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Infometrics

Wellbeing Analysis of the Ban on Livestock Exports

AUSTREX
Growing Livestock Communities

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Table of contents

TDB Advisory Limited
L5, Wakefield House
90 The Terrace
P.O. Box 93
Wellington
New Zealand

Email: info@tdb.co.nz

Principal contacts for this report:

Philip Barry
phil.barry@tdb.co.nz
021 478 426

Adolf Stroombergen
adolf.stroombergen@infometrics.co.nz
021 990 066

Nigel Atherfold
nigel.atherfold@tdb.co.nz
027 465 0057

Glossary

The Act	Animal Welfare Act 1999
AWEC	Animal Welfare Export Certificate
The Bill	Animal Welfare Amendment Bill
Bobby calf	A calf no more than one to two weeks old that is sent to be slaughtered
CO_2e	Carbon dioxide equivalent
EBIT	Earnings before interest and tax
ESSAM model	Energy Substitution, Social Accounting Matrix
FTE	Full time equivalent
Gold Standard	The counterfactual to the ban, where livestock export by ship continues but with stricter regulatory controls
Heifer	A young female bovine until completion of first lactation
Livestock	Cattle, deer, sheep and goats
LSF	New Zealand Treasury's Living Standards framework
kgMS	Kilogram of milk solids
MPI	Ministry for Primary Industries
RGNDI	Real gross national disposable income
RIS	Regulatory Impact Statement
YE	Year end

Key findings

- The government plans to ban the export by sea of cattle, deer, sheep and goats (collectively referred to as livestock) from April 30, 2023.
- This report analyses the costs and benefits of the ban to New Zealanders' wellbeing using the Treasury's Living Standards Framework. This framework is designed to analyse and make transparent all the impacts of a policy – both those that are quantifiable in monetary terms and those that are not.
- The costs and benefits of the ban on livestock exports by sea from New Zealand are assessed in this report in relation to a scenario where livestock exports continue but under stricter regulatory controls – the 'Gold Standard'.
- We find the ban results in a net cost to farmers of around $49,000 to $116,000 per farm p.a. These costs incurred by around 1,060 to 2,900 farms.
- There is a net cost to New Zealand's GDP in the short-term (1 to 2 years after the ban) of around $475m p.a. and ongoing net costs to national financial wellbeing of around $320m p.a. (or around $150 p.a. per New Zealand household).
- The impacts of the ban on the natural environment include a benefit to the natural environment from a reduction in CO_2e (with an estimated value of around $75m in 2030); a benefit to animal welfare of reduced health risks to livestock; and a cost to animal welfare in the form of increased bobby calves slaughtered by around 150,000 calves p.a.
- Oher impacts of the ban arise in the "social cohesion" domain and include a benefit to New Zealand's reputation from the perspective of some animal-welfare proponents; a cost to New Zealand's reputation from the perspective of some in the international trading community; a benefit from the reduction in the risk of sea-freight incidents; and a cost to our trade relationships with livestock-trading partners.
- Overall, the ban is likely to impose a net monetised cost to national wellbeing of around $475m p.a. in the short run and around $320m p.a. on an ongoing basis. The costs to financial wellbeing will be concentrated around rural communities.
- With ongoing monetary costs of $320m p.a. arising from the ban, the non-monetised net benefits - ie, the net benefits to the natural environment (other than the reduction in CO2e emissions which is included in the monetised benefits) and the net benefits to social cohesion, if any, would need to be judged to be worth more than $320m p.a. for the ban to enhance overall national wellbeing.

Executive summary

The Animal Welfare Amendment Bill seeks to ban the export by sea of cattle, deer, sheep and goats (collectively referred to as livestock) from April 30, 2023.

TDB Advisory Ltd and Infometrics have been commissioned by Austrex (NZ) to provide an assessment of the impacts on national wellbeing of the ban on livestock export by sea (the ban). This report analyses the wellbeing costs and benefits of the ban using the New Zealand Treasury's Living Standards Framework. We assess the costs and benefits of the ban in relation to a counterfactual scenario where livestock exports continue but under stricter regulatory controls – the 'Gold Standard'.

Livestock exports by sea today largely consist of cattle exports to China, being dairy cattle for breeding and milking and beef cattle for breeding. In 2021/22, around 150,000 cattle were exported by sea, with a total value of $382m. Cattle spend an average of 18 days at sea with an average mortality rate of around 8 deaths per 10,000 animals transported.

Like almost all policy changes, the ban on livestock exports by sea is likely to result in both costs and benefits to wellbeing in New Zealand. Some of these wellbeing impacts are financial – these can be modelled and quantified in monetary terms. Other impacts relate to the natural environmental or social domain (such as animal health outcomes or New Zealand's reputation) – many of these impacts cannot readily be quantified in monetary terms and are therefore discussed in this report in qualitative terms.

National wellbeing analysis is a framework for analysing and making transparent all impacts of a policy – both those that are quantifiable in monetary terms and those that are not. The New Zealand's Treasury's latest framework for wellbeing analysis is the Living Standards Framework 2021 (LSF). The LSF has three interconnected levels to analyse wellbeing.[1] This report examines the impact of the ban in relation to the third fundamental level of the LSF – the wealth of Aotearoa New Zealand. The ban has material impacts on three domains in this level:

- financial and physical capital;
- natural environment; and
- social cohesion.

Sections 4, 5 and 6 of this report analyse in turn the costs and benefits of the ban in respect of each of the three domains.

The impacts of the ban on financial and physical capital are modelled in Section 4 from three different perspectives: firstly, from an individual farm-level perspective using micro-economic modelling; secondly, a short-term economy-wide perspective using multiplier analysis; and finally, a medium-term economy-wide perspective using general-equilibrium modelling (the ESSAM model).

We find the ban results in:

- a net cost to farmers who would have otherwise exported heifers of around $49,000 to $116,000 per farm p.a., with the costs incurred by around 1,060 to 2,900 farms;
- a net cost to New Zealand GDP in the short-term (1 to 2 years after the ban) of around $475m p.a.; and
- subsequent and ongoing net costs to national financial wellbeing of around $320m p.a. or around $150 per household on average per year.

The above cost estimates are not additive, they are different perspectives on the net financial costs arising from the ban.

Section 5 reviews the costs and benefits of the ban within the natural environment domain. This analysis includes both quantifiable and non-quantifiable impacts. We find the ban results in:

- a benefit to the natural environment from a reduction in CO_2e by 500kt (a 0.7% decline in New Zealand's emissions) with an estimated value of around $75m in 2030;
- a benefit to animal welfare of reduced health risk to livestock; and
- a cost to animal welfare in the form of increased bobby calves slaughtered by 150,000 calves p.a.

[1] The three levels are: Individual and collective wellbeing; institutions and governance; and the wealth of Aotearoa New Zealand. For more on the Treasury's LSF, see Appendix 1.

Finally, the costs and benefits of the ban within the social cohesion domain are analysed in Section 6. In this domain, we find the ban results in:

- a benefit to New Zealand's reputation from the perspective of some animal-welfare proponents;
- a cost to New Zealand's reputation from the perspective of some in the international trading community;
- a benefit relating to the reduction in the risk of sea-freight incidents; and
- a cost to our trade relationships with livestock-trading partners.

The two tables below summarise our findings. The wellbeing costs of the ban are presented in Table 1 while the benefits are presented in Table 2.[2]

Table 1: Assessed costs of the ban

LSF Domain	Cost	Description / Quantification
Financial & physical capital	Net cost from lost export revenue	Loss of earnings of $49,000 to $116,000 per farm p.a. incurred by 1,058 to 2,923 farms Reduction in GDP by $474m p.a. in the short-term (1-2 years after the ban) Ongoing reduction in national financial wellbeing (RGNDI) in the medium to long-term of around $319m p.a.
Natural environment	Increase in bobby calves slaughtered	With no calves reared for live export, the ban is estimated to increase the number of bobby calves slaughtered by 150,000 p.a. This represents an increase in 55 to 168 bobby calves per farm that would have otherwise been raised for export.
Social cohesion	Reputational cost in international trading community	The ban could be viewed by members of the international trading community as contrary to international trading rules or as a non-tariff barrier to trade, and thus be detrimental to our reputation as a trading nation. This could increase our exposure to non-tariff barriers to trade; reduce our voice in the international trade arena; and reduce our perceived reliability as an exporter.
Social cohesion	Cost to trade relationships	The ban could impact on New Zealand's relationships with livestock trading partners, i.e. China. It could be seen from the Chinese perspective as anti-collaborative, and non-supportive of China's economic and social development goals. This may have market access implications for other exports to China, in particular for dairy and other animal products.

[2] The colours in the table reflect the different domains (natural environment etc).

