice of regulatory regime affect the level of shareholder risk in regulated companies? A new study shows that investors bear the greatest nondiversifiable risk with price caps and the least with rate-of-return regulation.

The World Bank
Private Sector Development Department
December 1996

Summary findings

Evidence about how choice of regulatory regime affects the level of shareholder risk for the regulated company has traditionally focused on studies in the United Kingdom and the United States. Broad comparisons of price-cap-based regimes (as practiced in the United Kingdom) with rate-of-return regulation (as practiced in the United States) show price-cap-based regimes to be associated with higher levels of shareholder risk (as measured by the beta value) than rate-of-return regulation is. But so few countries were compared that other factors could be at work.

Alexander, Mayer, and Weeds broaden the investigation by studying more countries (including regulated utilities in Canada, Europe, and Latin America), doing a sectoral comparison to control for some risks related to factors other than the regulatory regime, and use narrower classifications for regulatory regime. They also look at such recent evidence as the move from relatively pure price caps in the U.K. electricity sector to a mixed-revenue/price-cap-based system.

The results of their survey are in line with results from earlier research. They find that investors bear the greatest nondiversifiable risk with price caps and the least nondiversifiable risk with rate-of-return regulation.

Once governments and regulatory agencies quantify how the choice of regulatory regime affects the average level of shareholder risk, they can weigh the relative merits of various options not only in terms of incentives for cost reduction but also in terms of the allowable level of investor profit.

This paper — a product of the Private Sector Development Department — is part of a larger effort in the department to improve understanding of the impact of regulation on infrastructure firms. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Randee Schneiderman, room G4-039, telephone 202-473-0191, fax 202-522-3481, Internet address rschneiderman@worldbank.org. December 1996. (60 pages)

Regulatory Structure and Risk and Infrastructure Firms

An International Comparison

Ian Alexander[1]
Colin Mayer[2]
Helen Weeds[3]

Prepared for the Private Sector Development Department, Private Participation in Infrastructure Group

1 London Economics (tel. 44-171-446-8400)
2 Oxford Economic Research Associates (tel. 44-1865-251-142)
3 Merton College, Oxford University

Contents

1. Introduction

This paper investigates the impact of different regulatory systems on the degree of market risk to which a regulated company is exposed. Market risk, unlike firm-specific, idiosyncratic risk, cannot be eliminated by means of portfolio diversification and is therefore of great importance to risk-averse investors. A higher level of market risk must be compensated with higher average returns, thus an increase in non-diversifiable risk raises a company's cost of capital.

Price-cap regulation as practised in the UK is widely thought to provide superior incentives for cost efficiency compared with US-style rate-of-return regulation, benefiting consumers in the long run through lower prices. However, there is a possible drawback of price controls: in its pure form, this type of regulation takes no account of cost or demand changes related to the economic cycle, thus raising the degree of market risk to which a company is exposed. This 'regulatory risk' increases the company's cost of capital as investors require higher average returns in compensation. Ultimately, consumer prices must be raised so that the company can finance its investments, undermining the benefits in terms of lower prices from the efficiency gains associated with the system.

A few studies have attempted to compare the risks associated with the UK price-cap system and US rate-of-return regulation by studying the asset beta coefficients[1] of utility companies in these two countries. In general, US utilities are found to have much lower asset beta values, supporting the hypothesis that rate-of-return regulation involves lower regulatory risk. However, the observed difference in beta values may be due to a number of other factors and could, therefore, have little or nothing to do with alternative regulatory systems. The companies' operating environments are very different, with variations in the level of competition, market risks, geographical composition and non-utility activities.

[1] Section 2.2 explains the difference between asset betas and equity betas.

In order to study the effects of alternative regulatory regimes on market risk, it is necessary to control for all other factors that may influence beta values. However, it is not feasible to find two companies that are similar in every respect apart from their regulatory systems and such a straightforward comparison cannot be made. A study involving a large number of companies, operating in environments that are similar in some respects but different in others, should allow the effects of various factors to be disentangled so that the influence of regulation on the cost of capital may be inferred. This paper considers evidence from a large number of countries, covering Europe, North and South America, and the Pacific region.

Linked to the above question of considering the whole regime, is the problem of focusing on just one specific element of what is a complete financial package. Betas cannot be studied in isolation from the determination of the rate base, the way in which investment is treated, and several other financial factors. This analysis focuses on one specific element of regulation: namely, the systematic risk of utilities operating under different regulatory regimes.

Another benefit of this approach, aside from the US/UK studies, is that the UK can be compared with other newly-established systems of regulation. Even if the higher beta values of UK compared with US utilities can be attributed to regulatory risk, this may be because the US system is long established and enshrined in case law whereas the UK regime is new and subject to change (particularly by political influences), rather than the difference between rate-of-return and price-cap regulation per se. A comparison of recently privatised companies under alternative systems of regulation will allow a more accurate assessment of the effect of regime differences on the cost of capital.

There are also a few cases where a shift of regulatory regime occurs within a country. Such an example is useful as it automatically controls for market factors and should therefore provide an accurate picture of the influence of the regulatory regime on the cost of capital. Care must be taken, however, if other factors change at the same time: for example, a change in regulatory regime is often accompanied by liberalisation to increase competition in the sector. The data series must be split into two periods, corresponding to the two regulatory regimes, so that beta values can be calculated in each case. The date at which the break should be made is less clear than may be thought: if the change is anticipated, the shift in beta occurs at the announcement date, but if it takes time for investors to learn about the change and its effects, a later date may be appropriate.

The paper is organised as follows. Section 2 examines the measurement of a company's systematic risk, while the influence of alternative regulatory systems on this form of risk is considered in Section 3. Other factors affecting systematic risk and the cost of capital, which tend to obscure international comparisons of regulatory risk using beta values, are covered in Section 4. After outlining the possible approaches to analysing regulatory risk using international data in Section 5, calculated beta values and significant comparisons are summarised in Section 6. Section 7 reviews these results and considers what conclusions concerning regulatory risk may be drawn from this study.

There are four appendices to this paper. Appendix A1 considers the practical and conceptual difficulties that arise when estimating beta values. These problems are likely to be particularly serious when international comparisons are made, such that the beta estimates for different countries may be biased to differing extents or in different directions, which could result in distorted and misleading estimates. Appendix A2 contains details of asset beta values estimated for companies in a wide variety of countries and utility sectors. Appendix A3 illustrates the effect of varying the interval length of the data from which beta estimates are derived, and Appendix A4 examines confidence limits for beta estimates.

2. Market Risk and the Cost of Capital

2.1 Risk and return

Risk-averse investors holding a portfolio of assets wish to maximise their returns and minimise the degree of risk to which they are exposed. When a stake is held in a particular security, two types of risk must be considered. Firm-specific risk, unlike market risk, can be eliminated by portfolio diversification as changes in one share price will be offset by opposing movements in others. All securities, however, bear a degree of market risk which cannot be reduced by diversification. This form of risk is due to economy-wide factors which affect all securities simultaneously, although to varying degrees. For example, when an economy enters recession, most companies tend to be adversely affected, although the extent of the falls in turnover and profit will differ across firms. Because it cannot be reduced by diversification, investors demand greater returns in compensation for bearing a higher level of market risk, thus increasing the cost of capital.

The most commonly used measure of the undiversifiable risk associated with a company is its equity beta value. This measures the extent to which the returns on the security moves with the market as a whole. It is defined as follows:

$$\beta_{Ei} = \frac{\text{covariance } (r_i r_m)}{\text{variance } (r_m)}$$

where: β_{Ei} = beta value for security i;

r_i = return on security i;

r_m = return on the market portfolio.

2.2 Asset betas

The equity beta measures two types of risk; fundamental business risk and financial risk. When making comparisons across countries it is the fundamental risk that should be compared. This is measured through the asset beta. Comparable asset beta values can be calculated as follows:

$$\beta_{Ai} = \beta_{Ei}\,(1 - G_i) + G_{i.}\,\beta_{Di}$$

where: β_{Ai} = asset beta for security *i*;

β_{Ei} = equity beta for security *i*;

G_i = gearing ratio for security *i*.

B_{Di} = debt beta for security *i*.

Correction for gearing differences is particularly important in an international context. For example, firms in the United States tend to be highly geared relative to those in the UK due to differences in tax policy, institutional arrangements, industrial structure and business culture. Changes in gearing ratios over time must also be taken into account. If a company has experienced significant shifts in gearing (or any other factor), beta values must be calculated over fairly short periods, otherwise the resulting estimate is an average of several regimes and is not very meaningful. For this reason, the beta estimates in this paper have been produced using daily data over periods of a small number of years.

A general assumption that is applied is that $\beta_{Di} = 0$; this simplifies the calculation of the amount to:

$$\beta_{Ai} = \beta_{Ei}\,(1 - G_i)$$

The validity of the $\beta_{Di} = 0$ assumption can be questioned, especially when debt forms a large proportion of the capital structure of a company. [2] However, for the purposes of this study the standard assumption will be applied. The impact of non-zero debt betas is investigated further in Appendix 1.

[2] The debt beta can be estimated as $\beta_{Di} = \frac{\text{Debt premium}}{\text{ERP}}$.

3. The Effect of Regulatory Structure on Risk

The design of a regulatory system has a significant impact on the degree of systematic risk borne by a company. In general, there is a trade-off between incentives to improve efficiency and the degree of risk to which a company is exposed. A company will not strive to lower its costs unless it benefits from these reductions, but an inability to pass on cost changes to customers means that the company faces risk from uncontrollable cost fluctuations.

The impacts of alternative regulatory regimes may be illustrated by means of the following formula for a company's profits:

$$\Pi = PQ - C_x(Q) - C_n(Q)$$

where: Π = total profits;

P = unit price;

Q = quantity sold;

PQ = revenue earned;

C_x = exogenous (uncontrollable) costs, a function of quantity;

C_n = endogenous (controllable) costs, a function of quantity.

