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Terrorism insurance subsidies and social welfare

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Abstract

A model of the effects of terrorism risk on building construction suggests that subsidy of terrorism insurance can increase social welfare. Such a subsidy program should cover a fixed level of risk per location.
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> "The inability to diversify risks through insurance and reinsurance will make new construction infeasible. Thus, my fear is that, for at least a decade, the primary real estate issue regarding terrorist attacks will not be 60- vs. 100-story buildings or downtown vs. suburban locations, but whether any unsubsidized office buildings can be built by the private sector at all."
>
> Edwin Mills, Journal of Urban Economics, 2002.

> "With this new law, builders and investors can begin construction in real estate projects that have been stalled for too long, and get our hard hats back to work."
>
> George W. Bush, signing the Terrorism Risk Insurance Act of 2002.[1]

1. Introduction

In November 2002 President Bush signed legislation under which the federal government would subsidize insurance coverage of losses from terrorist acts. Insurance for other disasters is already subsidized in various ways, to the dismay of many free-market-oriented

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economists.[2] These economists correctly point out that, in theory, subsidized insurance leads to levels of risk-taking behavior that are higher than the social optimum. For instance, since each new building constructed adds to the total likely damage from future floods and earthquakes, building owners should take these costs into account when deciding whether or not to build. If they do not take this risk into account, then the number of buildings constructed will be higher than economic efficiency would dictate. At first glance, terrorism insurance subsidies appear to suffer from the same defect. Terrorism increases costs associated with building ownership, so it would seem that the socially optimal level of construction would be lower if the risk of terrorism was significant than if there was no terrorism risk. An insurance subsidy would therefore seem to boost construction above the socially optimal level.

Terrorism, however, differs from earthquakes and floods in a way that might undermine the objections of economists to an insurance subsidy. Losses from floods and other natural disasters are an increasing function of the number of buildings that are in their path. Terrorists, on the other hand, can strike anywhere but have limited resources. Their ability to inflict damage might not depend on the number of buildings constructed in their target country. Suppose, for example, that a terrorist group has a limited supply of bombs, each of which can destroy a single building. The damage that this group can inflict will not increase if more buildings are constructed, since the group can only destroy as many buildings as they have bombs. If a new building is not constructed because of fear that the building will be destroyed by terrorists, total losses from terrorism will remain the same, since terrorists will simply destroy another building.

If losses are not a function of the number of buildings constructed, then potential losses from terrorism do not affect the socially optimal level of building construction. Without subsidized insurance, however, developers must pay for their share of expected losses from terrorism, and, as a result, they will construct fewer buildings. If the socially optimal level of building construction has not changed but developers construct fewer buildings, then there is a welfare loss to society, and an insurance subsidy may be desirable.

Other justifications have been proposed for government subsidy of terrorism insurance.[3] For example, terrorism is often described as less predictable than other risks. A small number of past incidents and the potential for huge losses is often held to make private insurance nearly impossible. This may be true, but it still does not address the question of whether subsidized insurance improves social welfare. If private insurance is expensive or unavailable, it may be that the risk of terrorism is so high that certain building projects should simply not be undertaken. In other words, the high price of private insurance might be the correct price, and subsidy might distort the efficient workings of the market. Another argument often raised is that losses from terrorism are potentially catastrophic, and private insurance companies will risk bankruptcy if they offer coverage. If this argument is valid,

[2] See, for example, Harrington [10]. Moss [15] provides an overview of federal disaster programs. Bohn and Hall [2] discuss moral hazard resulting from government subsidy of insurance. Flood insurance is discussed in more detail in Harrison et al. [11], Browne and Hoyt [4], and Shilling et al. [16].

[3] See Brown et al. [3], Kunreuther [13], and Hubbard [12]. Vaughan and Vaughan [17] contains a general discussion of possible reasons for subsidy of insurance.

it would suggest that government programs only insure huge risks above some very high threshold.

