

# **Extraordinary Circumstances and Regulatory Pricing**

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**E**xtraordinary events cause significant supply disruptions for major utility industries. When the relevant suppliers are regulated firms, standard market responses to extraordinary events, such as individual customer contracts with an allocation of liability, are unavailable. Both the existence of regulation and political necessity mean that such events often involve a costly response by government, the regulated firms or the public. State-based regulators around Australia are grappling with the problem of how to deal with these costly responses in on-going utility regulation. In this paper, we provide a framework for analysing regulatory responses to extraordinary circumstances. We note that dealing with the risk of extraordinary events is a standard insurance problem. The regulatory issue involves incorporating relevant insurance principles into the on-going system of regulation. This is likely to involve a balance of mandated precautionary activity combined with government and public liability, together with risk-bearing and self-insurance by the regulated firm. This balance determines the liability for expenses and compensation arising from an extraordinary event. It also determines both the pre-event and post-event regulatory procedures that will govern the utility. In particular, it is impossible to separate the pre-event regulatory regime and the post-event liability for costs.

## **Background**

Infrastructure regulators are currently investigating the establishment of pricing principles to cover investments made either under extraordinary circumstances or in response to an extraordinary circumstance (for example, the Queensland Competition Authority and the Essential Services Commission in Victoria). These regulators set the prices and vet the costs for regulated firms in gas, electricity, water and other infrastructure industries. The key issue they face is how to use their regulatory powers to allocate the costs of unexpected investments that are needed to address an extraordinary circumstance. While the precise definition of an extraordinary circumstance is still to be established, there is some confidence that the severe drought conditions affecting Gladstone's water supply, the electricity outage in Auckland, the Longford gas disaster in Victoria and the Sydney water crisis, all fall into any reasonable definition.

In this paper, we provide an overview of the pricing instruments and trade-offs associated with extraordinary circumstances and regulatory pricing. We

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consider both the definition of an extraordinary circumstance and the underlying regulatory economic issues raised by the possibility of such extraordinary circumstances. In particular, we note that the way a regulator deals with investments made in response to an extraordinary circumstance is critically dependent on the regulatory approach to risky events established prior to any extraordinary circumstance occurring. In other words, dealing with extraordinary circumstances involves a regulatory role and requires consistency of regulatory approach both before and after an extraordinary circumstance. In this sense, it is impossible to consider the appropriate regulatory response to be taken after an extraordinary circumstance unless the regulatory approach to risk before such a circumstance is fully articulated.

This paper proceeds as follows. We begin by considering the definition of an extraordinary circumstance. Then we consider the relevant regulatory approaches that can be adopted to risk *before* an extraordinary circumstance arises and in preparation for such a circumstance. We also discuss how these *ex ante* regulatory alternatives feed into compensation for extraordinary circumstances.

### **Definition of ‘Extraordinary Circumstance’**

Regulators use the term ‘extraordinary circumstance’ (or EC) to characterise events that have two specific characteristics. First, regulators define an EC as an event that occurs with low probability. Second, to be an EC, the relevant event must involve some major disruption to supply that can be made less likely by reduced consumption and increased investment in capacity. Regulators control either the ability of a regulated infrastructure firm to invest or the ability of that firm to recover its investment expenses, so this second characteristic means that there is potential for a regulatory response to the EC.

Both of these characteristics involve a continuum. The probability of an event occurring can range between zero and unity. Consequently, any definition of an extraordinary circumstance that captures both of these characteristics will either rely on arbitrary boundaries on both the probability and degree of disruption, or will have a significant ‘grey area’ for dispute.

At its simplest, as used by regulators, an EC could be defined as a highly unlikely event involving a prolonged and widespread loss of supply. However, such a definition would be inadequate. Neither the probability of a particular supply-side event, nor its intensity, is outside the control of the infrastructure firm and the regulatory authority. Further, such a definition would capture a wide range of events in industries that require no government intervention whatsoever.

There are many industries where a major disruption to supply is possible. For example, in 2003 the Australian car industry was brought to a standstill due to an industrial dispute that prevented a key component being delivered to automotive plants. This was a major disruption to supply in that industry. However, it did not lead to a regulatory response because the supply shock was an internal matter to the relevant supplier, the workers and the car plants that purchased the component. From a regulatory perspective, the supply shock did not require intervention.