Table 3.1 shows the coverage of alternative regulatory regimes: in each case, some elements of the profit formula are controlled by regulation while others are ignored, so that the company has incentives to act efficiently. These are the 'pure' cases; hybrids can be designed to allow a different set of elements to be controlled.

Table 3.1: Profit elements covered by alternative regulatory regimes

Regulatory system	Covered by regulation	Ignored by regulation
Price cap	P	Q, C_x, C_n
Price cap with cost pass-through	P, C_x	Q, C_n
Revenue cap	PQ	C_x, C_n
Rate-of-return regulation	PQ, C_x, C_n	–

3.1 Price-cap regulation

Pure price-cap regulation involves the setting of prices over a long period of time such that a well-run company can expect to earn a fair rate of return, but the opportunity to earn higher profits gives it a greater incentive for efficiency. The system is forward-looking: reasonable cost levels must be forecast far into the future with a high degree of accuracy so that reasonable prices can be set. If this is done effectively, higher profits come from greater efforts by the company in reducing its cost levels below those which were reasonably expected and reflect the efficiency benefits of the system.

However, the desirable incentive properties of price-cap regulation have a cost in terms of the risk to which the company is exposed. The lack of automatic price adjustment mechanisms means that the company is exposed to all cost changes, including those over which it has no control. The risks involved in price-cap regulation are likely to be reflected in its cost of capital, as investors will demand a higher average rate of return in compensation for bearing additional risk.

In practice, price-cap regulation requires periodic price reviews in order to correct imbalances and eventually to pass the benefits of greater efficiency on to customers. At this point, the price-cap system bears some similarities to rate-of-return regulation, as one important consideration in the setting of prices is the rate of return that the company may be expected to earn at those levels.

When utility privatisations were carried out in the UK, a price-cap system, known as RPI – X, was introduced to regulate monopoly businesses. Under this regime, price levels are constrained to rise each year only by the amount of the retail (consumer) price index (RPI) minus an efficiency factor, X (or plus a K factor in the case of the water companies). Price-cap regulation was also introduced into the regulation of the US telecommunications company AT&T in 1989.

3.2 Price caps with cost pass-through

In recognition of the fact that certain cost elements are beyond the control of the regulated company and that exposure to such variables increases risk with no benefit in terms of incentives, most price-cap regimes allow for some cost pass-through. These mechanisms allow certain cost changes outside of the company's control to be passed on to customers without waiting for the next periodic price review. The level of risk borne by investors is lowered and the company's cost of capital should therefore be reduced, while the incentive properties of the system are not undermined as long as these cost elements are truly uncontrollable.

The only drawback for a regulated company is the possibility that cost pass-through may be carried out in an asymmetric manner and therefore expose the company to more, rather than less, risk. The regulator may use discretionary powers to recoup company profits when exogenous costs have fallen (say, lower construction costs due to the recent slump in the building industry), but then refuse to allow unavoidable cost increases to be passed on to customers. Thus, unless cost pass-through mechanisms are formalised so as to be fair to both the company and its customers, they could give rise to asymmetric risk and increase rather than lower beta values.

Most of the UK RPI – X formulae allow for certain uncontrollable cost elements to be passed through to customers. The water companies were initially allowed to pass through a variety of uncontrollable cost elements, such as rates, construction expenditure and the costs of compliance with new legal requirements, although the number and extent of these 'relevant changes of circumstance' has since been curtailed.[3] In the electricity industry, the regional electricity companies (RECs) are permitted to pass on any changes in electricity generation costs (although these are subject to separate controls). In Argentina, on the other hand, electricity companies are not entitled to automatic pass-through of fuel costs, presumably to give them an incentive to generate electricity as cheaply as possible and to respond to changes in relative fuel prices by altering the fuel mix.

3.3 Revenue caps

A revenue cap places a limit on the total income of the company rather than the per-unit price it charges. This system makes sense when the majority of a company's costs are fixed rather than increasing with the number of units sold. A company with high fixed costs that is under price-cap regulation faces excessive risk from demand fluctuations as these movements significantly affect the company's income but leave its cost level relatively unchanged. Thus, a revenue cap reduces the risk-exposure of the company without undermining cost incentives in any way (as long as the permitted revenue is not based on actual cost levels).

In the UK, Northern Ireland Electricity was privatised in June 1993 with a revenue-cap rather than a price-cap formula, while partial revenue caps have been introduced for the RECs and National Grid Company following periodic reviews. This change was due partly to arguments concerning the level of fixed costs in the industry, which the

[3] The companies that agreed to the changes were allowed a higher rate of return at the 1994 Periodic Review in recognition of the increased cost of capital arising from the loss of cost pass-through.

companies claim are not recouped through the existing fixed charges to customers, and also to correct a perverse incentive effect of the pure price-cap system. When company income is linked to the number of units sold while costs are mainly fixed, the companies have no incentive to encourage the efficient use of electricity. In fact, companies would gain by encouraging customers to waste power, in conflict with the energy-efficiency measures that they are supposed to encourage.

Several variants of revenue-cap regulation are available. A pure revenue cap sets a lump-sum annual amount without reference to actual cost elements, presumably based on historical levels. Alternatively, permitted revenues could be linked to an observable feature, such as the number of customers, to which fixed cost levels are related. This would allow changes in the exogenous factors driving fixed costs to be matched by changes in revenue without waiting for the next periodic review. Another possibility is the use of an hybrid price/revenue cap to mimic the balance between fixed and variable costs in the industry, so that incentives to increase sales are not distorted. This essentially is the approach now taken in the regulation of the UK electricity industry.

3.4 Rate-of-return regulation

Under pure rate-of-return regulation, a company is guaranteed an agreed rate of return on capital and its prices are adjusted as required to ensure that this rate is earned. In this situation, the company bears very little risk as any unforeseen costs can quickly be passed on to customers. Due to the lack of risk, the agreed rate of return can be fairly low and prices to customers can be kept down.

In practice, however, rate-of-return regulation is not this straightforward or free from risk. Price adjustment reviews, although frequent, do not allow instantaneous cost pass-through and the company is exposed to some risk. The rate-of-return system encourages over-capitalisation by companies, as allowable profits are directly related to the size of the capital base, and regulators in the United States have responded to this by disallowing (for regulatory purposes) any capital expenditure seen to have been imprudently incurred. The need for regulatory approval adds to investment risks, particularly if the regulator cannot precommit to including the asset in the capital base. If investors feel that they are not assured of gaining a return on their investment, a higher allowed rate of return will be required on projects that gain approval so that the *ex ante* expected rate of return is sufficient for funds to be obtained.

3.5 Hybrid and discretionary systems

3.5.1 Price/revenue cap

As explained in Section 3.3, revenue caps have recently been introduced into the regulatory formulae of the UK electricity industry to reflect the level of fixed costs in the industry. This has generally been achieved in conjunction with the existing price caps rather than by replacing them altogether. Hybrid price/revenue caps are now applied to the distribution businesses of the RECs in England and Wales, and to the transmission and distribution revenues of Northern Ireland Electricity.

A pure revenue cap should not be used in industries with a high level of marginal costs as, in this case, an increase in demand would raise costs with no matching increase in revenues, exposing the company to excessive risk. Rather, an hybrid price/revenue cap should be used to mimic the balance between fixed and marginal costs, so that the company is given the correct incentives to promote sales and is not exposed to excessive risks from demand fluctuations. Cost-efficiency incentives are maintained since the regulated company benefits in full from any cost-reducing activities it undertakes.

3.5.2 Price-cap/rate-of-return regulation

Most regulatory systems can be regarded as hybrids between pure rate-of-return and pure price-cap regulation, depending on the length of time that elapses between reviews and the degree of automatic cost pass-through. For example, the UK RPI – X price-cap system reviews prices approximately every five years and, in most sectors, allows pass-through of certain unavoidable costs. Discretionary powers may also be used to recoup excessive profits between periodic reviews, in effect, reducing the price-cap system to a rate-of-return regime. The ability of the regulator to claw back high profits exposes the regulated company to asymmetric risk, as high profit rates cannot be earned but there is no corresponding floor on the amount of losses that may be made.

To reduce the degree of asymmetric risk, it must be made clear that discretionary powers will be used to protect companies from excessive and unexpected cost increases, as well as to recoup excess profits, so that the companies' downside risks are also curtailed. For example, the water companies may press for an assurance that allowance will be made for the costs of complying with any additional environmental requirements which they may face in the future.

Explicit hybrid schemes may place a floor and a ceiling on the rate of return which may be earned by a regulated company. Alternatively, a less extreme system might allow all profits to be kept in a band around the 'target' rate of return, while any further gain or loss relative to this level is shared between the company and its customers. Explicit profit-sharing or 'sliding-scale' regulation was used in the UK and United States in the late nineteenth century and is currently under discussion in the UK.[4] Under such a scheme, a sharing rule divides excess profits between customers and shareholders by allowing dividend or rate-of-return increases only if prices are simultaneously cut.

[4] For further details see Burns, Turvey and Weyman-Jones (1995), 'Sliding scale regulation of monopoly enterprises', Centre for the Study of Regulated Industries, Discussion Paper 11, May.

An example of sliding-scale regulation is the system governing the New York Telephone Company established in 1986, which operated according to the following rules.

Table 3.2: An example of sliding-scale regulation

Rate of return, *R* (%)	**Adjustment to revenues**
Over 15	Revenues adjusted down by ½(*R* – 15)
Between 13 and 15	No adjustment
Under 13	Revenues adjusted up by ½(13 – *R*)

Source: Laffont and Tirole (1993), *A Theory of Incentives in Procurement and Regulation*, MIT Press, p. 16.