Table 2: Assessed benefits of the ban

LSF Domain	Benefit	Description / Quantification
Natural environment	CO_2e emmission reduction	Reallocation of resources to other industries results in a reduction in Co_2e emissions by 500kt p.a* (a 0.7% decline in New Zealand's emissions). The actual change is likely to depend on which industries benefit from the reallocated resources.
Natural environment	Reduced health risk to animals in transit	Sea transit can lead to negative health outcomes such as heat stress and lameness for animals. Mortalities can occur, but at a low rate of around 8 deaths per 10,000 These risks would be reduced under the counterfactual (the Gold Standard). However with livestock ceasing to be exported by ship, the ban eliminates the residual health risks from transit.
Social cohesion	Reputational benefit to animal-welfare proponents	To animal proponents (both individuals and institutions like World Animal Protection and RSPCA), the ban will be considered a benefit to New Zealand's reputation. This may or may not translate into monetary or other wellbeing benefits (e.g., through improved perception of New Zealand goods and services as welfare conscious).
Social cohesion	Reputational benefit from incident-risk reduction	All livestock exports could be considered to carry some risk to New Zealand's reputation. Should a major incident involving New Zealand livestock and animal mistreatment occur, our reputation as a responsible exporter of animal products could be damaged (with the effects felt in other animal-product industries). Banning the trade altogether eliminates this risk.

**The monetary value of the CO_2e reduction is taken into account in the RGNDI calculation in the costs table.*

Overall, the ban is likely to impose a net monetised cost on national wellbeing, primarily in the financial and physical capital domain, of around $475m p.a. in the short run and around $320m p.a. on an ongoing basis. This cost to financial wellbeing will be concentrated around rural communities. The ban also creates a number of non-monetised wellbeing costs and benefits within the natural environment and social cohesion domains such as the gains and losses to animal welfare and to New Zealand's international reputation.

With ongoing monetary costs of $320m p.a. arising from the ban, the non-monetised net benefits - ie, the net benefits to the natural environment (other than the reduction in CO_{2e} emissions which is included in the monetised benefits) and the net benefits to social cohesion, if any, would need to be judged to be worth more than $320m p.a. for the ban to enhance overall national wellbeing.

1 Introduction

1.1 The context for this study

The Animal Welfare Amendment Bill (the Bill) seeks to ban the export by sea of cattle, deer, sheep and goats (collectively referred to as livestock). The Bill would amend the Animal Welfare Act 1999 (the Act), and ban all livestock exports by sea from April 30, 2023.

TDB Advisory Ltd (TDB) and Infometrics have been commissioned by Austrex (NZ) to provide a national wellbeing analysis of the ban on livestock exports by sea. This report analyses the wellbeing costs and benefits of the ban using the New Zealand Treasury's Living Standards Framework. We assess the costs and benefits of the ban in relation to a counterfactual scenario where livestock exports continue but under stricter regulatory controls – the 'Gold Standard',

1.2 Background

In 2019, the Ministry for Primary Industries (MPI) began a review of New Zealand's livestock export industry. The objectives of the review were to improve the welfare of exported livestock and protect New Zealand's reputation.

During the review, MPI identified four potential options to improve the system:

1. Total ban – which could apply to all livestock, just certain species, or just certain aspects of export such as journey length or whether the animals travel by sea or air.
2. Conditional ban – whereby the approval of the Director-General of MPI would be required before someone could apply to export livestock.
3. New regulations – enhancing the export system using powers already available under the Act such as independent monitoring and an exporter registration scheme.
4. Continuous improvement – improvements to the system which would largely not need a formal rule change.[3]

After analysing the above options and considering the responses from public consultation, MPI recommended two options for consideration by the government: a ban on livestock exports; or continuing export but with stronger regulatory and non-regulatory interventions.

In MPI's Regulatory Impact Statement[4] (RIS), MPI's final recommendation was that allowing trade to continue, but with stronger regulatory and non-regulatory interventions, was the approach that would best meet policy objectives.

In April 2022 the Government made the decision to ban the export of live cattle, deer, goats, and sheep by sea from April 30 2023 (referred to in this report as the ban).[5] The main bases stated for the ban were protecting animal welfare and New Zealand's reputation.

The ban is set to be legislated under the Animal Welfare Amendment Bill. At the time of writing (July 2022), the Bill is at the Committee of the Whole House stage in Parliament.

1.3 Structure of this report

Following this Introduction, Section 2 continues this report with an overview of the livestock export industry in New Zealand; Section 3 establishes the framework for analysis; Section 4 presents the wellbeing costs and benefits within the Financial and Physical Capital domain; Section 5 presents the costs and benefits within the Natural Environment domain; and Section 6 those within the Social Cohesion domain. A summary of the overall wellbeing costs and benefits is presented in Section 7.

[3] Ministry for Primary Industries (2019). Available at: https://www.mpi.govt.nz/dmsdocument/38036-2019-Livestock-review-discussion-paper-for-consultation

[4] Ministry for Primary Industries (2021). Available at: https://www.treasury.govt.nz/publications/risa/regulatory-impact-assessment-livestock-export-review

[5] Live export by air is not affected by this proposed legislation.

2 The livestock export industry in NZ

2.1 A brief history of livestock exports by sea

While livestock exports have been occurring from New Zealand since the 1860s, the first large-scale shipments began in 1970.[6] The first large-scale shipment of sheep to the Middle East left Gisborne in 1973 and exports of cattle occurred around the same time. Public pressure, not just from animal welfare lobbyists but from meat workers who didn't want their trade to be taken offshore, saw the export of sheep banned the following year.[7]

New Zealand resumed the trade in 1985 and the numbers of live sheep and cattle exported grew rapidly. While the industry was growing, little regulation surrounded animal welfare. In 1990 the lack of regulation was highlighted as contributing to the 12% mortality rate of a single sheep shipment to Saudi Arabia. Following this incident, live exports were suspended in New Zealand until a code of welfare was developed and finalised in 1991. The code required a licensed veterinarian to accompany every shipment of live animals to the importing country and established a reporting system for all shipments. The aim was that mortality be no higher than 1% on any ship. Ventilation systems, veterinarian checks and animal welfare standards all became part of the shipping process.

Trade was mainly with the Middle East, which lacked local supply and sought meat for regular consumption and religious ceremonies. As the meat needed to adhere to Islamic law, livestock was exported for slaughter upon arrival.

In 2007 New Zealand placed a conditional ban on export for slaughter with exports for slaughter ceasing the following year. Current regulation[8] prohibits export for slaughter unless the exporter receives sign-off from the Director-General that the risks to the welfare of the animals and New Zealand's trade reputation can be adequately managed. No such case has been signed off since the conditional ban came into force.

All livestock exports by sea since 2008 have been either for breeding or milking purposes.

[6] Low (2008).

[7] Griggs (2016).

2.2 The livestock export industry

Table 3 below details the composition, mode of transport, most common destination and value of live animal exports from New Zealand in 2021/22[9] (excluding re-exports and aquatic life).

Table 3: Live animal exports, 2021/22, $m

Animal	Mode of transport	Most common destination	Value
Cattle	Sea	China	382
Horse	Air	Australia	104
Poultry	Air	Pacific islands	39
Bees	Air	Canada	2
Other mammals	Air	Australia	1
Goats	Air	China	2
Sheep	Air	United Kingdom	0.3
Total			530

Source: Statistics New Zealand, Overseas Merchandise Trade datasets

As Table 3 indicates, cattle exports by sea, with a value of $382m, accounted for around 72% of total live animal exports in 2021/22. Other live exports are generally by air, including horse exports worth $104m, poultry worth $39m and some export by air of bees, goats, sheep and other mammals (such as dogs and other pets).

The ban only impacts on livestock exports by sea, so no further mention is made in this report to other modes of live export.

Figure 1 below presents the value and composition of livestock exports by sea between 2015/16 and 2021/22.

[8] Animal Welfare (Export of Livestock for Slaughter) Regulations 2016.

[9] All data in this report is presented on a March year basis.

Figure 1: Livestock exports by sea, YE Mar 16 to Mar 22, $m

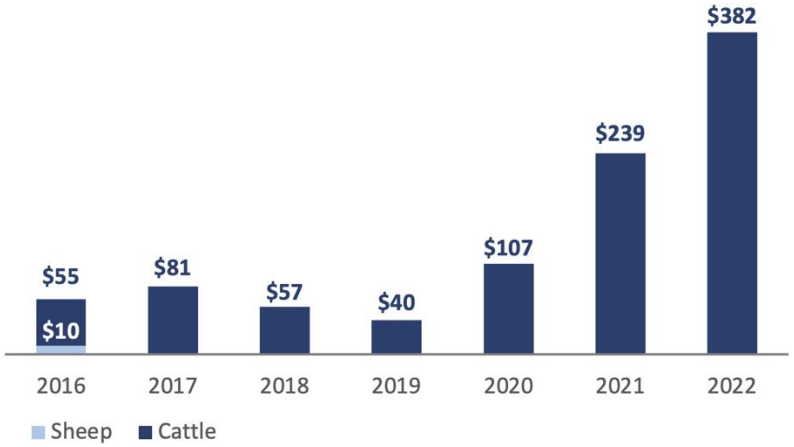


Figure 1 illustrates significant growth in the value of livestock exports by sea, largely occurring within the last three years. Growth has however been quite volatile, with no clear trends in the earlier years.