Thus, if we are to consider the definition of an EC for a *regulated* infrastructure industry, we cannot simply refer to it as a significant supply shock without considering why the supply shock calls for a government regulatory response.

From an economic perspective, there are *prima facie* efficiency grounds for government intervention in a supply shock that gives rise to large effects that are not internalised by the relevant market participants. If a supply shock leads to a relevant market response without external costs, then there is little if any need for government regulation. For a regulated infrastructure provider, however, such a market response to an external shock will be muted at best. The contracts between regulated firms and their customers are usually controlled by the regulator. The regulator vets investment both before and after an EC and any responses to an EC by a regulated firm usually require regulatory approval. Customers have a limited ability to seek compensation for the costs of an EC through the legal system. Politically it is often impossible for governments to ‘stand by’ and let the market work out the consequences. As a result, an EC will often lead to external costs that cannot be internalized by the market. Therefore, when considering the definition of an EC in a regulated industry the relevant dimension for analysis is not the size of the supply disruption *per se*, but rather the size of the external costs to the community of the supply disruption. In other words, when considering an EC, we need to focus on the size of the external social costs of the supply shock.

The second problem with a definition that focuses on small probability events involving large supply shocks is the failure to recognise the roles of the firms and regulators in determining the probability of specific events. There is clearly a wide range of potential factors that creates supply risk in any industry. Supply risk could relate to acts outside the relevant firm’s control (for example, acts of God, acts of terrorism) or to factors such as maintenance and investment in capacity that are directly controlled by the firm. In many circumstances, an extraordinary event will involve both controllable and uncontrollable risk. For example, in the case of the Gladstone Area Water Board, drought resulted in a severe reduction in the local supply of water, and the potential for the area to literally run out of water. Clearly the extraordinary drought was beyond the Water Board’s control. But the potential supply disruption created by the drought was not beyond control. The Board could have lowered the risk of an extraordinary drought creating supply disruption by building larger water storage facilities before any drought occurred. In other words, while the probability of extraordinary drought was outside its control, the Board had control over the probability of an extraordinary drought causing a significant supply disruption.

Similarly, the regulator’s actions prior to the drought affected the probability of a significant supply disruption. The regulator (or another government agency) could have required the building of extra storage capacity. It chose not to do so. While this could be an economically sensible decision, it highlights that the probability of supply disruption is not exogenous to the regulatory process.

The relationship between the probability of supply disruption and regulation highlights two factors. First, to the degree that supply disruption is outside the control of the relevant parties, regulation dealing with the disruption will resemble

insurance. If there is exogenous risk of supply disruption then some party must bear that risk. This may be the community serviced by the regulated firm, the regulated firm itself, the broader community — either State-wide or Australia-wide — or a combination of all three groups. Whichever party bears that risk, will need to be compensated for it. The principles of good insurance suggest that the risk should be borne by the parties who: (a) are the least risk averse in the sense that they place the lowest cost on bearing risk; and (b) are in the best position to pool risk in order to lower the total variance of risk faced. At the same time, these principles will need to fit in with practical regulatory constraints.

Second, to the degree that supply disruption and the intensity of any disruption depend on the individual firm, the regulator has a role in *risk regulation*. The regulator needs to establish regulatory principles that lead the regulated firm to take appropriate care in order to reduce the probability of a severe supply disruption that creates significant external community costs. This does not mean that risk should be reduced to zero. Such risk minimisation will generally be prohibitively expensive and the costs will outweigh any benefits. Rather, the regulator needs to determine: (a) the optimal level of risk for society; and (b) how best to lead the regulated industry to have that desired level of risk.

In summary, a naive definition of an extraordinary circumstance as a major supply disruption that occurs with a low probability is unsatisfactory because it does not address the key social costs and because it ignores the endogenous nature of the probability of a supply event. For this reason it is better to define an EC in terms of the magnitude of the external cost imposed on the community through a supply disruption for a regulated firm. Such a definition focuses clearly on the issue of importance for regulatory intervention and draws attention to the necessity of isolating the regulatory reasons why the social costs are not internalized.