The argument in this paper is different from earlier justifications of terrorism insurance subsidy and has different implications for the design of government policy. Section 2 describes a model in which subsidy of terrorism insurance can increase overall welfare. Section 3 discusses possible objections and alternatives to the model. Section 4 discusses policy implications of the model and describes insurance subsidies in a number of countries. Section 5 concludes.

2. Model

The key feature of this model is the assumed nature of losses from terrorism. I will assume that, on average, d buildings will be destroyed by terrorists each year. As long as the total number of buildings in the economy, n, is greater than d, then losses from terrorism will be independent of n.[4] Building owners do not know which buildings will be destroyed, so, assuming that all buildings are identical, their expected loss from terrorism each year will be d/n, multiplied by the market value of a building. It is important to note that d need not be constant from year to year. Many factors might affect the value of d, including law enforcement efforts, foreign policy, or the past success or failure of terrorist attacks. The important assumption about d is not that it is constant, but that it is independent of n.

In the model, constructing a new building costs K. For simplicity, I assume that all buildings are identical and that new buildings can be constructed instantly. I also assume that, given sufficient expenditure on maintenance, buildings do not depreciate, so they can be valued as perpetuities with a discount rate of r. The cost of operating and maintaining a building for a year is c.

Rental income from a building, R, is a function of the total number of buildings in the economy, n. When new buildings are constructed n increases, and since the demand curve for rental space in buildings slopes downward, equilibrium rent will decline. Developers are assumed to be competitive, so they will build as long as the market value of a building is greater than K. In equilibrium, therefore, the market value of buildings will always equal K.[5]

Another assumption of the model is that when new buildings are constructed, the level of protection against terrorist attack per building remains constant. In other words, construction of a new building does not strain the resources of the police or other authorities. A possible justification of this assumption is that a new buildings will generate sufficient additional tax revenue to pay the marginal cost of protecting the building.

[4] If n is less than d then terrorists would be capable of destroying all buildings in the economy. Since it would be impossible to destroy more buildings than the number existing, terrorists will destroy all n buildings.

[5] This will not be true if income and wealth effects reduce the demand for rental space by enough to make building construction economically unfeasible. This possibility is discussed in Section 2.4.

2.1. The market for buildings without terrorism

If there is no terrorism, then the net operating income to building owners will be rental income minus operating and maintenance costs, and, since buildings are valued as perpetuities, the market value of a building will be equal to net operating income divided by the discount rate. In equilibrium, building value will equal construction costs,

$$\frac{R(n) - c}{r} = K. \tag{1}$$

Solving Eq. (1) for n yields n^*, the equilibrium number of buildings in the economy. Construction will occur in response to positive shifts in the demand curve for rental space. In other words, suppose that population or income increases and that this increases the demand for rental space at any given rental rate. The new demand curve could be labeled as $R_1(n)$. Rent at the previous value of n^* will exceed K and new buildings will be constructed.

Solving Eq. (1) for $R(n)$, the equilibrium rent, yields $rK + c$.

2.2. The market for buildings with terrorism

For each building owner, the annual expected cost of terrorism is d/n. If owners are risk-neutral, then this is the maximum premium they would be willing to pay for terrorism insurance. If owners are risk-averse, then they would be willing to pay more. Suppose owners are risk-neutral and pay a premium equal to d/n or simply bear this amount of expected risk. The cost of operating and maintaining a building will increase by this amount. The market for buildings will then be described by

$$\frac{R(n) - c - d/n}{r} = K. \tag{2}$$

Solving Eq. (2) for n will yield a different answer than the solution to Eq. (1). Suppose that the solution to Eq. (2) is n^{**}. Replacing n with n^* in Eq. (1) and with n^{**} in Eq. (2), and combining both equations yields

$$R(n^*) = R(n^{**}) - \frac{d}{n^{**}}. \tag{3}$$

Since d and n^{**} are both positive, Eq. (3) implies that $R(n^*) < R(n^{**})$. Assuming that $R(n)$ is a monotonic decreasing function, this implies that $n^{**} < n^*$. In other words, developers will construct fewer buildings, since operating costs have increased, driving down the market value of a building.