The total number of cattle exported in 2021/22 was 150,000. Though sheep were a major livestock export at the beginning of the millennium, no sheep have been exported by sea since 2015/16. Deer and goats are also included in the proposed ban, however neither have been exported by sea since 2015/16.[10]

Of the 86 livestock export voyages since 2015/16, 80 have been to China. Furthermore, China has been the sole destination of livestock exports by sea since 2018.

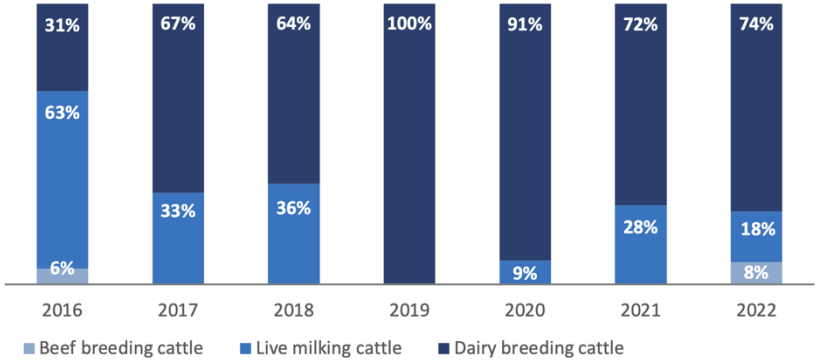
Live cattle are recorded as being exported to China for three purposes:

1. dairy cattle for breeding;
2. dairy cattle for milking; and
3. beef cattle for breeding.

In terms of the dairy cattle being exported for breeding and milk production, in the case of dairy, the two go together: heifers are exported for milk production but they need to be mated in order to produce milk. In that sense, the dairy breeding and milking numbers can be consolidated. In the case of beef cattle for breeding, cattle are pure-bred animals exported largely as maternal stock for the development of beef breeding herds.

Figure 2 below illustrates the relative proportions of each of these cattle exports.

Figure 2: Composition of cattle exports by sea, YE Mar 16 to Mar 22, $m



The majority of stock for export currently goes to new farm development projects in China Aiming to improve the quality and reliability of milk supply, China undertook a culling programme in 2015 and 2016, decreasing its herd by 50%. More recently, subsidies have been made available at a provincial level for farmers to increase the size of their herds. Subsidies are part of China's current economic and social development plan that includes the strategic goal of greater food security with the aim of becoming 60% self-sufficient in dairy production.[11]

China's dairy supply chain has been transforming for more than a decade under a masterplan developed by government and industry to industrialize dairy farming, consolidate and vertically-integrate processing, and strictly regulate dairy products and their marketing. The impetus behind this transformation dates to the 2008 melamine scandal, which led many Chinese consumers to lose trust in locally produced dairy products.

The importation of young stock is critical to the Chinese development plan. According to customs data, China imported 361,000 head of live cattle in 2021.

[10] Both goats and sheep for breeding are currently exported by air. In 2022, goat export by air totalled $2m, while sheep export by air totalled $3.6m.

[11] https://sustainabledevelopment.un.org/memberstates/china#:~:text=China%20will%20pursue%20green%20development,to%20improve%20people's%20well%20being.

China's National Bureau of Statistics reported 7% growth in milk production to 36.8 billion kilograms, or 81.1 billion pounds, in 2021. Production growth should continue in 2022, albeit at a slower rate. Large-scale farms provided the engine for last year's production gain, growing output by an estimated 20% and increasing cow numbers by 18% compared to 2020 levels[12].

Demand for fresh chilled milk, which constitutes approximately 20% of milk sales in China, has shown rapid growth climbing 21% in the first 11 months of 2020 versus 10.9% for room-temperature milk[13].[14]

In relation to the cattle export industry to China, concern has been expressed in the past by some farmers about New Zealand exporting its best genetics. Assuming New Zealand continues its genetic improvement trajectory, we understand it would take the importer around eight years to catch up with New Zealand from a genetic merit stand point.

2.3 Animal welfare

This section of the report discusses various aspects of animal welfare relating to livestock exports including: the regulatory environment; factors affecting animal welfare on board; the Gulf Livestock 1 voyage and animal mortality rates.

Regulatory environment

Exporting of live animals is currently permitted under the Animal Welfare Act 1999, subject to regulations surrounding animal welfare. The Act sets out the obligations of animal owners or people in charge of animals, who are required to meet the animal's physical, health and behavioural needs and must alleviate pain or distress. Physical, health, and behavioural needs are defined in the Act as:

- proper and sufficient food and water;
- adequate shelter;
- the opportunity to display normal patterns of behaviour;
- appropriate physical handling; and
- protection from, and rapid diagnosis of, injury and disease.

The basis for the regulation of exporting live animals is found in Part 3 of the Act. Part 3 is also designed to ensure New Zealand's reputation as a responsible exporter of animals and animal products is preserved.

The Act establishes that live animals can only be exported if the exporter has obtained an Animal Welfare Export Certificate (AWEC) from MPI. MPI must be satisfied that the exporter will uphold animal welfare standards with various regulations applying pre-departure, onboard and after arrival. These requirements are summarised below.

Pre-departure:

- MPI is in regular communication with exporters to determine the health status of the animals and assess an application for the issue of an Animal Welfare Export Certificate.
- Animals must pass through pre-export quarantine facilities, approved by MPI in accordance with World Organisation for Animal Health's animal health standards.
- Animals are preconditioned to the diet (dry pellet food) they will be fed on the voyage. Animals which are unable to successfully transition to the pellets are not selected for export.
- MPI vets inspect all animals pre-departure to ensure they are in good condition. The animals are only cleared to travel when the vet is satisfied they are fit to travel.

Onboard

- Animals must be given the right amounts of water, food, space and facilities. Medicines and equipment for treating any animals that become unwell during the journey must also be on hand.
- People experienced in handling animals must be on-board. For sea voyages, the minimum requirement is at least one experienced stockperson per 1,400 cattle and at least 2 experienced stockpersons

[12] https://hoogwegt.com/media/tdfce24t/hoogwegt-horizons-march-2022.pdf

[13] https://www.reuters.com/world/americas/china-seeks-milk-milk-market-doesnt-have-enough-cows-2021-06-02/

[14] Chinese consumers' daily intake of dairy products is reported at 97 grams (fluid milk) in 2019, compared to the global average of 303 grams[14].

for a shipment of up to 60,000 sheep in addition to the crew of the vessel. A veterinarian is also required for all sea voyages.

- The on-board veterinarian is required to send daily reports to MPI during the voyage.

At destination

- The exporter is required to provide reports to MPI on how the animals travelled between 5 working days and 40 days after arrival of the animals in the destination country.
- If MPI becomes aware of any information that contradicts information provided by the exporter the additional information would be taken into account when applications for future exports are considered.[15]

Other regulations important to the livestock export industry include the Animal Welfare (Export of Livestock for Slaughter) Regulations 2016, which dictate that cattle, deer, goats and sheep cannot be exported for slaughter without the approval of the Director-General of MPI.

The Animal Products Act 1999 also includes some provisions to facilitate international trade in live animals, including in relation to a database of registered livestock exporters and provisions surrounding government-to-government trade.

Factors affecting animal welfare onboard

Heat stress

As ships cross the equator, animals are subject to increases in heat and humidity. The temperature in each pen can depend on the ship. Strategies to reduce heat stress include moving cattle to increase airflow around them and introducing more fans to increase ventilation where required.

Lameness

Depending on the surface of the pens and the ship's on- and off-loading ramps, cattle can experience lameness. Crowded pens and scrambling when being moved can also contribute to lameness issues.

Effluent management

Effluent needs to be managed well onboard. Poor management can result in faecal buildup on the animals' coats (contributing to heat stress) and faecal sludge buildup in pens, creating discomfort when sleeping and standing in the pens.

On-loading and off-loading

'Pile ups' can occur during the on-loading and off-loading process when one animal stalls and throws others off balance.

Sea conditions

Rough weather at sea can lead to sea-sickness and therefore discomfort for cattle onboard.

The Gulf Livestock 1 voyage

Gulf Livestock 1 departed for China from Napier on August 14, 2020. On September 2 the ship was passing across the East China sea when Typhoon Maysak caused rough sea conditions. The ship's main engine then failed and Gulf Livestock 1 capsized, resulting in the death of all 5,867 cattle onboard and 41 of 43 crew members.

In the wake of the Gulf Livestock 1 tragedy, MPI commissioned an independent review into maritime safety requirements for the export of livestock by sea, often referred to as the 'Heron review'.[16] A number of recommendations from the report were incorporated into the regulations, including:

- maritime inspection of livestock carrier ships entering New Zealand to transport livestock by Maritime New Zealand as an additional safeguard;
- restricting stocking density on vessels to 90 percent of then-current limits to match new Australian standards;
- increased requirements for voyage reporting, including daily veterinary reports during voyages; and
- increased minimum fodder requirements that ensure at least 20 per cent of feed is available for unplanned delays during the voyage.

