RURAL AND REGIONAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE

INQUIRY INTO THE ADEQUACY OF AUSTRALIA'S BIOSECURITY MEASURES AND RESPONSE PREPAREDNESS

Submission by the Centre for Market Design

BIOSECURITY RISK INSURANCE: A MECHANISM TO IMPROVE FUNDING SUSTAINABILITY, ECONOMIC EFFICIENCY AND FAIRNESS IN AUSTRALIA'S BIOSECURITY SYSTEM

THE CMD

The Centre for Market Design (CMD) is an innovative economic research centre hosted by the University of Melbourne. We support policy innovation by applying economic design techniques to public policy, procurement and resource allocation problems. We have particular expertise in mechanism design, auction theory, matching markets, experimental economics, and structural econometrics. The CMD was created specifically to build capabilities needed in economic design and to harness these ideas and techniques to create solutions to 'real world' public policy problems.

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1. INTRODUCTION

Australia has world-leading scientific and organisational capabilities in the prevention, detection, and control of exotic pest and disease threats. Australia's biosecurity system is largely designed from a scientific perspective. We have deep scientific expertise relevant to pests and diseases, how they spread and the interventions needed to control incursions. However, humans are largely responsible for the spread of pests and diseases across the globe and within jurisdictions such that the objectives of the biosecurity system cannot be achieved without consideration of how humans interact with the rules and processes of the system. The current biosecurity system relies almost solely on regulations to manage the human behaviour dimension of biosecurity. It is widely understood[1] that regulation is only effective in specific circumstances (e.g., to ban actions that lead to catastrophic outcomes) but is not an efficient or effective form of intervention where the objective involves moderating human behaviour. In the biosecurity system, regulation is an appropriate form of intervention in managing Australia's exposure to imported good that would cause catastrophic losses (e.g., meat products from countries with foot and mouth disease) but is not effective or efficient in managing Australia's exposure to other biosecurity risks. In the latter case, regulations that define what can and cannot be imported, country and product specific testing and treatment regimes etc. are subject to: information asymmetry problems (the regulated entity holds information needed to make good decisions); gaming (regulated individuals/bodies find ways around rules); and incentive alignment problems (rules based on technical considerations alone create incentive structures that cause unintended behavioural responses). The Inspector-General of Biosecurity review into the adequacy of the biosecurity operational model (IGB, 2021)[2] highlighted this problem. It made a number of recommendations to design and incorporate incentives into the biosecurity system (see Chapter 3 of the IGB — shared responsibility and co-regulation and Chapter 4 — understanding behavioural drivers). Example recommendations include:

- *"This incentivisation approach should include finding ways to achieve overall biosecurity (and cost) benefits by implementing innovative strategies that will achieve more compliant behaviour and impactful disincentives for noncompliant behaviour" (p48).*

- *"The department needs to boost its capability in behavioural science and behavioural economics (internally or by partnership) so that the targeting of communication, co-regulation, and compliance and enforcement strategies can be improved" (p52).*

Major advances in microeconomics[3] have been made that allow us to design more efficient and effective intervention mechanisms than regulations[4]. Unfortunately, these advances are yet to be routinely applied in the biosecurity sector in Australia or across the globe. A research program initiated by the Centre for Market Design (CMD) in collaboration with the Centre of Excellence for Biosecurity Risk Analysis (CEBRA)

[1] See Laffont, J.J and Tirole, J. (1993). The Theory of Incentives in Procurement and Regulation. MIT Press.
[2] Inspector-General of Biosecurity 2021, Adequacy of department's operational model to effectively mitigate biosecurity risks in evolving risk and business environments, Department of Agriculture, Water and the Environment, Canberra, January. CC BY 4.0.
[3] The majority of Nobel Prizes in economics, for example, have been awarded in areas of economics that support the design of incentive structures embedded in institutions, markets and other mechanisms.
[4] Regulations are relevant to some classes of biosecurity threat.

and the Centre for Actuarial Studies (CAS), all located at the University of Melbourne and funded by the Commonwealth, has been investigating how humans interact with the rules and processes that define the biosecurity system. The aim of this research is to identify the interventions (collectively the mechanism) needed to align the actions of humans with the national objectives of the biosecurity system. Although our research program in still underway, the first stage of this research has identified a mechanism that creates the incentive structure needed to improve the economic efficiency, efficacy and financial sustainability of the biosecurity system. This is referred to as *biosecurity risk insurance*. We are currently progressing this approach into the biofouling domain of the biosecurity system, but it has general application to all imported goods and inbound passengers. It is specifically of interest to the current debate about a sustainable funding model for Australia's biosecurity system.