Under this scheme, full cost-efficiency incentives are retained in the intermediate band of 13–15% as any profit changes are passed through to the company in full. In the higher and lower bands, incentives are weakened as 50% of any gain or loss accrues to customers: this is the cost of avoiding excessive profits on the upside and excessive risk to the company on the downside. Incentives are stronger than under US-style rate-of-return regulation but far weaker than under the price-cap system.

3.5.3 Discretionary systems

In many countries, particularly in continental Europe, utility companies are controlled without the kind of explicit regulatory framework that exists in the UK and United States. In Austria, for example, gas prices are set by a committee composed of a wide spectrum of interests, with representatives from government ministries, industry, agriculture and labour.

Under a discretionary system, it is unclear what criteria are used in setting prices and the regime cannot even be approximated to rate-of-return or price-cap regulation. It seems unlikely that high-powered efficiency incentives are in force or that high profits or losses may ever be made, thus the system seems close to rate-of-return regulation. On the other hand, the scope for political interference may expose companies to excessive risk and cause their beta values to be higher than those of US utility companies.

4. Other Factors Affecting the Cost of Capital

This section examines factors other than the form of regulatory regime which have an impact on the beta value of a regulated company. In this study it is very important that such influences are taken into account as they prevent any straightforward comparison being drawn between the beta values of utility companies operating under alternative regulatory regimes. International variations in these factors are briefly outlined as these must be considered as possible explanations for any cross-country differences that may be found in estimated beta values.

4.1 Ownership

Although this study covers only privately-owned, quoted companies, many have partial or even majority stakes held by the national government. In some countries, the national constitution or public sentiment prevents full privatisation of utility companies, while in others, partial privatisation is merely a prelude to full floatation. In several European countries, the mix of state and private ownership is the result of the historical development of these industries and may vary widely across sectors and geographical regions.

Partial or majority government ownership is likely to have the following effects on a company:

- implicit state control over prices and other business matters;
- protection from bankruptcy and takeover;
- a lower cost of capital as the government is seen as the ultimate guarantor of any debt.

Government protection from bankruptcy and takeover should reduce a company's cost of capital, but political interference in business activities may increase it. In a few cases, privatisation is complete but the government retains a 'golden share', enabling it to veto any proposed takeover bid. The golden shares in the UK water companies and the RECs were redeemed in December 1994 and March 1995 respectively.

Additional controls were enforced through a 15% shareholding rule, preventing individual shareholders from holding more than 15% of a company's voting equity. This control was removed from all water companies apart from Welsh Water in December 1994 and is due to be removed from all RECs in the year 2000. However, the restriction can be abolished by an extraordinary general meeting, a move which so far has been taken by the majority of RECs. These changes are summarised in Table 4.1. It is possible that these changes may affect the companies' cost of capital, if the sensitivity of their share prices to the state of the economy has been altered.

Table 4.1: Abolition of government controls in UK utility sectors

Date	Event
December 31st 1994	Abolition of golden shares in the water companies
	Abolition of the 15% shareholding rule in all water companies apart from Welsh Water
March 31st 1995	Abolition of golden shares in the RECs
March 31st 2000	Abolition of the 15% rule in any RECs where it still applies

Golden shares and limits on the level of shareholding are seen in other countries; Copenhagen Airport is one such example.

Utility privatisations in South America have frequently taken place through the sale of an initial stake to a private (perhaps international) consortium followed by a public flotation at a later date. This procedure increases the value of the company at flotation due to improvements made during the initial period of private operation, which may also involve the introduction of foreign expertise. It may result, however, in the final structure of the company being dominated by the stakeholdings of companies involved in the preliminary private sale, which may therefore exercise considerable control over the company and affect its cost of capital.

In south-east Asia, limited privatisation of utility industries has generally occurred via private finance deals for new projects rather than the sale of existing state-owned assets. In such a deal, a private consortium is granted a concession to build and operate a plant for a fixed period, after which ownership may be transferred to the national government. In the absence of any public flotation, equity betas cannot be calculated. Instead, the risk of the project will be incorporated into the cost of capital of the participating companies, which frequently include foreign utilities.

4.2 Product market competition

The degree of market risk involved in holding a company's shares is likely to be influenced by the level of competition in the relevant industry. A monopolistic firm has more power than a competitive company to pass unavoidable cost changes on to consumers and it is therefore less exposed to business risks. It would therefore be expected that a monopoly firm would have a lower beta coefficient than a competitive firm operating under otherwise similar circumstances.

When a utility sector is privatised, governments have a choice between restructuring the industry to introduce competition where feasible, or simply selling off an existing monopoly firm. In the UK, restructuring was considered only in the later utility privatisations: the electricity sector was restructured prior to privatisation whereas the gas and telecommunications industries had been privatised as monopolies. In Argentina, considerable restructuring took place before privatisation, with the gas and electricity sectors being vertically and horizontally separated.

In the telecommunications sector, new entry has occurred since privatisation and this may be expected to change the beta coefficient of the incumbent firm. In the UK, Mexico and Peru, statutory monopolies on fixed-line telephone services have already been undermined by the introduction of new technology, such as cellular networks, by competitors.

4.3 Industry structure

The degree of vertical integration of an industry may have an impact on the level of market risk to which a company is exposed. Different parts of an industry tend to differ in their systematic risk levels: in the gas and electricity industries, for example, trading businesses tend to be more risky than the transportation or transmission sectors. Thus, if a company operates in a single part of a vertically separated industry it must be compared with other companies operating in the same sector.

The beta coefficient of a vertically integrated company might be expected to be an average of the betas of its individual component businesses. However, this does not always appear to be the case (although such comparisons are difficult to make). It is possible that a vertically integrated company may be able to manage its operating and investment decisions in such a way that it is better able to deal with cyclical fluctuations. Such 'beta synergy' is possible due to the impracticality of writing 'complete' contracts and the existence of residual control rights conferred by ownership which cannot be replicated through contracts. Another possibility is that a vertically integrated company may be able to foreclose potentially competitive sectors of the business and maintain monopoly power. In either case, a vertically integrated company may be expected to have a lower beta value than the average of its component parts.

4.4 Diversity of operation

A serious difficulty arises in trying to estimate the beta coefficient for a utility sector in that few companies are pure utility operators. First, in many countries the same companies operate in the electricity, gas and water sectors, making a separate beta value for each of these sectors impossible to estimate. In both the United States and Germany, for example, it is usual for energy companies to supply both electricity and gas to a particular geographical area. In such cases, beta values of companies with a similar utility mix may be compared with one another but not with those of other companies which operate in a single utility sector.

Second, many companies which operate in a single utility sector have diversified into non-utility areas, such as engineering and environmental services, communications, property management and leisure activities. Again, it is not possible to estimate separate beta coefficients for different divisions of a company, so the pure utility beta cannot be determined. The non-utility areas tend to be unregulated, competitive and more risky than the core utility services, thus diversification is expected to increase a company's beta coefficient. This can help explain why some beta estimates appear unstable in Appendix 2 when the annual estimates are calculated.

Several large utility companies have international interests in the same utility sector. In particular, many European and US companies are involved in utility projects in south-east Asia and South America. Different types of involvement exist including equity participation in existing companies and stand-alone projects. These deals often allow the company to build a power station or water-treatment plant and then operate it at a profit for a certain period of time before ownership of the asset passes to the state. They are likely to be far riskier than capital investments in the domestic market, due to political risks and greater uncertainty over building costs and future revenues. A company with considerable involvement in overseas projects is therefore expected to have a higher beta value than one which operates solely in the relatively secure domestic market.

5. Empirical Approaches

Two types of comparison may be carried out using international data on privately-owned utility companies. First, comparisons may be drawn between companies operating in the same utility sector but in different countries where alternative regulatory regimes are in force. Second, the effects of changing regulatory systems on systematic risk may be assessed by studying the same number of cases where such shifts have occurred. This section considers these approaches in turn.

5.1 Cross-country comparisons

Cross-country comparisons of utility beta coefficients are informative if one of the following two circumstances applies:

- two companies in the same utility sector, but operating in different countries, are similar in every respect apart from their regulatory regime;
- a number of companies in the same utility sector operating in different countries differ in many respects, which may or may not include their regulatory regimes.

The first case is a straightforward comparison of regulatory systems, controlling for all other influences. This is the ideal form of international comparison but it is impossible to carry out because such a pair of comparators does not exist—often, even within a country, it is difficult to find two directly comparable companies. Direct comparisons of just two countries without regard for other important differences, such as the existing UK/US studies, are likely to be misleading and reveal little about the influence of regulatory risk on the cost of capital.

The second case is more complex but is more likely to allow the effects of alternative regulatory regimes to be inferred. Provided that a sufficient number of comparator countries can be assessed and all important factors affecting the cost of capital can be identified. It should be possible to disentangle these effects and determine the importance of regulatory risk. Although a full regression analysis may be preferable,[5] broad indicative values may be established by averaging a number of companies operating under similar regulatory regimes despite differences in other factors.

Averaging is not a perfect way of controlling for differences in the other explanatory factors but if sufficient companies from a wide enough sample of countries are used, the impact of other explanatory factors should be lessened. Of course, if all the companies under one type of regime face additional risks that bias the beta coefficient upwards then averaging will have no effect. This extreme situation is unlikely.

5.2 Within-country comparisons

In a few countries, existing regulatory systems have been significantly reformed. If this has taken place without industrial restructuring or other changes occurring around the same date, an effective control for non-regulatory factors is available. The data series must be split at the appropriate date and two beta values estimated, and any significant difference between the two should reflect a shift in regulatory risk.

Changes have been made to existing frameworks of regulation in the UK, where the price-cap system is now tending towards revenue-cap regulation, and in the United States, Japan and Spain, where price controls and efficiency incentives are being introduced into existing rate-of-return regulation systems. In Malaysia and Argentina, initial privatisations took place with no consideration being given to regulation; price-cap systems were introduced at a later date.