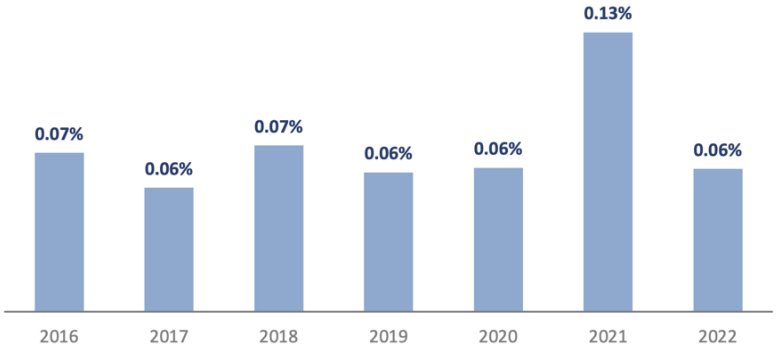
[15] Ministry for Primary Industries (2022).

[16] Heron (2020).

Animal mortality rates

On average cattle spend 18 days at sea on a voyage to China. The figure below shows the average annual mortality rates for livestock exported from New Zealand between 2015/16 and 2021/22.[17]

Figure 3: Average annual mortality rates, YE Mar 2016 to Mar 2022, %



As the chart highlights, the mortality rate was highest in 2020/21 at 0.13%. The mortality rate between 2015/16 and 2021/22 has averaged 0.08%. The 2021/22 mortality rate of 0.06% correlates to 6.4 deaths per 10,000 cattle transported.

Over the last seven years, only 1 ship has had a mortality rate that exceeded 1% and that was in January 2015 when a ship from Napier to China lost 34 cattle, of which 32 died due to acidosis and other metabolic conditions as a result of an incorrect feeding regime.

[17] The 5,867 mortalities from Gulf Livestock 1 are not included in the calculation of mortalities or mortality rates for completed journeys.

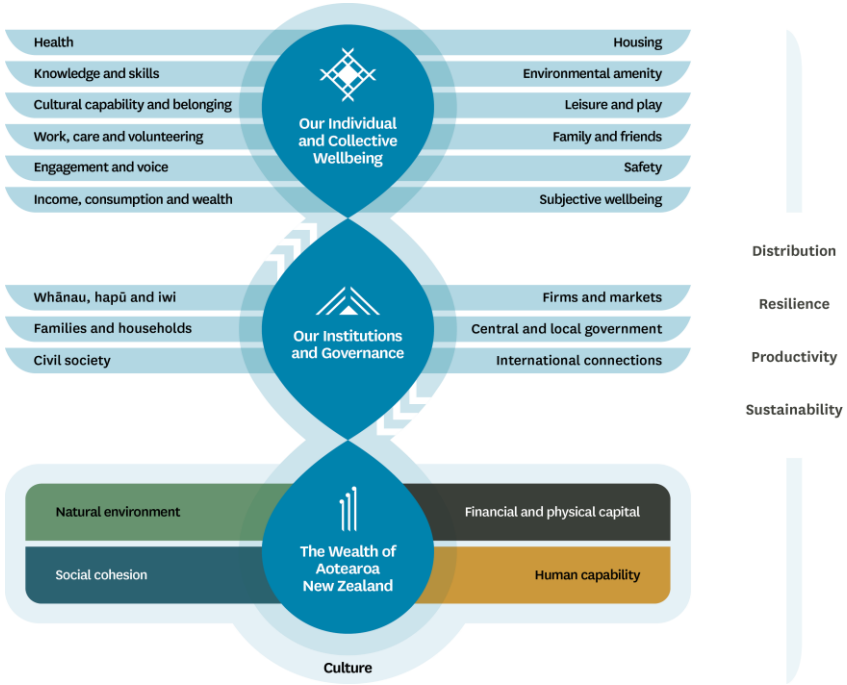
3 Framework for analysis

3.1 National wellbeing analysis

This report analyses the impact of the livestock export ban using a national wellbeing approach. National wellbeing analysis considers, as far as is feasible, the effects of a policy or project on society's overall wellbeing. A good national wellbeing analysis considers not just the monetary or financial effects on people of a project or policy but also the impacts on relevant non-market-values such as environmental, cultural, physical and mental-health values that affect wellbeing, even though these values are often difficult or impossible to quantify in monetary terms.

The New Zealand's Treasury's latest framework for wellbeing analysis is the Living Standards Framework 2021 (LSF). The framework is summarised in Figure 4 below.

Figure 4: The Living Standards Framework 2021



Source: New Zealand Treasury

The LSF includes a number of dimensions across three levels: individual and collective wellbeing; institutions and governance; and the wealth of Aotearoa New Zealand. The three levels and the dimensions within each are interconnected. The framework includes analytical prompts on the right-hand side, which act as key criteria to analyse wellbeing across the three levels of the framework. Further explanation of the LSF is provided in Appendix 1.

This report uses the Treasury's framework to analyse the costs and benefits to national wellbeing of the livestock export ban. To do so, we examine the costs and benefits as they impact on Level 3 of the LSF – the wealth of Aotearoa New Zealand. The four 'wealths' (referred to in this report as domains) can be thought of as stocks (rather than flows), that together contribute to individual and collective wellbeing of New Zealanders and their institutions. Changes in these domains flow through to wellbeing dimensions in other levels, often impacting on specific groups rather than uniformly across New Zealand.

The livestock export ban will have costs and benefits to national wellbeing within the following three domains:

- Financial and physical capital;
- Natural environment; and
- Social cohesion.

The fourth domain, human capability, is not considered to be materially impacted by the ban.

Sections 4, 5 and 6 of the report analyse the costs and benefits to each of the three domains in turn.

In national wellbeing analysis, costs and benefits that are able to be quantified in monetary terms with a reasonable degree of precision are quantified, while those costs and benefits that are not able to be rigorously and reliably quantified in monetary terms are incorporated qualitatively. When undertaking national wellbeing analysis, the New Zealand Treasury encourages users to:

- focus on monetising key effects that have a good evidence base rather than trying to monetise all effects;
- consider all effects, whether monetised or not; and
- leave effects as unmonetised, or provide sensitivity analysis and ranges, when the evidence base is limited or the connection is tenuous and uncertain.

The specific modelling assumptions we make are discussed in detail within each section of this report.

Section 7 of this report presents the overall costs and benefits of the ban, alongside a discussion of the four wellbeing criteria: distribution; resilience; productivity and sustainability.

3.2 The counterfactual – The Gold Standard

In national wellbeing analysis, all costs and benefits of a policy or activity are measured relative to a counterfactual (i.e., what would happen if the project or policy being assessed did not occur).

In this case, the counterfactual is no ban, i.e., a situation where livestock exports by sea continue to occur. As MPI's RIS noted[18] if the ban did not occur, the recommended alternative is to continue exports with a stronger standard of regulatory and non-regulatory interventions than the status quo.

This stronger standard was industry-led and is known as the 'Gold Standard'. The Gold Standard includes new regulation and new standards of best-practice at each phase of the export process, as detailed below.

Pre-departure:

- new minimum weight standards and independently verified condition score;
- enhanced environmental and nutritional management; and
- enhanced social and behavioral management.

On-board:

- reduced stocking densities;
- specialist training of stockman and veterinarians onboard;
- phasing out the export of pregnant cattle;
- contingency fodder and provisioning;
- new minimum standards of vessel quality;
- improved reporting systems that measure and report on animal welfare onboard; and
- behavioural measurement and management.

At destination:

- a two-way training, support and information programme for buyers focused on long-term animal welfare; and
- independent inspections of farms that buy New Zealand animals by a trusted verification agency to ensure they meet the Gold Standard in environment; nutrition and management; veterinary care; transport and humane end of life policy.

As the RIS notes,[19] the continuation of trade with a new Gold Standard will increase compliance costs to exporters. MPI will also incur additional administrative costs in developing, monitoring and enforcing the new regulations.

[18] MPI (2021, p. 22.)

[19] MPI (2021, p. 24).

4 Financial and physical capital

4.1 Introduction

The first section of analysis in this report examines the effects of the ban on financial and physical capital in New Zealand. To do so, we model the financial impacts of the ban on farmers and wider New Zealand using three separate and distinct approaches:

1. **A farm-level perspective** – what are the estimated financial impacts of the ban on New Zealand farmers? This section analyses the impacts of the ban at the micro-economic farm level.

2. **A short-term economy-wide perspective** – what are the likely short-term impacts of the ban on the economy (i.e., the impacts felt in the first two years or so from April 2023). This section analyses the impacts of the ban at a macro-economic level in the short-term.

3. **A medium-term economy-wide perspective –** what are the likely lasting economic effects of the ban, taking into account that resources will be reallocated in the medium term. This section analyses the likely impacts of the ban at a macro-economic level in the medium-term.

Analysing the financial impacts of the ban with these three lenses provides a rigorous understanding of the impacts of the ban within the financial and physical domain. However, it should be noted that the results of these three approaches cannot be aggregated. Rather, this analysis examines the following three questions:

- What are the likely the financial impacts on the average farmer who exports livestock?
- what are the likely financial impacts of the ban on New Zealanders as a whole directly after the ban?
- what are the likely financial impacts of the ban on New Zealanders as a whole over time?