### **The Economics of Risk Regulation**

The economic principles underlying risk regulation need to be considered before looking at the issues that regulators need to address when considering the pricing principles for EC related investments by regulated firms. Why is risk a matter for concern in regulated infrastructure industries? How can regulators deal with risk regulation *ex ante* before there is an EC? How does the regulatory response after an EC tie into the general framework of regulatory risk adopted by the regulator?

#### *The basic problem*

The basic concern is that a regulated firm in an infrastructure industry may not provide a socially optimal level of supply security. More particularly interruptions may occur too frequently and at too high a cost to the general community.

The socially optimal level of supply security is unlikely to be a standard of perfect reliability where there are no interruptions. While reducing the probability of an interruption to zero would benefit the community, the cost of doing so would often be prohibitively high. These costs are associated with actions that agents in

the economy can take to increase the security of supply. Although these actions may be conveniently labelled, *precaution*, they comprise investments in redundancy, safety protocols, substitute supply sources, alert-awareness and the like. Each of these actions is costly. To evaluate whether they are worthwhile, the cost of these activities must be compared with the benefits they generate.

A competitive firm in a private market will often face incentives to invest in a socially appropriate level of precaution, particularly if consumers can hold that firm liable for the costs of any supply disruption. To the extent that different consumers require different levels of security, this can be written into supplier-customer contracts. While standard issues such as asymmetric information and moral hazard may limit the ability of competitive markets to achieve optimal solutions, market outcomes will often be adequate and require no further intervention.

Such a market-based approach cannot be relied on for large infrastructure firms subject to strong regulation. First, the regulator usually sets the prices and the relevant service standards. There is no scope for standard market solutions to achieve an optimal level of precaution. Second, regulators usually vet investments and other activities such as maintenance to ensure that a firm is not artificially 'gaming' the regulatory system. Thus, even if a regulated firm wishes to alter precautionary activities, it would need to satisfy the regulator that this is legitimate. Asymmetric information between the regulated firm and the regulator may make this vetting process difficult.

Third, to the extent that the infrastructure involves networks and security is part of network integrity, then it is difficult for a consumer in a locality to have secure supply while another does not. Thus, any private market solution is likely to fail because customers purchasing higher supply security are likely to create a positive benefit for other customers, who may not pay for the improved security.

Finally, an EC often generates large costs that, politically, cannot be ignored. If a major town runs out of water or loses power, it is politically impossible for regulators not to respond even if they believe adequate precaution was taken. Further, advising consumers to 'sue the regulated firm' is unlikely to be considered an appropriate response.

### *The issues*

Given that the privately provided level of precaution by a regulated infrastructure provider is likely to differ from the socially optimal level, there are three key regulatory issues to be resolved. First, should the government specify a set of precautionary investments and activities (that is, mandate standards) or should it let the regulated firm decide these for itself? This is a question of the allocation of decision authority with regard to precaution. Second, how should the regulated firm be compensated for its precautionary activities, whether mandated or not? This is a question of how precautionary expenses and risks are built into regulated prices. Third, if an extraordinary event occurs and there is a supply shock that requires significant rapid investment or other mitigation costs, who should bear

the costs? This question recognises that optimal risk regulation will not eliminate risk of significant supply disruption, and the regulator needs to establish well defined rules in advance to deal with such a disruption if and when it occurs. We consider each of these issues in turn.

#### *Allocation of decision authority*

Consider a situation where, left to itself, the level of supply risk in a regulated infrastructure industry is too high from a social perspective. Regulators have an incentive to raise the level of precaution undertaken by firms. How might they approach the regulation of supply risk to ensure appropriate precaution is taken?

One approach would be that of *mandated standards*. In this situation, the government assesses the precautionary actions, procedures and investments an infrastructure provider should make and requires the regulated firm to carry out them out. Alternatively, the government specifies the *penalties* that would be imposed on a regulated infrastructure provider in the event of a disruption to supply. It would then be up to the provider to manage the risks. Thus, there are two broad classes of regulatory instruments for managing supply risk:

- *On-going regulation*. Instruments designed to monitor (or audit) the current (or historic) levels of precaution taken by regulated infrastructure owners and provide incentives or performance sanctions to ensure a socially optimal level of precaution.
- *Liability rules*. Operation of these instruments is triggered by an actual interruption. Each specifies a set of sanctions and compensations that must be paid by the regulated infrastructure firm if an interruption occurs.