[5] Dummy variables for specific factors could be introduced, or if the additional explanatory variables are observable and quantifiable, they could be directly included in the regression.

In practice, however, analysing structural parameter shifts is not so straightforward. There are few examples of such reforms, and some have been accompanied by changes in other influential factors such as the degree of competition in the industry. The assessment of recent reforms is weakened by the scarcity of data: when the returns series is short, even daily returns give such an imprecise beta estimate that significant effects are difficult to identify. Another difficulty is the role of expectations in the stock market, these are important in determining the date at which the structural shift occurs. If the change in regulation is anticipated prior to its implementation, the shift in beta occurs at the announcement date, while, alternatively, if investors take time to learn about the change and its effects, a later date may be appropriate.

Another possibility is to compare the beta values of various utility sectors in a particular country where all are subject to the same regulatory system and degree of competition. This would allow sector-specific risk factors to be identified, which may assist the analysis of regulatory differences. For example, a comparison of the electricity and gas industries in a single country where structural and regulatory factors are identical may allow the difference in market risk levels to be identified. This may then assist in drawing comparisons between combined energy companies (such as those found in Germany and the United States) and separate electricity and gas industries in other countries.

6. Methodology and Results

6.1 Choice of stock market index

In calculating beta values, it is usual to use an established stock market index as a proxy for the market portfolio. In several countries, a choice of possible indices is available. Furthermore, a few large companies are quoted on more than one stock exchange, raising the possibility of calculating beta values using data from a foreign stock market. World indices are also available, quoted in either US dollars or pounds sterling, which appeared initially to be a more appropriate market portfolio from which the beta estimates could be derived.

The findings of this report are illustrated by the case of the US telecommunications operator, AT&T, as shown in Table 6.1. AT&T is quoted in both dollars and pounds sterling, thus beta estimates could be calculated using a range of US, UK and world indices as shown. The two world indices ($ and £) give significantly lower beta estimates than the two US indices (NYSE All-share and Dow Jones Composite 65), while the two UK indices (FTSE-A All-share and FTSE 100) produce estimates which are lower still. These results indicate that systematic risk is largely country-specific and a meaningful beta estimate can only be derived using a national index from the company's own country of operation. Beta estimates calculated using a world index reflect the proportion of the index that is made up of the relevant country's securities, rather than the riskiness of the company in question. Quotations on foreign stock markets are likely to incorporate exchange-rate effects, which further undermine these estimates as an accurate measure of beta. For these reasons, beta estimates have only been calculated against national indices—although there is a risk that different stock markets will produce beta estimates that are not entirely comparable, the use of a world index or quotations on foreign stock markets does not appear to overcome this problem.

If attention is restricted to national stock markets, several indices are generally available. Often the choice is between an 'all-share' index and one that is only made up of the largest or most frequently traded companies. In an analysis of the interval problem (see Section 6.2 and Appendices A1.3 and A3), the beta values of large companies (as the utilities tend to be) are found to have a smaller, upwards bias when calculated against an index consisting only of frequently traded shares. As is clear from Table 6.1 for AT&T, the large-security indices (Dow Jones Composite 65 and FTSE 100) produce lower beta estimates than their respective all-share indices. Economic theory suggests that large-security indices would produce more accurate beta estimates as they are less prone to price adjustment lags, and so, where possible, beta estimates in this paper have been derived from large-security national stock market indices.

Table 6.1: Daily asset beta estimates for AT&T against alternative indices

NYSE All-share	Dow Jones Composite 65	World ($)	World (£)	FT All-share	FTSE 100
0.85	0.72	0.42	0.35	0.20	0.17

In the case of AT&T, the value of 0.72, calculated using the Dow Jones Composite 65 index, has been chosen as the best estimate of the true beta value.

6.2 Choice of interval length

Another important issue is the frequency of the data used in calculating beta. Returns calculated over a daily, weekly, monthly or even longer period may be used in the calculation, but there is a trade-off between two problems. Literature on the interval problem (see Appendix A1.3 for a brief review) suggests that short-interval estimates are systematically biased, such that the beta values of highly traded securities are overstated while those of infrequently traded securities are understated. Use of longer intervals, on the other hand, lowers the number of data points available for the calculation and the accuracy of the estimate is significantly reduced. A monthly beta estimate, for example, requires at least five years' data (60 data points) to be used while a daily beta can be calculated for a single year (around 250 data points). The latter estimate is the more meaningful if a company is subject to changes in its operating environment or regulatory regime, as explained in Appendix A1.4.

Examples shown in Appendix A3 show the extent of the interval problem. Beta estimates for British Gas fall as the interval length is increased while those of the two US water companies rise with the interval length, as expected from the fact that the former is large and frequently traded while the latter are infrequently traded. US gas companies show a mixture of trends, reflecting the variety of sizes of the companies in this group. Beta estimates for the UK RECs rise with the interval length, a slightly surprising result which implies that these companies are relatively infrequently traded compared with the index as a whole. It should be noted, however, that the confidence intervals for the longer-interval estimates are very wide, as shown in Appendix A4. Taking the case of five-year asset beta estimates for BT, daily data produce a 95% confidence interval of 0.81 to 0.92, weekly data give a range of 0.79 to 1.02, while the monthly estimate lies between 0.61 and 1.03.

The response taken here to these problems has been to use daily beta estimates in order to obtain a narrow confidence interval for betas calculated over fairly short periods and to deal with the interval problem in the following ways. As explained in Section 6.1, a large-security index results in a smaller interval-effect bias than an all-share index. Industry averages have been calculated; where there is a range of company sizes, this procedure should overcome the bias involved in using any single estimate. This is indicated by the case of US gas companies given in Appendix A3: the average daily, weekly and monthly betas for the group as a whole are very close at 0.20, 0.21 and 0.25 respectively, while individual beta values vary substantially with the interval length.

6.3 Summary of results

Details of all the beta values calculated for this study can be found in Appendix A2. For each company, where possible, a five-year beta calculated over the period January 1990 to August 1995 is given in addition to a series of annual betas for the years 1990 to 1994. All are calculated using daily data and the index used in the calculation is given by the heading for each country. All estimates are asset betas (ie, corrected for the gearing level of the individual company) except where stated otherwise.[6]

Although individual companies are of interest, these results need to be summarised in some way so that overall trends may be identified. First, average beta values for the utility sectors in each country were calculated. These results are given in Table 6.2, while Table 6.3 summarises the corresponding regulatory regimes for each sector.

Table 6.2: Average beta values by country and sector

	Electricity	Gas	Energy	Water	Telecoms
UK	0.60	0.84	–	0.67	0.87
United States	0.30	0.20	0.25	0.29 †	0.72 (AT&T) 0.52 (others)
Canada	–	–	0.25	–	0.31
Japan	0.43	–	–	–	0.62
Argentina	0.81 ^{e}	–	–	–	0.86 ^{e}
Chile	0.95 ^{e}	–	–	–	1.20 ^{e}
Germany	–	–	0.66	–	–
Spain	0.43	0.81	–	0.57	–
Sweden	–	0.34	–	–	0.50
Australia	–	0.38	–	–	–
New Zealand	–	–	–	–	0.97
Other European	0.41	0.49	0.46	0.42	0.70

Key: † Monthly beta, ^{e} Equity (not asset) beta.

[6] Accounting data on a comparable basis was taken from Datastream. This was not available for all of the countries in the study.

Table 6.3: Summary of regulatory regimes

	Electricity	Gas	Energy	Water	Telecoms
UK	RPI – X / revenue cap	RPI – X	–	RPI – X	RPI – X
United States	RoR	RoR	RoR	RoR	AT&T: RPI – X Others: RoR
Canada	–	–	RoR	–	RoR
Japan	RoR	–	–	–	RoR
Argentina	RPI – X	RPI – X	–	–	RPI – X
Chile	RPI – X/ hybrid	–	–	–	–
Germany	–	–	Discretionary	–	–
Spain	Tariffs based on standard costs	Discretionary	–	–	–
Sweden	Discretionary	Discretionary	–	–	RPI – X
Australia	–	–	–	–	–
New Zealand	–	–	–	–	Anti-competitive rules, no price control
Other European	Discretionary	Discretionary	–	Discretionary	–

Key: RoR = rate-of-return regulation.

Regulatory regimes can be classified according to the strength of cost-efficiency incentives: RPI – X and revenue-cap regimes involve high-powered incentives, rate-of-return regulation is low-powered, while European discretionary systems are classed as intermediate. Cross-country averages for the three types of regime were calculated for each sector (using only asset betas); these figures are given in Table 6.4. Averaging across companies that differ in trading frequency, operating environment and other features should both help to overcome the interval problem and give estimates that reflect differences in regulatory risk rather than other factors. Finally, averages across sectors were produced to give a single figure for each regime type, as shown in Table 6.5.

Table 6.4: Average asset beta values by regulatory regime and sector

Incentives	Electricity	Gas	Energy	Water	Telecoms
High-powered	0.57	0.84	–	0.67	0.77
Intermediate	0.41	0.57	0.64	0.46	0.70
Low-powered	0.35	0.20	0.25	0.29	0.47

Table 6.5: Average asset beta values across regulatory regimes

	Average beta
High-powered	0.71
Intermediate	0.60
Low-powered	0.32

Both the sectoral averages and the overall regime estimates show a clear trend: high-powered incentives appear to be related to higher systematic risk, while low-powered incentives imply low market risk.

7. Summary and Conclusions

This paper has covered a wide range of countries, utility sectors and regulatory systems in order to analyse the extent of regulatory risk under alternative regimes. Economic theory suggests that regulatory differences may cause the degree of market risk borne by a company to vary significantly, with an inverse relationship existing between the degree of risk and the level of cost-efficiency incentives imposed on the company.