This section answers each of these questions in turn. Appendix 5 provides a reconciliation between the farm-level and economy wide analyses.

4.2 Farm-level analysis

Introduction

To analyse the farm-level impacts of the ban, we first model a base case for the earnings of an average dairy farm. Having established a base case, we calculate the incremental earnings from livestock exporting under three different scenarios. The different scenarios reflect the different approaches dairy farmers could take to supplying heifers for export – from selling heifers in excess of their replacement requirements resulting from a “standard" reproduction programme to breeding heifers specifically for the live export market. The incremental earnings from live-export revenue are what farmers lose financially with the ban.

Base case

The base-case modelling information comes from the latest 2019–20 DairyNZ Economic Survey, which is informed by the DairyBase® database.[20] For the Survey, groups of farms are selected that closely match the average regional herd size, hectares, and milk solids production.[21] Assumptions surrounding the base case are listed below.

- For the purpose of this analysis, we have used numbers that represent the middle 50% (i.e., excluding the bottom and top quartile) of farms run by owner-operators.[22]

- The annual farming cycle requires that farmers get all their cows in-calf and raise sufficient animals to replace all the cows that need to be replaced. The base case modelling assumes that all other calves are bobby calves.

[20] DairyBase® is available to all levy-paying New Zealand farmers.

[21] Participation in DairyBase® is voluntary and at this stage the database contains farms with above-average milk production levels. 2019–20 is the latest available information. As published in the New Zealand Dairy Statistics 2019–20.

[22] An owner-operator is a farmer who receives 100% of the milk revenue and either owns, leases, or both the herd and the land.

- Farmers produce milk and get paid for the fat and protein components of that milk. The fat and protein components are referred to as milk solids. The modelling has been done on both a per-kilogram-of-milk solids (kgMS) basis and a per-farm basis.

- There has been significant on-farm inflation in the last two years with cost pressures continuing into the current season (1 June, 2022 to 31 May, 2023). The base-case modelling doesn't adjust for inflation as it is only the incremental impact on live exports on dairy farmers' earnings that is relevant.

The resultant base-case group of dairy farmers milks 400 cows on 140 hectares and produces 160,000 kgMS. As well as revenue from the sale of milk, the farms generate revenue from the (non-export related) sale of livestock as well as a small amount of revenue from other miscellaneous sources such as quality premiums, processor loyalty payments and dividends. In the year being modelled, dairy farmers earned:

- $7.02 for each kgMS sold (on a kgMS-equivalent basis);
- $0.51 from the sale of livestock; and
- $0.04 from other miscellaneous sources;

for total revenue of $7.57 / kgMS.

On the cost side of their businesses, farmers' cash costs averaged $4.89 / kgMS with non-cash costs (depreciation) of $0.41.

Earnings before interest and tax were therefore $2.28 / kgMS.

On average, there were 261 bobby calves per farm.

Live exports model

The live-export model takes the base-case model and calculates the incremental earnings from each of the three scenarios as follows:

Scenario 1:

Farmers employ a standard herd-replacement strategy – being to mate their first-time calvers with a bull and to artificially inseminate (AI) the rest of their herd for the first heat two cycles followed by a bull for the next two cycles;

Under Scenario 1, farmers need 90 replacements and have 141 calves to choose from. Under this scenario, farmers have 51 surplus heifers available to be sold for live export.

Scenario 2:

Farmers mate their first calvers with a bull and use sexed semen over the rest of their herd for the first heat cycle followed by AI on the second cycle followed by a bull for the next two cycles.

Under Scenario 2, farmers need 90 replacements and have 202 calves to choose from. Under this scenario, farmers have 112 surplus heifers available to be sold for live export.

Scenario 3:

Farmers mate their first calvers with a bull and use sexed semen over the rest of their herd for the first two heat cycles followed by a bull for the next two cycles.

Under Scenario 3, farmers need 90 replacements and have 232 calves to choose from. Under this scenario, farmers have 142 surplus heifers available to be sold for live export.

Scenario 1 is the least expensive reproduction strategy. Scenario 3 is the most expensive.

The other underlying assumptions are:

- The herd replacement rate is 23%;
- The calving death rate is 15%;
- The ratio of female to male calves from AI is 1:1;
- The ratio of female to male calves from sexed semen is 9:1;
- Heifers are sold to the exporter at 14 months of age;
- Grazing land is leased for the surplus heifers;
- The summer grazing cost is $10 per head per week for 22 weeks from 1 December;
- The winter grazing cost is $20 per head per week for 24 weeks from 1 May;

- The selling price is $1,650 per head;
- Bobby calves have nil value; and
- 150,000 heifers are exported in total (based on live exports in 2021/22).

Live-export contracts

The live-export contracting process is reasonably simple from a farmer's perspectives. Farmers are required to raise their export heifers in exactly the same manner in which they raise their replacement heifers. Heifers are exported between the ages of 9 and 20 months. The heifers must come from a herd that is disease free, be healthy, meet a minimum required body condition score, and be at least 200kg in weight.

The heifers need to undergo a number of blood tests before they leave their farms. The costs of these blood tests are met by the exporter.

Once the exporter uplifts the animals from the farm, the farmer's obligations with respect to those animals are complete. Farmers are then paid within 14 days.

The buyers' preferences tend toward more pure-bred stock – mostly Holstein Friesian or Jersey although Kiwi Cross are also exported occasionally.

Farm-level results

The modelled results on a per-farm basis are as presented in Table 4 below.

Table 4: Farm-level analysis on a per-farm basis, p.a.

	Base case	Scenario 1	Scenario 2	Scenario 3
Exporting farms		2,923	1,344	1,058
Heifers exported per farm	-	51	112	142
EBIT, $/kgMS	2.28	2.58	2.87	3.01
Incremental EBIT, $/kgMS	-	0.33	0.72	0.86
EBIT, $	361,000	410,000	455,000	477,000
Incremental EBIT, $	-	49,000	94,000	116,000
Incremental EBIT per heifer, $	-	955	842	819
Incremental EBIT, $	0%	14%	26%	32%

Table 4 presents the returns to farmers under Scenario 1, 2 and 3 in relation to the base case (where the average farmer's EBIT is $361,000 or $2.28 / kgMS).

In Scenario 1, a total of 2,923 farms export 51 heifers each. Each farm makes 14% more EBIT than without live export (an additional $49,000 per farm p.a.).

In Scenario 2, a total of 1,344 farms export 112 heifers each. Each farm makes 26% more EBIT than the without live export (an additional $94,000 per farm p.a.).

Finally, under Scenario 3, 1,058 farms export 142 heifers each. Each farm makes 32% more EBIT than without live export (an additional $116,000 per farm p.a.).

The incremental EBIT presented above represents the financial loss to individual farms under the ban. If many farms (2,923) would have otherwise exported 51 heifers each, each farm is $49,000 worse off than without the ban. If fewer farms (1,058) would have otherwise exported 142 heifers each, each farm is $116,000 worse off than without the ban.

Given the base case EBIT per farm (EBIT before live export) is $361,000, this is a significant loss in earnings for these owner-operator farms. This loss in financial and physical capital at the farmer level has flow-on impacts for the individual and collective wellbeing of this group. These will vary per case, but could be expected in the health (physical and mental); housing; leisure and play; work, care and volunteering; and subjective wellbeing domains.

While this section estimates the financial impact of the ban at the individual farm level, the following two subsections look at the macro-economic or economy-wide impacts, in the short and medium-terms respectively.

4.3 Short-term economy-wide analysis

Introduction

To estimate the short-term (within the first year or two) macro-economic effects of the ban we employ economic multiplier analysis, as is commonly applied in economic impact assessments.

Economic multipliers are used to estimate the short-term flow-on impacts of a change in demand or supply of a good or service. For example, when a sum is injected into the economy (such as livestock export revenue), that sum travels through the economy and generates output in other industries. When the injection changes, it causes changes to other related industries. Multipliers are used in economics to estimate the value of these changes.

Reducing livestock exports to zero impacts not just on farmers (as calculated in the section above), but on related industries which supply inputs to farmers. For example, exports of live animals require initial inputs of land and food to rear the animals followed by transport services. Part of the revenue from sales is used to cover the cost of these inputs. Another part covers the cost of the buildings and equipment (spread over their useful lives) and there is a significant portion for wages and salaries.

The supplying industries such as fertiliser and energy require inputs themselves, pay wages and salaries, and so on. The effect on these supplying industries is known as the upstream or indirect production effect and is commonly measured by a number called a Type I multiplier.[23]

All industries pay wages and salaries, which are used in turn by the recipients of the wages and salaries to purchase household consumption goods. This second-order effect is generally known as the downstream or induced consumption effect. Again the effect may be measured by a multiplier, known as the Type II multiplier.[24]

Multipliers are typically calculated for three different measures of economic activity:

- gross output;[25]
- value-added; and
- employment.

Each of these is further disaggregated into Type I and Type II multipliers. Further technical details on multiplier analysis are provided in Appendix 2.