In what follows we will review instruments of each type in turn. It will be argued that a reliance on one type alone will generally be inadequate for the optimal regulation. Hence, it is likely that a combination of on-going regulation and liability will be the appropriate policy.

#### *On-going regulation*

On-going regulation involves more active government involvement in the actions of infrastructure firms. The objective of on-going regulation is to reduce the likelihood of a major interruption through the development and review of operating standards. Possible instruments include:

- *Periodic audits*: the government periodically holds inquiries into the level of precautionary actions undertaken by infrastructure providers.
- *Standards*: standards for precautionary actions are taken and monitoring used to ensure those standards are being met on an on-going basis.
- *Incentive regulation*: rewards and sanctions are instituted on a recurring basis for failure or otherwise to undertake precautionary actions.

On-going regulation has the potential to generate a socially optimal level of supply security. However, it places incentives directly on precautionary actions rather than indirectly on the observed consequences of those actions. As such, the information requirements for the regulator are more onerous. The regulator needs to have some way of assessing the optimality of desired levels of precaution as well as monitoring whether those actions have been taken. Each of these tasks is potentially costly. Two key features determine the success of on-going regulation:

- *Observational difficulties.* To be effective, a regulator must be able to observe the level of precaution undertaken. It will be difficult to impose sanctions on infrastructure providers if performance measures can be manipulated easily, (see Milgrom and Roberts, 1992; Baker, 1992).
- *Regulatory commitment.* There may be changes that alter the regulator's view of the optimal level of precaution. However, changes based on the past actions of infrastructure owners (for instance, easily achieved standards) may tempt regulators to 'ratchet-up' performance standards. Foreseeing this, infrastructure firms may not perform as well. Hence, on-going regulation requires commitment on the part of the regulator to previously set standards.

The key to the success of on-going regulation is the identification of appropriate levels of precaution and the ability to link these levels of precaution to sanctions if non-performance is detected. If either of these factors is difficult, on-going regulation will be less effective. On-going regulation also has the advantage of creating incentives for *user* investment in precaution. For example, a hospital might invest in back-up generation as a precaution against a power failure.

#### *Liability rules*

A liability rule specifies a set of sanctions or compensatory mechanisms that are triggered by actual realisations of interruptions to service. These include:

- *Strict liability rules.* Rules that hold infrastructure owners liable for the costs of all supply interruptions (regardless of how they are caused).
- *Contract damages.* Imposed contractual terms that specify the compensation that must be paid to users in the event of supply interruptions.

If specified correctly, each of these instruments has the potential to encourage socially optimal precaution on the part of infrastructure owners. Each is an obligation on infrastructure providers to ensure supply. If they cannot, then these mechanisms specify the penalty they must pay. If this penalty reflects the harm actually caused by the interruption, then a private infrastructure owner will internalise any social costs imposed by interruptions.

Liability rules, if working properly, have the key advantage of relatively low informational requirements. The only information required is an evaluation of the

actual harm done, which is observed when that harm is realised. Thus, information can be gathered *ex post*. So no information on the precautionary actions undertaken by the infrastructure provider is required. Indeed, liability rules demand no *ex ante* judgment on the levels of these actions whatsoever.

However, there are several conditions under which liability rules may not operate well:

- *Incomplete enforcement*: for a liability rule to work properly, compensation based on actual harm faced must actually be paid. If the court system only weakly enforces the rule, too little supply security will be realised (Shavell, 1987). Similarly, if after the EC occurs the payments by the regulated firm are deemed to be excessive and reduced or subsidized by government, then a liability rule will not work properly.
- *Limited liability*: if the magnitude of harm is larger than a firm capacity to pay it will limit the ability of a liability rule to encourage firms to internalise the costs of their actions (Shavell, 1984; Whittman, 1977).
- *Risk aversion*: a liability rule means that an infrastructure provider is liable for interruptions even if they are not related to precautionary actions. This is a key part of the informational advantage of liability rules. However, risk-averse agents bear additional costs from these risks. This may raise the cost of capital to infrastructure and deter investment (Polinsky and Shavell, 1979).
- *Many responsible agents*: liability rules presume that only the infrastructure provider is responsible for precaution, or that fault can be easily assigned if multiple players are involved. In reality, other agents, including users, regulators and even debt providers may also be responsible. Determining the optimal liability rule when this is the case is difficult (Pitchford, 1995).
- *Governance issues*: interruptions are rare events. So while the probability of one occurring in a given year, five years or even a decade is small, over twenty or fifty years that probability becomes much higher. Precaution is likely to be effective in reducing probabilities of interruptions over that longer time horizon. However, the time horizon of infrastructure managers and equity holders is much shorter. So while the costs of precautionary actions are borne immediately, the beneficial consequences are not realised during the economic life of those decision-makers. This means that the incentive effects of a liability rule might be weak.
- *Equity issues*: if the risky event is perceived as potentially severe, likely to cause substantial physical damage to humans, then there may be an emphasis on prevention rather than compensation in policy design. Community concerns regarding substantial environmental damage could also limit the scope for liability rules to be considered fully effective.