Existing comparisons of regulatory risk tend to be somewhat limited in scope. There is a clear disparity between the beta values of utility companies in the United States and the UK, which is usually attributed to the relatively safe operating environment in the United States provided by rate-of-return regulation. However, the observed difference may be due to any of a number of alternative factors and cannot be said to prove the existence of higher regulatory risk in the UK.

This study has covered a much wider sample of countries and regulatory systems in an attempt to formulate a more robust comparison of the risks borne by companies under alternative regimes. The method that was used, which averaged across a range of companies of varying sizes and operating in diverse environments, aimed to overcome the effects of other exogenous factors and therefore improve the accuracy with which regulatory risks may be identified. The results show a clear pattern at the level of individual utility sectors and for regulatory regimes as a whole. Regimes with low-powered incentives tend to coexist with low asset beta values, while high-powered incentives imply significantly higher beta values. These results, in accordance with existing comparisons of regulatory regimes, seem to imply that companies under RPI – X regulation are exposed to much higher levels of systematic risk in comparison with those under rate-of-return regulation, and that the cost of capital for these firms is therefore likely to be higher.

However, these figures must not be accepted without a number of caveats. First, the whole project of drawing comparisons between beta values on an international scale is subject to difficulties. Companies are quoted on individual national stock markets and different market indices must be used in each case. Indices differ in composition and calculation methods, introducing a possible source of non-comparability between beta estimates. For example, in a country where utility companies form a large proportion of total market capitalisation, the index reflects movements in utility shares to a great extent and beta estimates will be high.

Furthermore, national stock markets operate in different ways and are prone to different degrees of interval bias. Utility companies differ in size and, because of this, their beta values are likely to be biased in different directions. For example, UK utilities tend to be large relative to the market as a whole, whereas US utilities are regionally based and may be quite small. For this reason, estimated beta values could be expected to overstate the degree of market risk borne by UK utilities while the risk incurred by US utilities is understated. The much-quoted difference between US and UK utility betas, usually attributed to differences in regulatory risk, may simply reflect the systematic interval-effect biases that are present in these estimates.

Although this study has covered a wide range of countries and companies, the sectoral and overall regime averages for high- and low-powered incentives still tend to be dominated by UK and US companies respectively. This is due to difficulties in finding the necessary data for suitable comparator companies. In most countries, utility companies have traditionally been under state or local authority control and the number of private companies under alternative regulatory regimes is limited. Few European utilities are under explicit price-cap or rate-of-return regulation, indeed, the United States aside, clear regulatory systems are a relatively recent phenomenon. Privatisations in developing countries provide scope for interesting comparisons between regulatory regimes, but adequate data is difficult to come by and beta estimates derived from these markets are likely to be even more flawed that those for European and North American companies.

Where market data does not exist for a country or sector the information reported in this paper can provide a starting point for the estimation of an appropriate equity beta. Obviously, qualitative adjustments will have to be made to take account of special circumstances and specific company betas may assist in this. The data reported in this study should, however, be of value in providing initial assessments of betas of utilities operating under different regulatory regimes.

Appendix A1 Estimation Difficulties

This section considers practical and theoretical difficulties involved in estimating beta coefficients from available data. There are several explanations of why beta coefficients may be biased, and some of these reasons cause severe problems for international comparisons of estimated beta values. When these estimates are derived using data from different stock markets, the extent and direction of bias in each estimate may differ and the comparison is likely to be very misleading unless corrections can be made for these distortions.

A1.1 Data format and availability

A1.1.1 No trade periods

A fundamental assumption of the capital asset pricing model (CAPM) is that all securities are continuously traded and that the price at which such trades may take place is known at each moment in time. In practice, however, shares are traded at discrete times and there are many periods during which no trades take place.

In many stock markets, the measured price for a given share is the price at which its latest trade took place. This method opens up the possibility that the notional price at which a trade *would* occur may change without any actual trade taking place, resulting in discrepancies between measured and 'true' values. In more sophisticated stock exchanges data is available for quotation as well as transaction prices, which overcomes the no-trade problem in these markets but may distort comparisons with beta values estimated from transaction data.

A1.1.2 Transaction costs

A second difficulty is the spread between buying and selling prices arising from transaction costs, a feature of real-world markets that is ignored by the CAPM. When considering the returns to a portfolio of assets, these must be calculated as a percentage of the buying price of the portfolio. Difficulties arise when the bid/ask spread varies over time, due to changes in transaction procedures or the degree of competition in stock market trading. Changes in transaction costs affect the variability of measured returns while true returns remain unaffected, so distorting calculations of the beta estimate. These changes are unlikely to be synchronised across international capital markets, so there is no reason to expect that the direction of bias will be the same in different countries.

A1.1.3 Dividend corrections

The returns to holding equity are made up of two parts: a capital gain on the price of the share itself and any dividend payments made by the company. Thus, a calculation of the total return to equity requires a dividend correction. In order that the variance of a security and its covariance with the market may be calculated correctly, any dividend payment must be added to the share price at the time when the payment is made. Many documented returns series treat dividend payments as if they were spread throughout the year rather than occurring at particular moments, once or twice a year. International comparisons require returns data to be constructed on a consistent basis, which should also be as close to the true values as possible.

A1.1.4 Calculation of returns

As pointed out by Roll (1983),[7] the method by which the average returns on a portfolio or index are calculated can significantly affect their estimated value. Roll

[7] Roll (1983), 'On Computing Mean Returns and the Small Firm Premium', *Journal of Financial Economics*, **12**, 371–386.

compares three computational methods for obtaining the return on a portfolio of securities over an interval of time:

- arithmetic: the mean daily return is obtained by averaging across both firms and days—this is then compounded to give the portfolio return over a longer period;
- rebalanced: the return on a portfolio is rebalanced at the end of each period to maintain equal investments;
- buy-and-hold: individual security returns over the required time period are calculated from daily returns and then averaged over securities to give the portfolio return.

Roll finds that the method used to calculate mean returns has a significant effect on the estimated return, such that the apparent premium to holding a portfolio made up of smaller rather than larger issues is approximately halved when the buy-and-hold approach is used. He argues that this method is the most plausible as it mimics the behaviour of actual investors, as their transaction costs prevent regular rebalancing of portfolios. The buy-and-hold approach is the preferred method used in academic work on the estimation of beta values, such as Handa et al. (1989).[8]

In making international comparisons, it is important to ensure that returns data is calculated on the same basis, which should preferably be the buy-and-hold method. This may require new market indices to be calculated, as published indices tend to be rebalanced and the frequency of adjustment is likely to vary across countries.

[8] Handa, Kothari and Wasley (1989), 'The Relation Between the Return Interval and Betas', *Journal of Financial Economics*, **23**, 79–100.

A1.2 Aggregation and the market portfolio

A1.2.1 The market portfolio

The cost of equity finance for an individual security is related to the level of its non-diversifiable risk. Thus, the variance of the security's returns must be compared to their covariance with the market portfolio, consisting of the optimal combination of all available assets. This calculation requires some proxy for the market portfolio to be used. Ideally, this should be an index of world assets including not only equities but also bonds and durable goods such as housing.

In practice, however, researchers usually take a national equity market index as a proxy for the world index. The use of national rather than international markets can be justified by the argument that today's capital markets are essentially international and arbitrage ensures that prices and the risk–return trade-off are equalised between markets. Other assets, such as housing and bonds, are generally ignored—again, arbitrage is assumed to ensure that the risk–return profile for these assets mirrors those of the assets included in the index and so their omission does not cause problems.

However, differences in the composition of national stock markets mean that comparisons of beta values calculated using national market returns could be misleading. For example, some small stock markets are dominated by a single large company, in which case market returns are not representative of the world index. A few capital markets, such as that of Korea, are insulated from international influences and are therefore likely to differ considerably from the world index, rendering a meaningful comparison of beta estimates impossible. It may be necessary to construct a portfolio of world assets and use its returns index to estimate beta values for all securities in order to eliminate problems associated with unrepresentative national markets.

A1.2.2 Differential taxation and transaction costs

As argued above, arbitrage is a powerful mechanism for ensuring that the risk–return trade-off is equalised between different types of assets and across countries. However, even with complete arbitrage, prices are affected by differences in transaction costs and levels of taxation applied to various assets. Investors respond to post-tax returns while the companies themselves are concerned about pre-tax levels, thus variations in this spread affect the cost of capital. In several countries, steps are being taken to eliminate gross distortions in the tax system, for example, the recent reductions in the preferential treatment of house purchases in the UK. However, significant cross-country differences in transaction costs or taxation systems are likely to undermine the comparability of beta estimates unless corrections can be made for these distortions.

A1.2.3 Weighting of the index

Another issue concerns the weights that should be applied to different assets in the market portfolio. A portfolio consisting of an equal investment in each security is unlikely to be optimal, as most investors would choose to put fewer funds into very risky assets. Thus, market capitalisation is generally used to weight each security, so that large companies form a greater proportion of the portfolio. However, when making international comparisons, there is no guarantee that the different national market indices are weighted in a consistent manner and calculation of a new index may be necessary.

A1.3 Choice of interval period

Beta coefficients may be calculated from daily, weekly, monthly or even annual data, as long as a sufficient number of data points are used. Theoretically, the length of the interval over which returns are calculated should not affect the result. However, empirical studies have found the estimated value of beta to alter significantly and systematically with the interval length, resulting in a wide-ranging academic debate. Several sources of bias have been noted and analysed, with conflicting affects on the estimate of beta as the interval length is increased.