This submission discusses the implications for Australia's biosecurity system if it were based on a biosecurity risk insurance approach. The material presented is relevant to:

- TOR (a): *the adequacy of Australia's biosecurity measures and response preparedness, in particular with respect to foot-and-mouth disease and varroa mite*. This submission does not make any suggestions that would enhance the adequacy/preparedness for current biosecurity threats (e.g., FMD, varroa mite) but is highly relevant to the efficiency, efficacy, and funding of the biosecurity system in the future.
- TOR (b): *response to and implementation of previous reports into biosecurity.* This submission is directly relevant to recommendations made in the IGB (2021) about the incentive problem in the current biosecurity system. It identifies the mechanism needed to create incentive structures need to align the actions of self-interested importers/vessel operators/passengers (risk creators) with national biosecurity objectives.

This submission firstly provides a brief overview of biosecurity risk insurance, its advantages and the status of our research program. Key messages, relevant to the Committee's TOR (a and b) are noted in the final section.

2. BIOSECURITY RISK INSURANCE

The research program noted above, frames biosecurity as an economic problem in which biosecurity is understood as a class of risk created when inbound goods, vessels and passengers inadvertently introduce pests and diseases that expose Australia to expected financial losses. Key losses arise from the costs of responding to incursions, biosecurity system costs, loss of market access, restoring environmental amenity, human health etc. In other domains of the economy, risk is managed through a range of measures including the creation of risk markets in which those exposed to financial loss can take out insurance. Risk markets are designed and created by actuaries with the objective of establishing the efficient price of risk.

An initial paper published from our research (Stoneham et al. 2021[5]) clarified why markets for biosecurity risk have not emerged autonomously as they do for other classes of risk. The key finding is that biosecurity risks are insurable – they display the characteristics that underpin the creation of risk markets (insurance). The reason such markets have not evolved as they have for other classes of risk (i.e. life, car, health, cyber, natural disaster, terrorist etc.) is that risk creators (i.e., importers of goods and inbound vessels and passengers) are not exposed to the financial losses of their actions. In the case of biosecurity, it is not practical (and in many instances not technically possible) to attribute financial losses arising from the introduction of pests and diseases to specific importers/vessels/passengers. In the biosecurity domain, risk creators pass on the financial consequences of their actions to the Australian taxpayer and there is no incentive for importers, vessel owners, passengers to take out insurance. It is this *externality* that causes market failure – not the characteristics of biosecurity risk. This finding has important implications for the way we manage and fund biosecurity effort in Australia.

Working with actuaries at the University of Melbourne's Centre for Actuarial Studies (CAS), we have shown how a biosecurity risk insurance scheme could be set up. In summary, if the externality (noted above) were to be addressed by mandating risk creators to purchase biosecurity risk insurance; then actuarial science can be applied to design biosecurity risk insurance products in the same way they are developed to manage other classes of risk. If adopted, this approach has important implications for the biosecurity system in Australia because it would reveal the efficient price of biosecurity risk and expose risk creators to the monetary consequences of their actions.

2.1 How would biosecurity risk insurance work?

The key elements of a biosecurity risk insurance scheme include:

Compulsory purchase of biosecurity risk insurance by risk creators – Biosecurity insurance would need to be compulsory (like third third-party motor vehicle insurance) on all inbound movement of goods and vessels[6] and could even be extended to inbound passengers. For example, importers of goods such as cut flowers, timber, fruit, and other cargo would be required to purchase biosecurity risk insurance (from a government-run insurance agency) where the premium is based on the level of risk associated with the type and origin of imported good. Similarly, vessel operators would be required to purchase biosecurity risk insurance to cover expected losses from biofouling threats with higher premiums for higher-risk vessels.

Biosecurity risk insurance premiums determined by actuaries – Biosecurity risk insurance premiums would be calculated by actuaries applying the same principles[7] used to determine insurance premiums relevant to other classes of insurable risk. In the case of biosecurity risk insurance, the revenue pooled from biosecurity risk insurance premia would fund: i) biosecurity system costs (pre-border interventions) and ii) the cost of controlling outbreaks (post-border) of pests and diseases as they occur.

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[5]. Stoneham, G., Hester, S.M., Li, J., Zhou, R. and Chaudhry, A. 2021 The boundary of the market for biosecurity risk insurance. *Risk Analysis*, 41(8), 1447-1462. https://doi.org/10.1111/risa.13620

[6] Inbound vessels can pose significant biosecurity threats from biofouling.

[7] The fundamental principles applied to price risk are: i) risk pooling – spreading risk across many uncorrelated risks; and ii) actuarial pricing – higher premiums imposed on higher risk activities.

Importers/vessel operators (and potentially passengers[8]) would pay premia based on the expected losses (i and ii above) determined from the risk rating of the relevant import/vessel/passenger. Higher-risk imports/vessels/passengers would pay higher insurance premia than low-risk imports. Our current research into the application of biosecurity risk insurance to biofouling risk illustrates that changes to the biosecurity system would be needed but that it can be implemented in the biosecurity system.