Each of these difficulties reduces the ability of a liability rule to ensure that decision-makers responsible for precautionary actions internalise the full social costs of those actions.

### *Combining instruments*

Both on-going regulation and liability rules are imperfect instruments to promote precaution. The appropriate policy to promote optimal supply security will rely on each of these approaches to the degree that the marginal benefit of each approach is equated. This is likely to lead to a mixture of liability rules and on-going regulation unless one approach strictly dominates another for a particular regulated firm. The relative strengths, or alternatively the limitations of the different policies in influencing risk management practices, will drive the mix. The trade-off between the alternative policy approaches will depend on their relative efficiency. For example:

- How large is the magnitude of possible harm? If an interruption results in harm whose monetary value exceeds the ability of a corporation to pay (that is, it would go bankrupt first), then liability rules will be less effective.
- Are many agents responsible for precaution? If many agents are responsible, then liability rules are unlikely to be fully effective. However, if there is scope for negotiation among those responsible, such rules could be effective.
- How easy is it to evaluate the social costs and benefits of a precautionary action? If a government inquiry could establish that certain precautionary actions were worthwhile, then on-going regulation of their performance is desirable. If cost-benefit analysis is difficult or impossible before an EC then liability rules may be preferred.
- Is on-going monitoring of performance costly? If periodic performance monitoring of infrastructure providers is costly, it may not be easy to ensure that firms are complying with desired standards under on-going regulation.
- Do community standards regarding a desirable level of supply security change infrequently? If they are more or less constant over time, then the temptation of regulators to increase performance standards is reduced and on-going regulation is more effective.

### *Summary*

In summary, there are two main approaches to deal with the decision to determine the level of *ex ante* precaution for extraordinary circumstances. The regulator can respond to the potential risk of an EC by:

- regulating actions to mitigate risks; or
- establishing liability for outcomes.

The choice between these alternative policies depends on the particular circumstances facing the regulator, including the information available to them and their ability to monitor precautionary activities over time. As we have indicated, legal, political and commercial limitations undermine sole reliance on liability rules.

The choice between regulatory alternatives and the degree of intervention depends fundamentally upon the nature of the interruption. The discussion above provides a basis for characterising the interruption and for determining whether policy instruments for risk regulation lie more with liability assignment or regulation of business practices.

### **Compensation for Precautionary Activities**

In the previous section, we discussed alternative approaches to *ex ante* risk regulation. In particular, such regulation can involve liability rules or mandated standards. These alternative approaches have different implications for on-going price regulation of infrastructure firms. We explain each in turn.

#### *Liability rules*

Liability rules involve the regulated firm itself determining and carrying out the relevant precautionary activities. Given the liability rules set by the regulator and the probabilities associated with relevant events, the regulated firm will decide which precautionary activities to engage in and the extent of these activities. For many potential ECs, it will not be socially desirable to reduce the probability of an event to zero and even under strict liability rules it will often not be privately optimal for the regulated firm to reduce the probability of a particular EC to zero. In other words, the firm will optimally trade off the cost of precautionary activity with the probability of an EC and the cost to the firm of an EC.

As already noted, the advantage of liability rules is that they leave the degree of precaution to the firm itself and the regulated firm is likely to be in the best position to judge both the cost and effectiveness of different precautionary activities. At the same time, it needs to be recognised that using liability rules effectively requires the firm to self-insure against the possibility of an extraordinary event. The firm will undertake relevant actions to optimally mitigate the risk of an EC but will bear the residual risk (subject to the relevant liability rules) itself. Thus, using liability rules to deal with risk regulation is similar to requiring the firm to 'self insure' against extraordinary circumstances.