A1.3.1 Non-synchronous trading

Fisher (1966)[9] pointed out that the prices recorded at the end of a time interval are often due to a transaction which occurred earlier in or prior to that period. For this reason, the market index is in fact an average of the temporally ordered underlying values of the shares rather than synchronised trades. This causes the returns calculated from the index to be serially correlated and their estimated variance to be biased downwards. If, in addition, a share suffers from non-trading or is traded only infrequently, its covariance with the market will be significantly underestimated. Both the market variance and an asset's covariance with the market rise with the return interval, but if these increases are not proportional, the estimated beta coefficient will be biased. Scholes and Williams (1977)[10] find the following directions of bias in beta estimates when a short interval is used.

Table A1.1: Bias in beta estimation due to non-synchronous trading

Type	Direction of bias in beta estimate
Infrequently traded securities	Downwards
Securities with average trading frequencies	Upwards
Very frequently traded securities	Downwards

The availability of quoted prices at times when no transaction occurs should overcome the non-synchronous trading problem. If the close-of-day prices from either a trade or a quote are synchronous, then the Scholes–Williams bias is no longer an issue.

[9] Fisher (1966): 'Some New Stock-market Indexes', *Journal of Business*, **39**, 191–225.
[10] Scholes and Williams (1977), 'Estimating Betas from Nonsynchronous Data', *Journal of Financial Economics*, **5**, 309–327.

A1.3.2 Price-adjustment delays

Dimson (1979) and Cohen *et al.* (1983)[11] consider more persistent price-adjustment delays, due to frictions in the capital market, which may affect quotation as well as trade prices. These authors find a different pattern of biases in beta from that analysed by Scholes and Williams, as shown in Table A1.2. Also, they find that these biases occur even for interval lengths longer than a single day, with estimates becoming asymptotically consistent as the period length is increased.

Table A1.2: Bias in beta estimation due to price adjustment lags

Type	Direction of bias in beta estimate
Infrequently traded securities	Downwards
Very frequently traded securities	Upwards

A1.3.3 Length of the investment horizon

Levhari and Levy (1977)[12] comment on a different form of bias in calculated beta coefficients: several researchers report a tendency for high-risk (aggressive) stocks to earn lower returns than those estimated by the CAPM, while low-risk (defensive) stocks exceed predictions. Levhari and Levy give an explanation based on a discrepancy between the actual and theoretical length of the investment horizon. The CAPM assumes that investors maximise their returns over a single time period, which may be of any length as long as it is identical for all investors. When the assumed investment horizon differs from the actual one used by investors, the estimated beta coefficient will be systematically biased. The direction of this effect varies according to whether the assumed horizon is too long or too short, as summarised in Table A1.3.

---

[11] Dimson (1979), 'Risk Management When Shares are Subject to Infrequent Trading', *Journal of Financial Economics*, **7**, 197–226; Cohen, Hawawini, Maier, Schwartz and Whitcomb (1983), 'Friction in the Trading Process and the Estimation of Systematic Risk', *Journal of Financial Economics*, **12**, 263–278.
[12] Levhari and Levy (1977), 'The Capital Asset Pricing Model and the Investment Horizon', *Review of Economic Studies*, 92–104.

Table A1.3: Bias in beta estimation due to investment horizon length

Type	Assumed investment horizon is too long	Assumed investment horizon is too short
Aggressive stock ($\beta > 1$)	Beta is over-estimated	Beta is under-estimated
Neutral stock ($\beta = 1$)	Beta is correctly estimated	Beta is correctly estimated
Defensive stock ($\beta < 1$)	Beta is under-estimated	Beta is over-estimated

The authors argue that the true horizon for most investors is likely to be more than a year, thus estimates based on a period length shorter than this will tend to under-estimate high beta values and over-estimate low ones.

A1.3.4 International differences in interval effects

The biases in estimated beta values for different national markets are unlikely to be of the same degree and may not even be in the same direction. First, the availability of quotation data for some markets should reduce misestimation in these cases, while serious biases remain in other markets. Second, differences in transaction costs and trading methods may affect the extent of adjustment delays and non-synchronous trading problems, such that the degree of autocorrelation in market returns, varies between countries.

Third, there is some evidence that the size of the relevant stock market affects the seriousness of the intervalling effect. Berglund et al. (1983)[13] find the length of the adjustment process to be related to the total turnover of the exchange rather than the trading frequency of the particular stock, such that adjustment takes longer in a small stock market. Martikainen and Perttunen (1991)[14] demonstrate that, contrary to the findings of Handa *et al.* (1989), the size effect tends to increase rather than decrease with the return interval in a thin stock market.

[13] Berglund, Wahlroos and Örnmark (1983), 'The Weak–form Efficiency of the Finnish and Scandinavian Stock Exchanges', *Scandinavian Journal of Economics*, **85**, 521–530.
[14] Martikainen and Perttunen (1991), 'Return Intervals, Systematic Risk Estimates and Firm Size', *Economic Letters*, **36**, 311–315.

A1.4 Changes in company structure or environment

Some of the arguments outlined above imply that a longer rather than a shorter returns interval should be used to estimate beta. However, use of a longer interval (say, one month) requires several years' data, whereas a beta estimate based on daily data could be calculated for a single year. The common approach of calculating a monthly beta from data over a five-year period is flawed if the company's capital structure or operating environment is not constant over this time.

A1.4.1 Changes in company gearing

The CAPM implicitly assumes that a company's gearing ratio is constant over time and that its marginal gearing (the proportions in which debt and equity are currently being issued) is therefore equal to its overall gearing ratio at the present time. For real-world companies, however, significant shifts in gearing over relatively short periods of time can be observed. When data over a long period (say, five years) is used to estimate a company's equity beta and its gearing ratio changes over this time, calculation of its asset beta using end-of-period gearing is likely to be misleading. The riskiness of the company's equity tends to change with its gearing ratio and so the use of an inappropriate gearing ratio causes the asset beta to be miscalculated.

When a company's gearing ratio is found to change over the estimation period, two approaches may be used:

- use the average gearing ratio over the estimation interval, rather than its end-of-period value;
- carry out the estimation over a shorter interval; say, one year instead of five.

The second approach is related to the intervalling effects covered in Section A1.3: clearly, the gearing issue must be considered along with the issues discussed earlier when a choice of estimation period is made.

A1.4.2 Regulatory changes

As outlined in Section A1.3, one approach to the assessment of regulatory risk is to study the effect on a company's beta value when its regulatory regime is altered. This methodology requires beta values to be estimated over short time periods of one to two years so that the effects of recent changes can be assessed. In such cases, the short data period requires beta values to be estimated from daily rather than monthly returns so that the number of data points is sufficient for a reasonable degree of accuracy to be obtained.

A1.5: Estimating debt betas

In Section 2 the relationship between asset, equity and debt betas was briefly outlined. Although this paper has adopted the standard assumption of zero debt betas it is worth considering the evidence on the value of debt betas if this assumption is relaxed. It is not possible to apply any assumption but that of zero debt betas in the main body of the work, owing to the amount and sophistication of the information required. However, by considering the available evidence the relevant importance of this assumption can be tested.

Table A1.4: Data on debt betas

Company	Bond	Premium (basis points)	Debt beta[a]
BAA	£250m, 8.5%, 2021	85	0.14
Electrobras	$50m, 10%, 1999	431	0.72
Telebras	Lira 350 billion, 13%, 1999	345	0.58
BT	£500m, 7.125%, 2003	16	0.03
BT	£229m, 12.25%, 2006	35	0.06
Nynex	$150m, 8.75%, 2004	76	0.13

Note: [a] A simplification has been made by assuming that the equity risk premium is constant across countries at 6%.
Sources: *Financial Times* and Datastream.

As can be seen from the table, debt betas can vary from close to zero, for large utility companies in developed countries, to close to one, for utilities in developing countries. Of course, the assumptions underlying the debt beta calculation have an important impact on the value found and so these figures are being used purely for illustrative purposes rather than precise measures of the actual debt betas. Table A1.5 provides an estimate of the asset beta for two of the companies with debt betas. These are then compared to the asset betas calculated on the standard assumption.

Table A1.5: Asset beta estimates

Company	Equity beta	Debt beta	Gearing	Asset beta
BT	0.98	0.06	0.12	0.87
Nynex	0.69	0.13	0.35	0.49

Table A1.6: Impact on asset beta estimate

Company	Zero debt beta	Non-zero debt beta
BT	0.87	0.87
Nynex	0.45	0.49

From Table A1.6 it can be seen that the impact of relaxing the assumption is slight. In BT's case there is no change in the asset beta estimate while for Nynex the asset beta rises by 0.04. Where larger debt betas exist it is likely that a more significant impact will be observed, however, lack of data makes quantifying this impact impossible.

A1.6 Conclusions

The estimation of beta values, particularly in an international context, is fraught with practical and theoretical difficulties. Hence a great deal of care must be taken in making the estimates if any meaningful comparisons are to be drawn. First, some methodology for overcoming the theoretical sources of bias must be established, perhaps involving a particular choice of returns interval or a regression procedure for obtaining unbiased estimates. Second, appropriate and consistent data must be collected for the various countries, and then beta estimates calculated in the same way in each case.

Appendix A2 Asset Beta Estimates

Key: [e] indicates an equity rather than an asset beta estimate.

[t] indicates that security has severe infrequent trading problems and is likely to be biased downwards.