Biosecurity risk insurance premiums pooled by a government insurance agency – Funds collected through biosecurity risk insurance premiums would be pooled by a government insurance agency and used to fund the on-going cost of the biosecurity system (i.e., border control and other biosecurity system costs) and the costs of responding to incursions (referred to as response losses) when they occur. As an example, the cost of operating border inspection, early detection and responses to the recent varroa mite incursion would be funded from the insurance pool accumulated from insurance premia charged on relevant imported goods.

Taking out biosecurity risk insurance – Inbound goods/vessels/passengers would purchase biosecurity risk insurance as part of the entry process. Inbound vessels, for example would be required to reveal information needed to determine their biofouling risk rating (some of this information is already required in current entry protocols). Vessels would then be matched to the relevant vessel entry contract (specifying the biosecurity risk premium, testing and inspection regime etc.) with higher-risk vessels paying higher insurance premiums and subject to more onerous testing and inspection whilst in Australian waters. Our research in biofouling indicates that many of the processes needed for an insurance approach are either in use or are intended to be introduced.

Extreme biosecurity risks would continue to be regulated – Imports of some high-risk goods (such as meat products from countries with endemic foot and mouth disease) display characteristics that suggest they are uninsurable (i.e., systematic risk – one case of foot and mouth disease would cause loss of access to markets for all domestic producers). For these biosecurity risks, regulations that prohibit imports would continue to be used.

2.2 THE ADVANTAGES OF A BIOSECURITY RISK INSURANCE APPROACH

There are three key advantages of designing Australia's biosecurity system around an insurance approach.

2.2.1 Sustainable funding

Australian governments currently fund the biosecurity system which costs around $850m per year. This method of funding relies on bureaucratic decisions about the "appropriate level of protection" (ALOP) and the political decisions to appropriate funds for biosecurity in a competitive budget environment. This funding mechanism is often argued to be unsustainable because there is no guarantee that bureaucrats identify the right (appropriate) level of protection and appropriations do not necessarily scale according to the level of biosecurity risks exposure.

[8] This mechanism could be potentially applied to passengers via airline tickets.

A biosecurity insurance scheme in which importers (risk creators) are required to purchase actuarially based insurance would establish a **sustainable funding model for biosecurity**. This is because actuarial pricing of risk:

1. Ensures that the insurance pool (pooled premia) is sufficient to fund *biosecurity system costs* (i.e., administration, border inspection etc.) and *response losses* (i.e., costs incurred from controlling disease and pest incursions) as they arise. Actuarial pricing of risk in private sector applications ensures that insurance businesses remain financially viable.

2. Raises revenue that scales with Australia's exposure to biosecurity threats and volume of trade.

2.2.2 Economic efficiency

The second important advantage of a compulsory biosecurity risk insurance scheme is that it creates the incentives needed to align the actions of self-interested agents (i.e., importers, vessel operators, passengers) with national biosecurity objectives. When exposed to the efficient price of biosecurity risk importers/vessel operators/passengers face an incentive to change behaviour with respect to the type/origin/treatment of imported goods; vessel operation and maintenance; travel plans etc. When risk is priced efficiently it leads to the optimal level of biosecurity effort (economic efficiency) and aligns private actions with national biosecurity objectives. In contrast, the current biosecurity system defines an "appropriate", rather than "efficient" level of protection and seeks to achieve alignment through regulations (e.g., importers are required, by regulation to take specific actions intended to mitigate biosecurity risk). It is widely understood that humans respond very differently to being commanded to take some action (through regulations) vs. responding to financial incentives (i.e., higher biosecurity risk premiums for higher-risk activities) on their own accord. Under a biosecurity risk insurance mechanism, importers would be rewarded for taking actions that reduce Australia's overall exposure to biosecurity risk (i.e., lower biosecurity risk premiums).

Biosecurity risk insurance improves economic efficiency because it reveals information that:

1. Identifies the "right" level of national biosecurity effort – The insurance pool (the aggregate pool of funds raised from biosecurity risk insurance) creates funding that supports an optimal level of national biosecurity effort. As is the case in all markets, efficient pricing of biosecurity risk, through the application of actuarial science, is a precondition for efficient allocation of resources. In contrast, the current level of biosecurity effort is based on an administratively determined "appropriate" level of protection (ALOP) and the outcome of national and state budget appropriations.

2. Improves allocation of biosecurity effort within the biosecurity agency – The proportion of funds (in the insurance pool) raised from insurance premia in the various domains of biosecurity (e.g., plant, animal, biofouling, passengers) reveals the efficient allocation of funds within the biosecurity agency.