How should the regulated firm be compensated for this self-insurance? From an economic perspective, the preferred approach would be to consider the actuarially fair premium for self-insurance and to allow the firm to recover that premium through its on-going pricing.

The efficacy of such an approach depends on the ability of the regulator to accurately measure the relevant insurance premium. It should be noted that under liability rules, the regulator cannot directly compensate the regulated firm for precautionary activities. There are two reasons for this. First, the precautionary activities chosen by the firm will often be difficult for the regulator to verify. Using liability rules reduces the information burden on the regulator, and having compensation based on actual precautionary activity simply reintroduces the information difficulties that liability rules are meant to avoid. Second, if the firm

under liability rules can choose its own level of precautionary activity and is directly compensated for those activities, then the firm will choose an excessive level of precaution. The cost of any precautionary activity is 'refunded' through the regulated price of its goods or services, but increased precaution lowers the risk faced by the firm. Thus from the firm's perspective, direct compensation for precautionary activities under a liability approach means that precautionary activities have benefits but no costs. The firm will engage in too much precaution from the social perspective.

An alternative to self-insurance under a liability approach would be for an external party, such as the government, to effectively insure the firm. There are significant benefits from such an approach in terms of risk pooling. A self-insured firm is exposed completely to the idiosyncratic risks that face its industry. Under a pooled insurance scheme, however, those risks are shared between all firms covered by the insurance scheme. If the government effectively insured the firms, then the government might seek to recover the implicit insurance premium directly from the regulated firm or through broader tax instruments.

A significant problem, however, associated with 'government insurance' for ECs is that, in its role of insurer, the government would most likely need to set minimum precaution levels for the relevant firm and would need to monitor such precautions. In other words, the government would have to move away from a liability approach back to a regulatory approach based on strict standards. This may be avoided to some extent by offering only partial insurance. In other words, the government could offer EC insurance subject to a deductible that is borne by the firm if an EC occurs. Of course, this is really just a mixture of 'liability regulation' and 'standards regulation', being presented under another guise.

#### *Mandated standards*

If risk regulation is based on mandated standards, then the approach to compensation for precautionary activity is likely to be significantly different. Under a mandated standards approach, the government sets the required minimum level of precaution and compensates the firm directly for its through the firm's regulated prices. These costs would most likely be set according to some 'efficient' standard to avoid regulatory manipulation.

Under a pure mandated standards approach, the regulated firm would face no further liability for any community loss due to an EC so long as it had satisfied the mandated standards. In this situation, the risk of an EC is borne by the government and the community served by the regulated firm. In particular, if an EC requiring government intervention occurred, the risk would be effectively borne by the state tax payers.

It might be felt that a better approach to EC risk bearing would involve the state adopting an insurance type approach. For example, the state government could require that all regulated firms contribute to an extraordinary circumstances fund each year. This fund would accumulate over time and would be used to fund expenditure brought on by an EC (community assistance, community

compensation or sudden infrastructure expenditure). As noted above, a mandated standards approach exposes the government to EC risk. In effect, however, such a fund simply involves the regulated firm's customers paying for the pool of funds to cover the costs of an EC. Also, the accumulation of these funds may face political risks, particularly if the EC fund became very large.

### **Cost Recovery Following an Extraordinary Circumstance**

If an EC occurs, then there is likely to be significant expenditure borne by either the regulated firm or the government. The party that bears the expenditure depends on the exact nature of the liability rules established *ex ante*. In other words, the issue of *ex post* cost recovery cannot be separated from the issue of *ex ante* risk regulation.

To see this, consider a regime of strict liability. Under such a regime, the regulated firm determines the degree of precautionary activities and is compensated for both these activities and the risk it faces through a 'self insurance' premium or some other payment that the firm receives each year prior to an EC. But as the firm is 'self insuring', when an EC occurs the regulated firm would be required to bear the relevant EC costs without further compensation. The firm has already been effectively compensated for the *ex post* payments through the *ex ante* 'insurance premium' built into its prices.