A2.1 Europe

A2.1.1 Austria

Index: Austria traded index (ATX)

	OMV AG (elec)	Vienna Airport
Five-year beta	0.85	0.50 (1992–95)
1990	1.34	–
1991	0.65	–
1992	0.83	–
1993	0.69	0.71
1994	0.75	1.05

A2.1.2 Belgium

Index: Brussels Stock Exchange General Index

	Electrabel (electricity)	Tractebel (electricity & gas)
Five-year beta	0.40	0.46
1990	0.26	0.97
1991	0.33	0.33
1992	0.41	0.34
1993	0.48	0.28
1994	0.64	0.39

A2.1.3 Denmark Index: Copenhagen Stock Exchange Index

	Tele Danmark	Copenhagen Airport
1994–95	1.10	0.44[e,t]

A2.1.4 France Index: Paris CAC40

	Lyonnaise des Eaux-Dumez (water)
Five-year beta	0.64
1990	0.89
1991	0.66
1992	0.47
1993	0.59
1994	0.63

A2.1.5 Germany Index: Deutsche Aktien (DAX)

Regional energy companies

	Badenwerk	Berliner Kraft & Licht	Eschweiler Bergwerk	Isar Amperwerke
Five-year beta	0.23[t]	0.25[t]	0.03[t]	0.12
1990	0.31	0.36	0.10	0.12
1991	0.36	0.24	–0.05	0.13
1992	0.19	0.02	0.05	0.05
1993	0.09	0.16	0.03	0.13
1994	–0.02	0.24	–0.04	0.19

Regional energy companies (continued)

	Rheinelectra	RWE	Thyssen	VEBA	VIAG
Five-year beta	0.54	2.34*	0.84	0.83	0.77
1990	0.57	1.42	0.98	0.93	0.98
1991	0.49	2.11	0.81	0.86	0.80
1992	0.29	1.94	0.88	0.63	0.72
1993	0.79	2.19	0.82	0.62	0.71
1994	0.54	2.25	0.70	0.84	0.66

* High value due to large negative gearing ratio.

A2.1.6 Italy — Index: Milan Stock Exchange index

	Italgas	Acquedotti Potabili (water)	Acquedotti de Ferrari RNC (water)	Telecom Italia	Ferrovie Nord Milano (railway)
Five-year beta	0.44	0.16 [e t]	0.47 [e t]	0.30	0.44 [e t]
1990	0.36	0.42	1.28	0.21	–
1991	0.46	0.22	0.89	0.19	0.63
1992	0.31	0.22	0.24	0.16	0.13
1993	0.46	0.16	0.11	0.23	0.44
1994	0.58	0.08	0.32	0.45	0.65

A2.1.7 The Netherlands — Index: Amsterdam All Share general index

	KPN (post & telecoms)
Five-year beta	0.61 [e]

A2.1.8 Norway — Index: Oslo Stock Exchange index

	Norsk Hydro (gas)
Five-year beta	0.69
1990	0.57
1991	0.62
1992	0.77
1993	0.57
1994	0.71

A2.1.9 Spain Index: IBEX 35

	Endesa	Elec. Reunidas	Enher	Sevillana	Gas Natural SDG	Aguas Barcelona (water)
Five-year beta	0.58	0.60	0.31	0.24	0.81	0.57
1990	0.40	–	–	0.22	0.67	–
1991	0.31	–	–	0.14	0.61	–
1992	0.53	–	–	0.23	0.57	–
1993	0.65	–	0.32	0.21	0.94	0.68
1994	0.88	0.54	0.30	0.32	1.12	0.74

A2.1.10 Sweden Index: Veckans Affarer weighted all share index

	Sydkraft (gas)	Kinnevik Ind. (telecoms)
Five-year beta	0.34 [t]	0.50 [t]
1990	–	0.32
1991	–	0.13
1992	0.32	0.57
1993	0.32	0.51
1994	0.35	0.88

A2.1.11 Switzerland Index: Swiss market index

	Electrowatt (elec)	Motor-Columbus (elec)
Five-year beta	0.15 [t]	0.24 [t]
1990	–	0.34
1991	–	–
1992	0.12	–
1993	0.14	–
1994	0.19	0.13

A2.1.12 UK Index: FT-SE 100

Regional electricity companies

	Eastern	East Midlands	London	Manweb	Midlands	Northern
Five-year beta	0.55	0.56	0.59	0.57	0.56	0.54
1990	–	–	–	–	–	–
1991	–	–	–	–	–	–
1992	0.50	0.46	0.51	0.55	0.46	0.49
1993	0.33	0.42	0.41	0.40	0.44	0.35
1994	0.62	0.63	0.60	0.58	0.63	0.66

Regional electricity companies (continued)

	Norweb	SEEBOARD	Southern	South Wales	South Western	Yorkshire
Five-year beta	0.59	0.64	0.61	0.61	0.52	0.56
1990	–	–	–	–	–	–
1991	–	–	–	–	–	–
1992	0.55	0.56	0.58	0.65	0.46	0.52
1993	0.32	0.42	0.39	0.36	0.33	0.45
1994	0.69	0.76	0.66	0.57	0.54	0.55

Generators and vertically integrated electricity companies

	National Power	PowerGen	Scottish-Power	Hydro-Electric	Northern Ireland Electricity
Five-year beta	0.78	0.75	0.67	0.58	0.60†
1990	–	–	–	–	–
1991	–	–	–	–	–
1992	0.66	0.66	–	–	–
1993	0.84	0.82	0.69	0.63	–
1994	1.03	1.05	1.16	1.01	–

† 1993–95 figure.

Gas and telecommunications

	British Gas	British Telecom	Vodaphone
Five-year beta	0.84	0.87	1.13
1990	0.92	0.88	1.27
1991	0.84	0.77	0.86
1992	0.59	0.70	1.15
1993	0.89	0.95	1.22
1994	1.08	1.02	1.10

Water

	Anglian	Northumbrian	North West	Severn Trent	Southern
Five-year beta	0.53	0.66	0.71	0.79	0.60
1990	–	–	–	–	–
1991	0.60	1.08	0.74	1.12	0.66
1992	0.69	1.05	0.97	1.12	0.73
1993	0.36	0.25	0.42	0.46	0.30
1994	0.64	0.56	0.79	0.77	0.72

Water (continued)

	South West	Thames	Welsh	Wessex	Yorkshire
Five-year beta	0.87	0.63	0.76	0.66	0.53
1990	–	–	–	–	–
1991	1.75	0.71	0.95	0.61	0.54
1992	1.47	0.80	1.18	0.93	0.65
1993	0.45	0.38	0.39	0.25	0.32
1994	0.55	0.73	0.73	0.73	0.55

A2.2 North America

A2.2.1 Canada — Index: Toronto Stock Exchange composite index

	Atco	Canadian Utilities	Nova Corp.
Five-year beta	0.08 [t]	0.15 [t]	0.55
1990	0.12	0.13	0.42
1991	0.11	0.07	0.40
1992	0.03	0.18	0.50
1993	0.07	0.11	0.46
1994	0.06	0.21	0.68

	Nova Scotia Power	Transalta	Bell Canada Enterprises (telecommunications)	BC Telecom
Five-year beta	0.13 [†] [t]	0.36 [t]	0.31	0.31 [t]
1990	–	0.40	0.30	0.30
1991	–	0.22	0.27	0.30
1992	–	0.24	0.33	0.40
1993	0.04	0.05	0.17	0.06
1994	0.20	0.64	0.40	0.46

[†] 1992–95 figure.

A2.2.2 United States — Index: Dow Jones composite 65

Combined electricity/gas companies

	Baltimore Gas & Elec	CMS Energy	Consolidated Edison NY	LG&E Energy	Long Island Lighting
Five-year beta	0.32	0.19	0.47	0.19	0.15 [t]
1990	0.29	0.22	0.38	–	0.16
1991	0.20	0.20	0.20	0.15	0.14
1992	0.22	0.11	0.12	0.07	0.08
1993	0.45	0.14	0.28	0.19	0.19
1994	0.47	0.27	0.39	0.42	0.21

Combined electricity/gas companies (continued)

	MDU Resources	Niagara Mohawk Power	Northern States Power	Pacific Gas & Electric	Peco Energy
Five-year beta	0.12[t]	0.25	0.38	0.37	0.31
1990	0.08	0.26	0.48	0.36	0.33
1991	0.14	0.18	0.25	0.32	0.18
1992	0.05	0.20	0.25	0.26	0.21
1993	0.17	0.28	0.41	0.35	0.40
1994	0.25	0.41	0.50	0.57	0.42

Combined electricity/gas companies (continued)

	Public Service Co. of Colorado	San Diego Gas & Electric	Scana	Washington Water Power
Five-year beta	0.24	0.21	0.20	0.12[t]
1990	0.27	0.23	0.17	0.10
1991	0.15	0.09	0.16	0.07
1992	0.18	0.07	0.14	0.03
1993	0.31	0.24	0.16	0.16
1994	0.36	0.43	0.35	0.23

Gas companies

	Atlanta Gas Light	Brooklyn Union Gas	Connecticut Natural Gas	Enserch
Five-year beta	0.19	0.14[t]	0.14[t]	0.39
1990	0.18	0.10	0.10	0.40
1991	0.23	0.08	0.24	0.43
1992	0.10	0.09	0.07	0.36
1993	0.13	0.19	0.14	0.31
1994	0.29	0.41	0.17	0.51

Gas companies (continued)

	Florida Public Utilities	Natural Fuel Gas Co	New Jersey Resources	Nicor
Five-year beta	0.08 [t]	0.21	0.10 [t]	0.29
1990	0.18	0.18	0.11	0.28
1991	0.03	0.14	0.03	0.31
1992	0.01	0.31	0.06	0.18
1993	0.09	0.15	0.18	0.18
1994	0.09	0.37	0.20	0.48

Gas companies (continued)

	North Carolina Natural Gas	Northwest Natural Gas	ONEOK	Wisconsin Energy
Five-year beta	0.06 [t]	0.12 [t]	0.35	0.29
1990	0.12	0.18	0.38	0.26
1991	0.05	0.13	0.33	0.21
1992	–0.06	0.04	0.31	0.13
1993	0.00	0.11	0.39	0.43
1994	0.14	0.09	0.41	0.49