If insurance is subsidized and free to building owners then the market for buildings will be exactly the same as that described by Eq. (1).[6] Building owners will face no marginal costs of construction due to terrorism, and the stock of buildings will be equal to n^*, the same as if there were no terrorism.

If builders are risk-averse, then the effects described above will be greater. Risk aversion would increase insurance premiums, lowering net operating income and building value

[6] This assumes that any taxation used to subsidize insurance is non-distortionary.

by more than in the case of risk neutrality. Lower building values would further reduce building construction.

2.3. Terrorism and social welfare

A building stock of n^* maximizes the sum of consumer and producer surplus. Producer surplus is equal to zero, since the market for buildings is perfectly competitive. Consumer surplus is equal to the shaded area in Fig. 1 under the demand curve and above the equilibrium rental rate.[7]

A policy which discouraged construction and prevented the building stock from reaching n^* would reduce social welfare. Figure 2 shows that a building stock n_1 which is below n^* will reduce consumer surplus and increase producer surplus. The sum of the two, however, is less than the previous total surplus by the amount of the shaded triangle labeled "deadweight loss."

Under the assumptions I have made regarding the nature of terrorism, terrorism is a fixed cost which is independent of n. Annual losses from terrorism will be equal to d, the number of buildings destroyed, multiplied by the value of a building. Since the market for

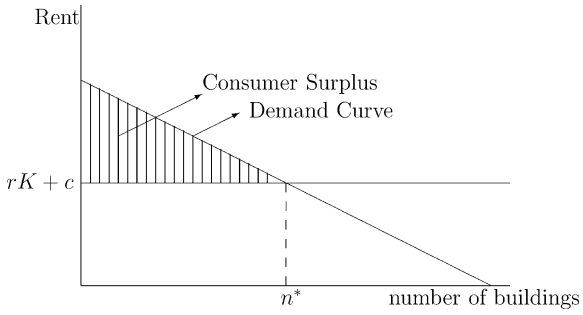

Fig. 1. Consumer surplus without terrorism.

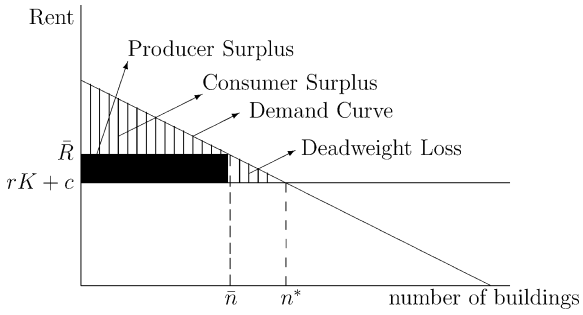

Fig. 2. Consumer and producer surplus with too few buildings.

[7] This method of evaluating social welfare originated with Harberger [9]. Browning [5] suggests that this method may underestimate welfare losses.

buildings is assumed to be perfectly competitive, buildings will always be worth K, and annual losses from terrorism will be equal to dK. Total surplus will be reduced by this amount (paid by building owners), but since dK does not depend on n, total surplus will still be maximized by a value of n equal to n^*.

The previous section demonstrates that if building owners must purchase terrorism insurance, developers will build fewer buildings. Since the socially optimal number of buildings has not changed, however, costly insurance leads to a sub-optimal result. Social welfare is improved with subsidized terrorism insurance.

2.4. Wealth and income effects

A complication to the model is the possibility of wealth and income effects. Terrorism will reduce the wealth and income of society, and so will probably reduce the demand for rental space at any given level of rent. Even if losses from terrorism are subsidized, taxation needed to support the subsidy will reduce the total wealth of society. If losses are not subsidized, building owners and tenants will be hurt by terrorist attacks and this loss of wealth could reduce overall demand for rental space.