Thus, under a strict liability approach, the firm is not compensated for any extraordinary expenditure associated with an EC. Rather, the firm itself must choose the appropriate way to tackle the EC. This may involve direct customer compensation, possibly tied in with customer incentives to minimise use of the relevant supply-constrained output. Alternatively, it could involve the regulated firm having to invest suddenly in substantial new infrastructure to overcome the supply interruption. The firm chooses the best way to limit the *ex post* damage associated with the EC because it is fully liable for this damage.

Note that this means that any capital investment made by a regulated firm in response to an EC under a strict liability approach would not be added to the firm's asset base. Rather the firm would bear those costs entirely by itself.

Such an approach raises important practical issues. As noted above, if the payment is of a size that will bankrupt the firm, then placing the full cost burden on the firm is infeasible. Similarly, in the face of an EC, the government may face substantial pressure to 'step in' and 'help out' the firm and the community.

To the extent that the government does assist the regulated firm with cost recovery in the face of an EC, either directly or by allowing it to add emergency infrastructure to its regulated asset base, the risk of an EC is shifted back from the firm on to the government and the public. This undermines the incentive effects of the strict liability approach to risk regulation. It might also distort the regulated firm's incentives when faced by an EC. For example, if the regulated firm is allowed to recover infrastructure expenditure due to an EC by adding this expenditure to its regulated asset base, but the firm is not allowed to recover once-

off customer compensation, then it will respond to an EC by building infrastructure, even if this is not the socially appropriate response.

Alternatively, consider the minimum standards approach to risk regulation. Under such an approach, so long as the regulated firm satisfies the minimum standards, it would generally not be held liable for any compensation or expenditure that is purely due to an EC. If an EC results in new infrastructure, then the funding of this infrastructure would be the responsibility of the government. The government would need to compensate a firm required to fund and build the infrastructure. If the government failed to compensate the firm, then it would be imposing EC liability on the firm.

When the response to an EC involves infrastructure expenditure, then this could be funded by rolling the infrastructure cost into the regulated asset base in full. However, this is simply one form of tax that can be used to pay for the infrastructure. Further, given the narrow base of such a tax, it would most likely be a highly inefficient tax. Effectively, such an approach would simply place all the risk associated with an EC (subject to the minimum levels of precaution being satisfied) back on to the community that suffers from the EC. Such an approach would not be consistent with the economic principles of good insurance as it would effectively prevent the local community from insuring against EC risk.

In summary, under a mandated standards approach, the burden of paying for a response to an EC, including any response that involved new infrastructure, would be borne by the State and would need to be funded through some mechanism. Funding could be through general revenue raising procedures (that is, debt or taxation), through an EC fund as discussed above, or through the local community by rolling the infrastructure into the regulated asset base.

## **Conclusion**

The discussion above shows that *ex post* cost recovery must be consistent with the *ex ante* risk regulation. *Ex post* cost recovery and *ex ante* risk regulation are inextricably connected and it is impossible to just consider *ex post* cost recovery in isolation. The discussion also points out that practical regulation is unlikely to involve a 'pure' liability or a 'pure' mandated standards approach. Rather, a practical regulatory solution is likely to have elements of both approaches.

In practice, while regulators have tried to address the consequences of an EC when dealing with infrastructure firms, they have not, in general, adopted a consistent approach. Rather than thinking about the risk implications of these events in advance and incorporating relevant procedures into regulatory regimes, regulators have adopted an ad hoc mixture of pre-EC and post-EC policies. This is unlikely to lead to appropriate levels of precaution and increases uncertainty for both the regulated firms and the public as no one is sure in advance where liability for losses arising from an EC will fall. It creates poor incentives for regulated firms to undertake precautionary actions that 'self-insure' against the risks of an EC. These incentives are exacerbated if regulators mistake legitimate risk-

reducing investments as unnecessary cost padding and remove these investments from the regulated asset base.

At its worst, an *ad hoc* approach to dealing with the costs of an EC means that regulators, governments, regulated firms and the public, rather than knowing their role after an EC, each has incentives to try to force another group to react. The results can be draconian, as for example the use of a large number of inspectors checking that residential gas supplies had been turned off by householders and fining non-compliant households in the face of the Longford gas disaster in Victoria.

The key result from this paper is that regulators must act consistently both before and after an EC. Treatment of extraordinary circumstances for regulated firms is like a variety of other insurance problems. Regulators must embed optimal insurance into ongoing regulation to prepare for extraordinary events.

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