2.2.3 Fairness

Under the current biosecurity system, creators of biosecurity risks do not contribute to management of biosecurity threats. An attempt to address this "fairness" problem through a flat levy on imported goods has been proposed in the past but was not implemented. The flat levy strategy has several serious problems including: i) imports that pose no biosecurity risk would have been required to pay the same levy as high-risk imports (a second fairness problem); ii) a flat levy does not create incentives for importers to seek alternative lower-risk alternatives. Actuarial pricing of biosecurity risk through biosecurity risk insurance is "fairer" on both of these criteria. It ensures risk creators pay for biosecurity effort imposed on Australia and high-risk imports pay higher premia (a form of levy) than low-risk activities.

2.3 THE STATUS OF THE BIOSECURITY RISK INSURANCE RESEARCH

As noted earlier in this submission, our research on biosecurity risk insurance is in progress. To date, our work has identified the mechanism (biosecurity risk insurance) needed to address the way humans interact with the biosecurity system. This initial stage of the project focused on the application of insurance to imported goods. Our current work program involves more detailed design into how this mechanism might be applied to manage biosecurity risks arising from biofouling. This application demonstrates that actuarial pricing of biosecurity risk in the biofouling domain appears to be feasible but would require the same investment in design needed to create commercial insurance schemes. Like all insurance schemes, systems need to be developed to:

- identify the attributes of vessels (in this instance) that determine their risk rating (scientific research exists for this purpose).
- allow vessel operators to reveal information needed to determine risk ratings.
- create a menu of insurance contracts relevant to different risk ratings.
- ensure truthful revelation of information from vessel operators.
- match vessels to the right insurance contract; and
- address moral hazard issues.

These are standard requirements of all insurance schemes and actuaries have well-developed principles and methods needed to address these issues. From an actuarial perspective, biosecurity appears to be class of risk characterized by low frequency, high expected losses. Natural disasters, cyber risk, terrorist attack etc. are examples of this class of risk and the actuarial methods developed to price these risks appear to translate readily to biosecurity risk insurance. The only substantive difference (as noted above) is that biosecurity risk insurance would need to be compulsory and mandated through legislation.

The creation of a biosecurity risk insurance approach is not a trivial task. It essentially involves creating risk markets in three domains: i) imported goods; ii) inbound vessels; and potentially iii) inbound passengers. For each domain, the following components will need to be addressed:

- Legislation change – Legislation would be needed to make it compulsory for importers and inbound vessel operators to purchase biosecurity risk insurance.

- Insurance premiums calculated – Actuaries will need to be engaged to calculate risk-based biosecurity premiums for different categories of imports/inbound vessels.

- Insurance agency established –A government insurance agency would need to be established to hold and manage the insurance pool.
- Reinsurance strategy – A reinsurance strategy will need to be developed including consideration of commercial and government-based reinsurance options.
- Response strategies aligned with the insurance model – For many industries, Australia has well-developed biosecurity response strategies (Agreements between State/Commonwealth Government, and industry). These agreements would need to be linked to an insurance model.

3. KEY MESSAGES

1. Biosecurity risk insurance could be used as an organising model for the biosecurity system in Australia. It specifically addresses the human behaviour aspect of the biosecurity system by creating a market that reveals the efficient price of risk. Insurance creates the incentive structures needed to align the actions of self-interested agents with national biosecurity objectives and to identify the optimal level of biosecurity effort.
2. The current biosecurity system relies on regulations to achieve alignment. It is widely understood that regulations cannot be effective because of information, gaming and incentive problems.
3. Biosecurity risk insurance has three advantages:
    a. Sustainable funding – revenue for biosecurity insurance premia scales with the volume of risk exposure.
    b. Economic efficiency – Biosecurity risk insurance:
        i. Creates financial incentives (through actuarial pricing of risk) that rewards risk creators for effort needed to reduce Australia's exposure to biosecurity risks.
        ii. Improves the allocation of funds within the biosecurity system.
        iii. Guides the national biosecurity effort toward an optimal, rather than appropriate level of protection.
    c. Fairness – risk creators fund the biosecurity system and high-risk imports/vessels/passengers pay higher premiums.
4. Biosecurity risk insurance appears to be implementable but a significant investment will be needed to design insurance processes for imported goods, biofouling and potentially inbound passengers.
5. The creation of risk markets for biosecurity will require integration of three disciplines: actuarial science, the physical sciences (e.g., epidemiology, veterinary, virology, entomology, plant sciences etc.), and economics. Importantly, actuarial science and economics create the institutional architecture needed to harness Australia's physical science capabilities more effectively.
6. The broad changes needed to implement biosecurity risk insurance include: legislation change to mandate the purchase on insurance; actuarial pricing of the biosecurity risk; the creation of a government biosecurity insurance agency; a reinsurance strategy; and alignment of existing emergency response strategies with the insurance model.

7. A flat-rate levy on imported goods is not an efficient, fair or sustainable funding model for biosecurity.