Suppose that the knowledge of current and future terrorism changes rent as a function of the number of buildings in the economy to $R_0(n)$. If $(R_0(n) - c)/r < K$ for all n down to 1, then this effect would be so great that no new construction would occur, and buildings would simply be destroyed until there were none left. In this case, the stock of buildings would eventually equal the socially optimal level of zero regardless of whether insurance was subsidized or not. However, if income and wealth effects are small enough that it is socially optimal to maintain a non-zero building stock, then it will still be the case that failure to subsidize terrorism insurance will result in a sub-optimal number of buildings. In other words, the argument of the previous sections can be repeated with the new demand curve replacing the original demand curve.

3. Alternative models of terrorism

The model described in the previous section assumes that the number of buildings that are destroyed by terrorists is independent of the number of existing buildings. In this section, possible objections to this assumption and alternative assumptions are discussed.

3.1. The quantity of buildings signals wealth and motivates terrorists

If the desire of terrorists to strike a country increases with the wealth of the target country, and the number of buildings in the target country is used by terrorists as a measurement of its wealth, then it might be advantageous for the target country to construct fewer buildings. In other words, it might attempt to “hide” its wealth from terrorists by channeling its resources away from the construction of buildings and into other projects. However, it seems unlikely that terrorists would be fooled by this tactic. In fact, if resources are diverted into activities like foreign travel, the wealth of the target country might be made more apparent than before. If the data available to terrorists were limited to satellite

photos, then the number of buildings might be the best available measure of wealth. A wide range of data are available to terrorists, however, including government data, movies, and direct observation. Increasing other forms of consumption or investment and reducing the number of buildings does not seem like a promising method of reducing the resentment of terrorists.

It is possible that huge "trophy" buildings are attractive targets for terrorists because they are very visible signs of wealth. This possibility suggests that subsidized insurance coverage should be limited to some fixed amount per building. A limitation of this kind is discussed in more detail in the next section of the paper. With such a limit, owners of buildings that are unusually large would have to pay for the extra terrorism risk, and so would have an incentive to reduce the size of their buildings.

If wealth itself attracts terrorism, then it is possible that the accumulation of wealth by individuals produces a negative externality. In other words, if an individual accumulates wealth, then the world will increase its general estimate of the wealth of that individual's country, increasing the likelihood of terrorist attack. Accumulation of wealth by an individual therefore increases risks to other citizens of her country. Government could respond to this externality with a tax on wealth, but the argument of this paper would remain. The optimal number of buildings would be reduced by the reduction in wealth, but the number of buildings constructed would still be below the new optimum if building owners are forced to pay the cost of terrorism insurance.

3.2. More buildings mean more opportunities for terrorists

Buildings represent opportunities for terrorists, and perhaps additional buildings in a country will make it easier for terrorists to conduct attacks. For example, suppose that security measures at buildings deter attacks, but these measures randomly fail and terrorists can identify and exploit these failures. If a terrorist group has a limited time to wait for such a failure, then a larger number of buildings will mean a greater chance of success in the time it has available.[8]

The major difficulty with this model of terrorism is that there are no practical building-specific security measures that would have prevented the largest recent terrorist attacks. The Murrah Federal Building in Oklahoma City, Oklahoma was destroyed when a 20-foot truck filled with explosives was detonated in front of the building, and the World Trade Center was destroyed by aircraft. Nearly all of the preparations for these attacks took place far from the buildings themselves, so building-specific security measures would not have helped, unless all traffic in front of the building was stopped and anti-aircraft defenses were installed. Buildings are inherently vulnerable to attack, and there are many more attractive targets in the United States than there are terrorists. Since there are already many more vulnerable targets than terrorists are able to strike, the idea that the construction of an additional building would change the odds of an attack seems implausible.