Modelling assumptions

The key assumptions underlying the short-term analysis are:

- The proposed ban is set to take effect on April 30, 2023. We do not know what the potential value of livestock exports by sea would have been for 2023/24, so for analytical purposes we use the 2021/22 value of livestock exports by sea of $382m.

- The multipliers are 89%/11% combinations of those for dairy farming and sheep & beef farming respectively, based on the 2021/22 composition of live animal exports.

- Calculations, including FTE estimates are made using the 2019/20 input-output table from Statistics NZ.[26]

Short-term economy-wide results

As mentioned above, the base value for gross exports and therefore gross output is $382m. Using the ratios from the 2019/20 IO table:

- base employment in the livestock export industry is 900 FTEs; and
- base value added is $188m p.a.

To calculate the total activity by Type I and Type II, we apply the multipliers presented in Table 5 below.

Table 5: Type I and Type II multipliers

	Type I	Type II
Gross Output	1.75	2.50
Employment	2.16	3.34
Value Added	1.71	2.52

Source: calculated from 2019/20 IO table

[23] The Type I multiplier is defined as the ratio of the direct plus indirect production effects to the direct production effect.

[24] The Type II multiplier is defined as the direct plus indirect production plus induced consumption effects, all divided by the direct production effect.

[25] Multipliers need to be cautiously interpreted and carefully applied. When applied to gross output they lead to double counting. For example, the value of food and drink supplied at a restaurant is counted as part of the gross output of both the Food and Beverage Manufacturing industry and the Restaurant industry. If one's aim is to measure overall business activity this double counting may be useful, but from the perspective of national wellbeing it is value added, or contribution to gross domestic product (GDP) which is of interest.

[26] Input-output tables show the relationships between industries, the goods and services they produce, and who uses them. The tables contain detailed data about the production and expenditure measures of gross domestic product (GDP). The source tables can be found here: https://www.stats.govt.nz/information-releases/national-accounts-input-output-tables-year-ended-march-2020

Applying these multipliers to the base values gives the results presented in Table 6 below.

Table 6: Analysis of short-term effects of the ban, p.a.

	Base Value	Total Activity by Type I	Total Activity by Type II
Gross Output, $m	382	669	**955**
Employment, FTEs	900	1,947	**3,003**
Value Added, $m	188	322	**474**

The key results column in Table 6 is Total Activity by Type II, which captures all the direct and indirect production effects, as well as induced consumption effects of livestock exporting by sea. The final estimate of the short-term value-added impact of the industry is $474m. This means that a ban of livestock exports of $382m (gross output in the base case) results in a short-term cost to New Zealand GDP of around $474m p.a.

The impact on employment is particularly pronounced. As indicated in the total activity by Type II column, in the short-term the ban results in total job losses of around 3,000 FTEs. While the direct loss to farms is around 900, the upstream and downstream losses are substantial, reflecting the relatively high labour intensity of industries that supply farming and those that supply goods and services to households compared to the labour intensity of on-farm activity.

As a result, the short-term employment effects of the proposed ban are likely to be more pronounced and probably somewhat longer lasting than a narrower analysis of on-farm effects would suggest, particularly given the smaller labour markets and less industrial diversification that exist in rural areas.

This analysis indicates that a ban on the export of livestock by sea would result in short-term losses of direct value add of $188m p.a., and of total value add (including upstream and downstream effects) of $474m p.a. By eliminating this value add, the ban therefore has a short-term financial cost to New Zealand's GDP of $474m p.a.

4.4 Medium-term economy-wide analysis

In the medium-term the resources initially displaced by a ban on live animal exports would be unlikely to still be idle or unused. Workers would move into different occupations or industries, or never even enter the relevant farming and associated industries.

In other words, those who lost their live-export related jobs (as discussed in the previous section) would find other work, generating output elsewhere. By eliminating the export revenue, however the ban does have a lasting impact on New Zealand's financial wealth in the medium-term. This section estimates that impact.

To assess the medium-term financial impact of the ban we use the ESSAM (Energy Substitution, Social Accounting Matrix) model. The ESSAM is a general equilibrium model[27] of the New Zealand economy. The ESSAM model takes into account the main inter-dependencies in the economy, such as flows of goods from one industry to another, plus the passing on of higher costs in one industry into prices and hence the costs of other industries.

The ESSAM model has previously been used to analyse the economy-wide and industry-specific effects of a wide range of issues, including:

- analysis of the New Zealand Emissions Trading Scheme and other options to reduce greenhouse gas emissions;
- changes in import tariffs;
- public investment in new technology; and
- funding regimes for roading and wider economic benefits.

Details on the ESSAM model are provided in Annexes X and Y.

Medium-term economy-wide results

The medium-term results of the evaluation of the ban on livestock exports are presented in Table 7 below. The numbers presented are relative to a baseline

[27] General equilibrium models describe the allocation of resources in a market economy as the result of the interaction of supply and demand, leading to equilibrium prices. The building blocks of GE models are equations representing the behaviour of relevant economic agents – consumers, producers, the government, etc. Each of these agents demands or supplies goods, services, and factors of production, as a function of their prices. Assuming that market forces will lead to equilibrium between supply and demand, GE models compute the prices that clear all markets, and determine the allocation of resources and the distribution of incomes that results from that equilibrium.

projection of 2030. The baseline is essentially the counterfactual to banning live exports (i.e. allowing exports to continue under the Gold Standard).[28] Although it is intended to represent a plausible picture of 2030 without major external shocks or large changes in policy, the baseline is not a forecast.[29] The baseline figures are therefore not presented below.

Table 7: Analysis of medium-term effects of the ban

	% p.a. change on baseline	$m p.a. change on baseline
Live animal exports	-65.6	-382
Private consumption	-0.11	-251
Exports	-0.14	-157
Imports	-0.17	-188
Wage rates index	-0.07	na
Real exchange rate	-0.11	na
CO_2e emissions	-0.73	-0.5 (Gt)
GDP	-0.07	-307
RGNDI	-0.08	-319

Table 9 shows the changes in a number of macroeconomic measures in 2030 attributable to a reduction in the value of live animal exports of $382m per annum. Key impacts are discussed below in turn.

Private consumption

Private consumption is essentially the consumption of goods and services by resident private households. It is a reasonably good measure of the economic standard of living, but has two notable exclusions. Firstly it ignores goods and services that are treated as being consumed by government (such as most healthcare and education) but actually benefit individuals.[30] Secondly it ignores the possibility that households could raise current consumption at the expense of future consumption. A measure such as GDP or better still RGNDI (discussed below) includes government consumption and gross investment, so presents a broader measure of economic wellbeing.

Banning live animal exports leads to drop in private consumption of 0.11%, or around $250m in 2030.

Exports and imports

Exports in the medium-term fall by $157m p.a. and imports fall by $188m p.a. Exports do not fall by the full amount of the decline in live animal exports. Over time, other exports will increase in response to enhanced competitiveness brought about by a lower exchange rate. In proportionate terms horticulture, forestry and mining are expected to lead the way, but in absolute terms the largest increases are in tourism, horticulture and processed food & beverages. A reduction in imports also assists with preventing a deterioration in the overseas current account balance, in line with the first closure rule (Appendix 4).

Wage rate

Consistent with the third closure rule, in the medium term we would not expect total employment in the economy to be related to the value of live animal exports, but we would expect to see an impact on wage rates if the country is poorer as a result of lower exports. Thus the medium-term employment multipliers are effectively zero and so are redundant. Average wages are projected to show a small decline of 0.07%.

CO_2e emissions

See the discussion in Section 5.2 below on the impacts on the natural environment.

[28] Arguably, this may not be exactly right as under the Gold Standard described above there would be an increase in compliance and administration costs in the industry (relative to the status quo). However, it is unclear how much of this increase in costs could be passed on to buyers without causing a reduction in demand. If the product (that is, the live animal) received by the buyer is a better product there may be very little adverse reaction. Regardless, we consider that any change in demand is likely to be small when compared to the historical volatility in the value of live animal exports. Hence we assume for the medium-term analysis the same $382m decline in exports as used for the short-term analysis. Although the model is inherently nonlinear, small changes are approximately linear.

[29] General equilibrium models are not forecasting models. Their strength is in scenario analysis, with the Baseline scenario acting as a frame of reference against which other scenarios may be compared.

[30] For the modelling here government consumption is held constant across scenarios.

GDP

The estimated medium-term change in GDP is $307m p.a. This is around 80% of the reduction in the value of live animal exports. In Table 9 above short-term Type II multiplier-driven value-added effect is 124% of the reduction in the value of live animal exports. The difference reflects the elapsed time span of seven years or so, during which existing workers involved in live exports find alternative employment and previously potential workers in that activity train for other occupations and enter other industries such as horticulture. Similarly, investment that might have gone into expanding capacity for exporting live animals instead capitalises on second-best prospects in food processing.

RGNDI

RGNDI stands for real gross national disposable income, and is defined as GDP plus adjustment for the terms of trade and net factor payments overseas, such as for emission units.[31] It is therefore a more wholistic measure of financial wellbeing than GDP.