Electricity companies

	AEP Industries	Carolina Power & Light	Duke Power	Entergy Corp.	KU Energy
Five-year beta	0.46	0.37	0.40	0.25	0.24
1990	0.68	0.40	0.34	0.26	0.25
1991	0.19	0.27	0.30	0.19	0.16
1992	0.43	0.19	0.24	0.16	0.16
1993	0.23	0.49	0.47	0.29	0.34
1994	0.84	0.57	0.42	0.36	0.32

Electricity companies (continued)

	New England Electric Systems	Puget Sound Power & Light	Union Electric	Unicom
Five-year beta	0.24	0.18	0.27	0.31
1990	0.27	0.15	0.25	0.43
1991	0.11	0.16	0.11	0.24
1992	0.18	0.13	0.25	0.16
1993	0.30	0.20	0.34	0.28
1994	0.43	0.32	0.48	0.47

Water

	Consumers Water	Philadelphia Suburban
Five-year beta	0.07 [t]	0.12 [t]
1990	0.12	0.15
1991	0.04	0.07
1992	0.20	0.13
1993	0.12	0.11
1994	–0.02	0.14

Telecommunications

	AT&T	Bell Atlantic	Bell South	Nynex
Five-year beta	0.72	0.57	0.55	0.45
1990	0.96	0.85	0.65	0.59
1991	0.69	0.52	0.62	0.38
1992	0.53	0.19	0.31	0.30
1993	0.78	0.56	0.55	0.33
1994	0.60	0.50	0.52	0.61

A2.3 South America

A2.3.1 Argentina

Index: IFC emerging markets weekly index
NB: These are weekly, not daily, beta estimates.

	Central Costanera (elec)	Central Puerto (elec)	Telefónica de Argentina
1994–95	0.74 e	0.87 e	–
1992–95	–	–	0.86 e

Index: Dow Jones Composite 65 (daily beta estimates)

	Central Costanera ADR	Central Puerto ADS	Telefónica de Argentina ADR
1994–95	1.92 e	1.21 e	–
1992–95	–	–	1.57 e

A2.3.2 Chile

Index: IFC emerging markets weekly index
NB: These are weekly, not daily, beta estimates

	Endesa (elec)	Emelsa (elec)	Emelat (elec)	Entel (telecoms)
Five-year beta	0.95 e	0.72 e	0.77 e	1.20 e

	Enersis (elec)	Enersis ADR*	Chilgener (elec)	Chilgener ADR*
Five-year beta	1.24 e	1.09 e (1993–95)	1.09 e	0.76 e (1994–95)

* ADR is quoted in $ and the beta calculation uses daily data and the Dow Jones Composite 65 index

A2.4. South-east Asia

A2.4.1 Japan Index: Nikkei 50

	Tokyo Electric Power	Chubu Electric Power	Kansai Electric Power	Matsushita Electric Works	Mitsubishi Electric	NTT (telecoms)
Five-year beta	0.28	0.29	0.34	0.57	0.69	0.62
1990	0.42	0.52	0.54	0.70	0.89	0.48
1991	0.32	0.25	0.37	0.60	0.75	0.65
1992	0.26	0.32	0.30	0.53	0.62	0.60
1993	0.36	0.30	0.37	0.62	0.65	0.98
1994	0.20	0.15	0.17	0.52	0.67	0.68

A2.5 Australia and New Zealand

A2.5.1 Australia Index: Australian All-share Index

	AGL
Five-year beta	0.38
	.25
	0.39
	0.28
	0.28
	0.45

A2.5.2 New Zealand Index: NZ Capital 40 Index

	Telecom Corp.
Five-year beta	0.97
1990	n/a
1991	0.52
1992	0.60
1993	1.20
1994	1.06

Note: NZ Capital 40 Index is not available prior to 1991.

Appendix A3 Examples of the Interval Problem

Five-year beta estimates using daily, weekly and monthly data.

A3.1 US companies

Index: Dow Jones Composite 65

Table A3.1: US gas companies

	Atlanta Gas Light	Brooklyn Union Gas	Connecticut Natural Gas	Enserch	Florida Public Utilities	Natural Fuel Gas Co
Daily	0.19	0.14	0.14	0.39	0.08	0.21
Weekly	0.26	0.11	0.14	0.38	0.14	0.24
Monthly	0.19	0.21	–0.05	0.56	0.19	0.26

Table A3.1 (continued)

	New Jersey Resources	Nicor	N. Carolina Natural Gas	Northwest Natural Gas	ONEOK	Wisconsin Energy
Daily	0.10	0.29	0.06	0.12	0.35	0.29
Weekly	0.13	0.26	0.24	0.10	0.27	0.30
Monthly	0.21	0.18	0.65	0.19	0.23	0.21

Table A3.2: US gas companies' average beta

	Average
Daily	0.20
Weekly	0.21
Monthly	0.25

Table A3.3: US water companies

	Consumers Water	Philadelphia Suburban
Daily	0.07	0.12
Weekly	0.18	0.14
Monthly	0.32	0.25

A3.2 UK companies Index: FTSE–100 index

Table A3.4: UK RECs

	Eastern	East Midlands	London	Manweb	Midlands	Northern
Daily	0.55	0.56	0.59	0.57	0.57	0.58
Weekly	0.66	0.74	0.70	0.63	0.71	0.65
Monthly	0.83	0.83	1.07	1.00	1.04	1.00

Table A3.4 (continued)

	Norweb	SEEBOARD	Southern	South Wales	South Western	Yorkshire
Daily	0.63	0.64	0.61	0.61	0.52	0.56
Weekly	0.67	0.83	0.71	0.72	0.77	0.64
Monthly	0.83	1.13	0.95	1.08	0.92	0.84

Table A3.5: UK RECs' average beta

	Average
Daily	0.58
Weekly	0.70
Monthly	0.96

Table A3.6: UK gas and telecommunications companies

	British Gas	BT
Daily	0.84	0.87
Weekly	0.76	0.91
Monthly	0.67	0.82

Appendix A4 Confidence Intervals for Beta Estimates

95% confidence intervals for asset beta estimates for BT calculated using the FTSE 100 index.

Table A4.1: Confidence intervals for five-year beta estimates calculated from data with different interval lengths

	Daily data	Weekly data	Monthly data
Asset beta estimate	0.87	0.91	0.82
Upper bound	0.92	1.02	1.03
Lower bound	0.81	0.79	0.61
Number of observations	1,422	294	65

Table A4.2: Confidence intervals for daily beta estimates for BT calculated over periods of different lengths

	Five year (1990–95)	One year (1994)
Asset beta estimate	0.87	1.02
Upper bound	0.92	1.13
Lower bound	0.81	0.90
Number of observations	1,422	252

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1678	Financial Development and Economic Growth: Views and Agenda	Ross Levine	October 1996	P. Sintim-Aboagye 38526
WPS1679	Trade and the Accumulation and Diffusion of Knowledge	Pier Carlo Padoan	November 1996	M. Pateña 39515
WPS1680	Brazil's Efficient Payment System: A Legacy of High Inflation	Robert Listfield Fernando Montes-Negret	November 1996	T. Ishibe 38968
WPS1681	India in the Global Economy	Milan Brahmbhatt T. G. Srinivasan Kim Murrell	November 1996	S. Crow 30763
WPS1682	Is the "Japan Problem" Real? How Problems in Japan's Financial Sector Could Affect Developing Regions	Shigeru Otsubo Masahiko Tsutsumi	November 1996	J. Queen 33740
WPS1683	High Real Interest Rates, Guarantor Risk, and Bank Recapitalizations	Philip L. Brock	November 1996	N. Castillo 33490
WPS1684	The Whys and Why Nots of Export Taxation	Shantayanan Devarajan Delfin Go Maurice Schiff Sethaput Suthiwart-Narueput	November 1996	C. Bernardo 37699
WPS1685	Macroeconomic Crises and Poverty Monitoring: A Case Study for India	Gaurav Datt Martin Ravallion	November 1996	P. Sader 33902
WPS1686	Institutions, Financial Markets, and Firms' Choice of Debt Maturity	Asli Demirgüç-Kunt Vojislav Maksimovic	November 1996	P. Sintim-Aboagye 37644
WPS1687	Regionalism versus Multilateralism	L. Alan Winters	November 1996	A. Kitson-Walters 33712
WPS1688	Risk, Taxpayers, and the Role of Government in Project Finance	Michael Klein	December 1996	S. Vivas 82809
WPS1689	Is Economic Analysis of Projects Still Useful?	Pedro Belli	December 1996	K. Schrader 82736
WPS1690	Stock Markets, Banks, and Economic Growth	Ross Levine Sara Zervos	December 1996	P. Sintim-Aboagye 38526
WPS1691	Integrating the Unofficial Economy into the Dynamics of Post-Socialist Economies: A Framework of Analysis and Evidence	Daniel Kaufmann Aleksander Kaliberda	December 1996	S. Torres 39012

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1692	Regulating Market Risk in Banks: A Comparison of Alternative Regulatory Regimes	Constantinos Stephanou	December 1996	P. Infante 37642
WPS1693	Famines and Economics	Martin Ravallion	December 1996	A. Ramirez 85734
WPS1694	What Can New Survey Data Tell Us about Recent Changes in Distribution and Poverty?	Martin Ravallion Shaohua Chen	December 1996	A. Ramirez 85734
WPS1695	Are There Dynamic Gains from a Poor-Area Development Program?	Jyotsna Jalan Martin Ravallion	December 1996	A. Ramirez 85734
WPS1696	South-North Migration and Trade: A Survey	Maurice Schiff	December 1996	M. Patena 39515
WPS1697	Strategies to Develop Mortgage Markets in Transition Economies	Dwight M. Jaffee Bertrand Renaud	December 1996	R. Garner 37670
WPS1698	Regulatory Structure and Risk and Infrastrcuture Firms: An International Comparison	Ian Alexander Colin Mayer	December 1996	R. Schneiderman 30191