[8] I thank an anonymous referee for this suggestion.

3.3. The economics of crime

Terrorism is a crime, and many economists have analyzed the factors which affect the level of crime (e.g., Becker [1], Cook [7], and Ehrlich [8]). Ehrlich [8] reviews the literature and reports that most research finds that the supply of crime is elastic with respect to punishment and prevention efforts. The model presented in this paper suggests that the level of terrorism is inelastic in some respects. This seeming contradiction is resolved by the fact that in the model, terrorism is only inelastic with respect to the number of buildings, not with respect to other factors. It may very well be that increasing penalties for terrorism, tightening border security, or changing foreign policy will reduce terrorism, even if changing the number of buildings in the country does not.

Certain crimes, such as motor vehicle theft and burglary, provide a useful analogy with terrorism. If, for example, there exist many more automobiles than thieves are able to steal, then the production of an additional automobile will not increase the amount of theft, assuming that security measures per automobile remain constant. If automobile theft insurance is not subsidized, then the presence of automobile theft will reduce the number of automobiles produced, even though this reduction will not decrease the amount of automobile theft. Failure to subsidize theft insurance for automobiles would therefore mean that the level of automobile production would be lower than the optimal level.

The effect of the number of potential targets on the level of crime has received less attention than the effects of other factors, but it has occasionally been discussed. Cook [7] wrote:

> Will the proliferation of branch banking offices in a small city tend to generate an increased volume of bank robberies in that city? It seems reasonable to suppose that every would-be bank robber can easily locate a suitable office to rob where they are, say, ten such offices in the city, and it is hard to see why his opportunity is improved if that number doubles.

Cook [6] regressed the robbery rates in different cities on a number of factors, including the number of stores available to rob, and did not find this variable to be statistically significant. This result supports the key assumption of the model in this paper.

4. Policy options

Some of the costs of terrorism clearly do depend on the level of expenditure by developers. For example, if the interior finish of a building is very expensive, then more resources would be lost in a terrorist action than if the interior finish were very cheap. Subsidized terrorism insurance would encourage developers to ignore this cost, and the quality of buildings would be higher than optimal. If, however, there are fixed costs associated with building construction that developers are unable to vary, then the conclusions of the model discussed in Section 2 will be relevant. The insurance subsidy, however, should not cover the entire value of a building, but only the fixed, necessary costs of construction. If an office building costs a minimum of, for example, $10 million

to build, then subsidized insurance coverage should be limited to $10 million. If this is the case, then developers will not be discouraged from constructing buildings because of the risk of terrorism, but they will conserve on optional expenses which might increase the cost of a terrorist attack. In other words, constructing more buildings will not increase the losses from terrorism, since terrorists can only attack a fixed number of buildings per year. Making buildings more expensive will increase losses, so social welfare is improved if developers take account of this cost when they decide how expensive to make their buildings.

It is also possible that policymakers would want to exclude existing buildings from coverage by subsidized insurance. Terrorism risk would reduce the value of existing buildings, but as long as net operating income remains positive, owners will not abandon the buildings and an insurance subsidy for these buildings is unnecessary to prevent terrorism risk from reducing the building stock. A possible problem with this strategy is that purchasers of new buildings might worry about whether their subsidies would be maintained in the future. By subsidizing all buildings and credibly committing to continuing this policy in the future, the government might be better able to convince developers that they face no additional costs from terrorism risk.

The actual policies that have been adopted by the United States and other countries differ from the policy described above. In the United States, the Terrorism Risk Insurance Act of 2002 now requires property and casualty insurance companies to offer terrorism coverage available under terms that do not differ materially from coverage they offer for other events. This means that most terrorism insurance will cover the full replacement value of buildings, not just the fixed, unavoidable costs of constructing buildings. Insurance companies are promised payments in the event of a large terrorist attack, but insurance companies must pay substantial deductibles and 10 percent of the cost of claims over the deductible. Premiums reflecting these costs will be charged to building owners. According to the model presented in Section 2, the result will be that the number of new buildings constructed will be sub-optimal, and the quality of new buildings will be higher than the optimal level. In addition, the act only covers international terrorism, even though the economic effects of domestic and international terrorism would seem to be the same.