As presented in Table 9 above, the medium-term modelling indicates a change in RGNDI of -0.08%, or $319m p.a. as a result of the ban on livestock exports. This equates to a loss of around $150 per household per year. On a per person basis the on-going reduction in national income is equivalent to around $60 per person per year on average.

The reduction in RGNDI arising from the ban is slightly greater than the reduction in GDP. This reduction reflects the net effect of two countervailing factors: the reduction in CO_2e emissions ($75m p.a.) which reduces the loss in RGNDI (from a decline in net factor payments overseas) and a more-than-offsetting decline in the terms of trade (by -0.1%) as exporters move down the economic value-added chain in order to sell more to compensate for the drop in live animal exports.

In reality of course, the medium-term reduction in financial wellbeing will not be felt equally across every single New Zealander – rather it will be concentrated around regions that dominate the supply of live animals for export and rural areas. Further discussion around the effects on rural communities and the distribution of wellbeing impacts is presented in Section 7 (Overall costs and benefits) below.

[31] We treat payments for emissions units like a licence fee, although the units could also be treated as a stock (asset) rather than a flow. This doesn't affect the essence of the results.

4.5 Overall impacts on financial and physical capital

This section has analysed the impact of the ban on financial and physical capital in New Zealand from a farm-level; short-term and medium-term perspective. These three lenses should be considered individually, and cannot be aggregated.

Overall we find the ban results in:

- a net cost to farmers who would have otherwise exported heifers, of around $49,000 to $116,000 per farm p.a. (with the cost incurred by 1,058 to 2,923 farms);
- a net cost to New Zealand GDP in the short-term of around $474m p.a. (1-2 years after the ban); and
- an ongoing net cost to national financial wellbeing in the medium-term of around $319m p.a. or around $150 per household on average per year.

The impacts of the ban on other dimensions of wellbeing are discussed in Sections 5 and 6 below,

5 Natural environment

5.1 Introduction

Following on from analysis of the impact of the ban on financial and physical capital, this section analyses the impacts on the natural environment. The natural environment domain is defined in the LSF as all aspects of the natural environment which support life and human activity, whether valued for spiritual, cultural or economic reasons.

In this national wellbeing analysis of the livestock export ban we analyse the impact on two aspects of this domain:

- environmental impacts; and
- animal welfare impacts.

An underlying assumption is that the ban of live exports by sea results in an reduction in the total number of dairy cattle exported and that sea transport is not replaced by air transport.

5.2 Environmental impacts

Section 4 above modelled the medium-term macro-economic impacts of the ban using the ESSAM model. As mentioned earlier, the ESSAM model captures the CO_2e impacts per industry, and has been used in the past to analyse the New Zealand Emissions Trading Scheme and other options to reduce greenhouse gas emissions.

The results from this medium-term modelling show that with somewhat less activity in pastoral agriculture, there is a small benefit with regard to New Zealand's emissions, totalling 500kt p.a. This represents a 0.7% decline in New Zealand's emissions. The model assumes dairy resources move into a range of other industries – with the biggest growth being in food processing, forestry and logging and horticulture. Given these are less emission-intensive than dairy, the net effect is a small reduction in overall emissions.

In the model, emissions in 2030 are assumed to be priced at \$150/tonne CO_2e, although agricultural methane emissions receive concessionary pricing under current policy. The New Zealand Government has set an international target to reduce the country's net emissions of greenhouse gases by 50% below 2005 levels by 2030. There is also a domestic target of net zero emissions by 2050, excluding biogenic methane emissions.

If the 2030 target is not met New Zealand will need to purchase emission units from overseas. International targets do not recognise a split gas approach, so any changes in domestic methane (CH_4) emissions are just as relevant as changes in CO_2, converted at the GWP100 greenhouse gas exchange rates.[32] If the price of international units is the same as that assumed for New Zealand's ETS, at \$150/tonne the reduction in emissions from the ban would be worth \$75m in 2030.

It should be noted that the monetary value of the CO_2e reduction benefits (i.e., the \$75m p.a. benefits) is taken into account in the loss in net income (RGNDI) estimate which, as noted in Section 4, deducts changes in net factor payments overseas, such as for emission units. That is, the financial and physical capital costs of the ban would be larger if it wasn't for the partially offsetting benefit from the reduction in CO_2e emissions that reduces New Zealand's net factor payments overseas.

There may also be potential impacts for water values from the ban. The government has put in place a fresh water work programme to restore and protect the health of New Zealand's waterways. The programme includes excluding stock from certain types of waterways, controlling intensive winter grazing practices, restricting significant agricultural intensification and managing excessive nitrogen discharges. Any land that is reallocated away from heifers as a result of the ban will be subject to these same regulations and restrictions, with the ultimate impact on water dependent on the nature and behaviour of new land users.

5.3 Animal welfare

Decreased health risk for livestock

National wellbeing analysis (and the LSF framework) consider the role of nature and animals mainly from the perspective of their role in sustaining human

[32] Global warming potential, measured over 100 years. The IPCC Sixth Assessment Report uses a conversion factor of 27.8 tonnes of non-fossil origin CH_4 equals 1 tonne of CO_2.

wellbeing. However, the LSF notes the intrinsic value of animals, as well as the idea that the natural environment and animals can be valued on a cultural or spiritual basis.[33]

As described in Section 2, sea transport can create discomfort for cattle and result in negative health outcomes for animals such as heat stress and lameness. Mortalities occur, but at a low average rate of 9 animals per 10,000. The Gold Standard is designed to reduce and mitigate these risks. Nevertheless, with livestock ceasing to be exported by ship, the ban eliminates the residual health risks to livestock arising from the transit.

It is important though to consider the counterfactual for animals if they are not exported, as discussed below.

Increase in bobby calves slaughtered

For cows to produce milk, they have to calve. The majority of these calves are surplus to requirements in the dairy industry and are known as bobby calves. Bobby calves are killed when they are one to two weeks old.

The practice of killing bobby calves is being increasingly scrutinised after negative publicity in recent years. In 2016 regulations relating to the welfare of young calves were introduced[34] and milk processors have recently increased measures to minimise bobby calves. The number of bobby calves slaughtered each year in New Zealand is not known precisely but it is estimated to be 1.6 to 2 million.

The farm-level analysis in Section 4 illustrates three scenarios of live export, each involving 150,000 heifers exported. If these heifers are not exported with the ban in place, they would more-than-likely be bobby calves. Therefore, on an industry basis, live exports of heifers reduces the number of bobby calves by 150,000. This represents around a 7 to 9% reduction in bobby calves at an industry level.

Table 8 below looks at the increase in bobby calves for the farms that provide live heifers for export, using the three scenarios developed in Section 4.

Table 8: Incremental bobby calves per livestock exporting farm, p.a.

	Base case	Scenario 1	Scenario 2	Scenario 3
Exporting farms		2,923	1,344	1,058
Heifers exported per farm	-	51	112	142
Bobby calves	261	210	149	119
Incremental bobby calves	-	-20%	-43%	-54%

Under Scenario 1, where around 2,923 farms provide the animals for live export, each farm increases its number of bobby calves by 20% (51 bobby calves) under the ban. Under Scenario 2, with around 1,210 farms exporting, each farm increases bobby calves by 43% (112 calves); while under Scenario 3 with only 1,058 farms providing livestock for export, there is an increase in bobby calves of 54% (142 calves per farm). The ban removes the ability of farmers to export rather than slaughter these calves.

A global perspective on animal welfare

This report looks at the wellbeing costs and benefits of the ban from a national perspective (i.e., to New Zealanders). However, the livestock export industry is part of a global supply chain, and the actual impacts of the ban extend further than our borders. Our current livestock trade with China is filling a portion of China's demand for cattle for dairy farms as part of its strategic plan for economic and social development. If New Zealand stops supplying China with livestock, China will inevitably import livestock from elsewhere. In the last five years, New Zealand and Australia have been the major suppliers of cattle to China for breeding and milking, alongside some smaller shipments from Chile and Uruguay. Other major international cattle exporters include the United States, Canada, Mexico, Brazil and the EU.

It is unclear exactly how China will fill its demand for livestock in the absence of New Zealand exports by sea. Trading history could suggest Australia, Chile and Uruguay may be the primary suppliers. Whether or not New Zealand is the supplier, cattle will more than likely continue to be imported by sea.

Should these animals be imported from a country with lower animal welfare standards than New Zealand animals are treated to, there is a risk that animal

[33] Treasury (2021, p. 53)

[34] https://www.mpi.govt.nz/animals/animal-welfare/safeguarding-our-animals-safeguarding-our-reputation/bobby-calf-welfare/

welfare (from a global perspective) will be lower with the ban. This risk exists unless the live export by ship trade ceases globally.

5.4 Overall impacts on the natural environment

This section has analysed the impact of the ban on the natural environment domain. Overall we find the ban is likely to result in:

- a benefit to the natural environment from a reduction in CO_2e by 500kt (a 0.7% decline in New Zealand's emissions) with an estimated value of around $75m in 2030)[35];
- a benefit to animal welfare in the form of reduced health risk to livestock in transit; and
- a cost to animal welfare in the form of increased bobby calves slaughtered by 150,000 calves p.a.