The UK's Pool Re is similar in many ways to the new terrorism insurance policies of the United States. The government is the ultimate guarantor of claims, but insurance premiums to property owners are often substantial. There are no limits to the amount of coverage that the government will cover. In France, a reinsurance pool known as GAREAT is backed by the government, but coverage only begins at losses of €6 million. This is the opposite of the type of subsidy suggested by the model presented in this paper.[9] In the French system, expensive buildings will receive some coverage, but the fixed, unavoidable costs of building construction are hardly covered at all.

Two small countries with long and terrible histories of terrorism have developed systems of terrorism insurance subsidy that, in some ways, fit the recommendations of the model of this paper. In Sri Lanka, the Riots and Strikes and Terrorism Fund is subsidized by the

[9] Other arguments, such as the inability of insurance companies to estimate the probability of large attacks, or the possibility of the bankruptcy of the insurance industry might justify subsidies of insurance of large losses.

government, and has a limit of approximately $300,000 per risk per location. In Israel, the Property Tax and Compensation Fund compensates owners of property damaged in terrorist attacks with funds collected from a tax on vacant land. Some economists have long claimed that land taxes are non-distortionary because the supply of land is inelastic. Others have questioned this type of taxation, but it is interesting to see this apparent attempt to avoid a potential market failure with a possibly non-distortionary tax.[10]

5. Conclusion

Terrorism insurance is widely believed to be a product for which private markets will fail. Government subsidies are common around the world, and are now being undertaken by the government of the United States. Many of the usual arguments given in support of this policy are difficult to defend with rigorous economic analysis. A high market price for a good that many people want is not a sufficient argument for government subsidy. High prices represent costs and scarcity, and subsidy usually distorts the efficient workings of the marketplace. However, there are unique features of terrorism which may make terrorism insurance a good candidate for government subsidy. Many political backers of subsidy seemed to hint at the argument contained in this paper; during the debate on the Terrorism Risk Insurance Act of 2002, many pointed to construction projects which seemed to be fundamentally financially sound, but which were delayed and in danger of cancellation because of the high cost or unavailability of terrorism insurance.

The model presented in Section 2 demonstrates that under certain assumptions, forcing building owners to bear the expected cost of terrorism is economically inefficient. Government subsidy, paid for with non-distortionary taxes, could improve social welfare. It is important to note, however, that the subsidy suggested by analysis of the model does not necessarily resemble that of actual government programs. If the model is realistic, then government should pay for all losses from terrorism up to the fixed, unavoidable costs of constructing buildings. The model does not provide support for subsidy of insurance covering complete replacement cost of expensive finish and furnishings. Determination of the correct limit for insurance coverage may not be an easy task, and could be the subject of future research.

Of course, completely non-distortionary taxation is impossible, and any cost-benefit analysis of an insurance subsidy must take into account the efficiency costs of financing the program. Future research might attempt to estimate the magnitude of the welfare costs associated with reduced construction which might result from the cost of terrorism risk and compare it to the costs of the taxation needed to support the subsidy.

Terrorism insurance subsidies might also create moral hazard problems. The incentives of developers and building owners to prevent terrorist attacks through building design or security programs would be reduced. On the other hand, the efforts of the federal government might be more important in the prevention of terrorism, and transferring the risks of attack to the federal government might be appropriate, although it is not clear

[10] A summary of international terrorism insurance programs can be found in Willis [18].

that the federal government would respond appropriately to this incentive. Again, future research might attempt to compare this potential cost of terrorism insurance subsidies with the potential benefits.

Acknowledgments

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