This section also notes the possible adverse impacts of the ban on global animal welfare. Depending on the animal welfare standards of alternate supplying countries, overall animal welfare from a global perspective could decline with the ban. Given this point extends beyond a national wellbeing analysis, it is not considered to be part of the final results.

[35] At $150 / tonne of CO2e versus the current price of approximately $75.

6 Social cohesion

6.1 Introduction

This section analyses the impacts of the ban on livestock exporting that fall within the social cohesion domain. This category is relatively broad, and most pertinent to the ban, includes:

- reputational impacts for New Zealand; and
- trade relationships.

While numerical analysis is included where possible, the majority of these impacts are found to be non-quantifiable costs and benefits.

6.2 Reputational impacts for New Zealand

The ban on livestock exports could have a number of impacts on New Zealand's international reputation. We do not attempt to quantify these impacts. Not only is reputation difficult to measure and assess, it is subjective and multi-directional – some parties will see the ban as creating a benefit to New Zealand's reputation while others will see it as creating a cost. This section qualitatively analyses these potential reputation-related impacts.

Animal-welfare proponents

To animal-welfare proponents both domestically and internationally, the ban is likely to enhance New Zealand's reputation. Those who put a very high value on animal welfare may consider the ban a major reputational benefit to New Zealand. The ban could be considered as positive for New Zealand's image as a country, which may or may not translate into monetary or other wellbeing benefits (e.g., through improved perception of New Zealand goods and services as welfare conscious).

Though some animal welfare proponents feel very strongly about the impact of the ban, qualitative and quantitative surveys by Talbot Mills Research find that overall public awareness of the livestock industry and the ban is relatively low.[36] In a survey of 739 New Zealanders 18 and older, 26% stated they knew a lot or a fair amount about live export. 44% stated they knew not that much, while 30% stated they knew hardly anything.[37] The most common rationale for those in favour of the ban were that:

- even if most exporters maintain very high standards there will be some who cut corners; and
- animal welfare is becoming increasingly important and there is likely to be more and more pressure to ban live export.

International trading community

On the other hand, the ban could be viewed by some members of the international trading community as contrary to international trading rules or as a non-tariff barrier to trade.[38] As a proponent of free trade and a beneficiary of the multi-lateral trade system, this could be detrimental to New Zealand's reputation within the international trading community. It may:

- increase our exposure to similar non-tariff barriers to trade;
- reduce our voice in the international trade arena if the ban is considered contrary to the multilateral rules-based trading system; and
- reduce our perceived reliability as an exporter.

On a secondary note, the ban could be considered as a missed opportunity to lead the animal-welfare discussion within the international trading community. By exiting the livestock export by sea industry, our ability to directly influence global animal welfare standards may be diminished.

Reduction in incident risks

As the RIS notes,[39] all livestock exports could be considered to carry some risk to New Zealand's reputation. Should a major incident involving New Zealand livestock and animal mistreatment occur, our reputation as a responsible exporter of animal products could be damaged. In such an event, there could be

[36] Talbot Mills Research (2022a), (2022b).

[37] The surveys also found that after being provided information on the alternative Gold Standard, there was a net +4% shift in opinion towards preferring a new standards system (or a trial of such a system).

[38] Non-tariff barriers to trade are trade barriers that restrict imports or exports of goods or services through mechanisms other than the simple imposition of tariffs.

[39] Ministry for Primary Industries (2021, p. 7).

a cost felt by exporters in other industries such as dairy and meat products. Banning the trade altogether eliminates this risk.

Significant further analysis would be required to assess this risk in monetary terms. However, given the relatively low likelihood of such an extreme event, it is considered less material than other reputational impacts.

6.3 Trade relationships

The ban will have an impact on New Zealand's relationships with livestock trading partners, in particular New Zealand's main livestock market, China. As mentioned above, the trade is currently part of the Chinese Government's strategic plan to reduce poverty and improve food security. New Zealand's decision to ban exports could be seen from the Chinese perspective as anti-collaborative, and non-supportive of China's economic and social development goals. Furthermore, New Zealand's position could come across as mistrusting and even patronising of Chinese animal-welfare standards.

Livestock trade operates within a wider trading system with China, including $5 billion of dairy exports. While perhaps a low risk, the relationship costs from the ban could result in some reduction in access to other export markets or at the extreme end, a change in preferred supplier for Chinese importers for agricultural products.

6.4 Overall impacts on social cohesion

This section has analysed the impact of the ban on the social cohesion domain. Overall we find the ban results in non-quantifiable costs and benefits in this domain including:

- a benefit to New Zealand's reputation from the perspective of some animal-welfare proponents;
- a cost to New Zealand's reputation from the perspective of some in the international trading community;
- a benefit relating to the reduction in incident risk; and
- a cost to our trade relationships with livestock-trading partners.

Three of these impacts relate to New Zealand's reputation. However, given the subjective and multi-directional effects on New Zealand's reputation, it is not possible to determine the net reputational impact or the net impact of the ban on the social cohesion domain.

7 Overall costs and benefits

Like almost all policy changes, the ban on livestock exports by sea is likely to results in both costs and benefits to wellbeing in New Zealand. Neither costs nor benefits should be considered in isolation, nor should quantifiable impacts be considered without consideration of non-quantifiable impacts.[40] The assessed costs of the ban are summarised in Table 9 below.[41]

Table 9: Assessed costs of the ban

LSF Domain	Cost	Description / Quantification
Financial & physical capital	Net cost from lost export revenue	Loss of earnings of $49,000 to $116,000 per farm p.a. incurred by 1,058 to 2,923 farms Reduction in GDP by $474m p.a. in the short-term (1-2 years after the ban) Ongoing reduction in national financial wellbeing (RGNDI) in the medium to long-term of around $319m p.a.
Natural environment	Increase in bobby calves slaughtered	With no calves reared for live export, the ban is estimated to increase the number of bobby calves slaughtered by 150,000 p.a. This represents an increase in 55 to 168 bobby calves per farm that would have otherwise been raised for export.
Social cohesion	Reputational cost in international trading community	The ban could be viewed by members of the international trading community as contrary to international trading rules or as a non-tariff barrier to trade, and thus be detrimental to our reputation as a trading nation. This could increase our exposure to non-tariff barriers to trade; reduce our voice in the international trade arena; and reduce our perceived reliability as an exporter.
Social cohesion	Cost to trade relationships	The ban could impact on New Zealand's relationships with livestock trading partners, i.e. China. It could be seen from the Chinese perspective as anti-collaborative, and non-supportive of China's economic and social development goals. This may have market access implications for other exports to China, in particular for dairy and other animal products.

Table 10 below presents the assessed benefits of the ban.

Table 10: Assessed benefits of the ban

LSF Domain	Benefit	Description / Quantification
Natural environment	CO_2e emmission reduction	Reallocation of resources to other industries results in a reduction in Co_2e emissions by 500kt p.a * (a 0.7% decline in New Zealand's emissions). The actual change is likely to depend on which industries benefit from the reallocated resources.
Natural environment	Reduced health risk to animals in transit	Sea transit can lead to negative health outcomes such as heat stress and lameness for animals. Mortalities can occur, but at a low rate of around 8 deaths per 10,000 These risks would be reduced under the counterfactual (the Gold Standard). However with livestock ceasing to be exported by ship, the ban eliminates the residual health risks from transit.
Social cohesion	Reputational benefit to animal-welfare proponents	To animal proponents (both individuals and institutions like World Animal Protection and RSPCA), the ban will be considered a benefit to New Zealand's reputation. This may or may not translate into monetary or other wellbeing benefits (e.g., through improved perception of New Zealand goods and services as welfare conscious).
Social cohesion	Reputational benefit from incident-risk reduction	All livestock exports could be considered to carry some risk to New Zealand's reputation. Should a major incident involving New Zealand livestock and animal mistreatment occur, our reputation as a responsible exporter of animal products could be damaged (with the effects felt in other animal-product industries). Banning the trade altogether eliminates this risk.

**The monetary value of the CO_2e reduction is taken into account in the RGNDI calculation in the costs table.*

Overall, the ban is likely to impose a net cost on national wellbeing in the financial and physical capital domain of around $475m p.a. in the short run (the first one or two years) and around $320m p.a. on an ongoing basis. The estimate of the ongoing net financial costs to national wellbeing of $320m p.a. takes into account the benefits of the ban in reducing CO_2e emissions. The ban also creates non-monetised costs and benefits within the natural environment and social cohesion

[40] While it would be ideal to be able to reliably monetise all wellbeing impacts and conclude a net cost or benefit to national wellbeing, it simply is not possible given the available reliable information. For example, how does one put a number on a decreased health risk to livestock, the increased number of bobby calves, or the net reputational impacts to New Zealand. Unlike the impacts on financial and physical capital for example, these impacts cannot be valued without subjective assertions, which is not good economics. A good economic analysis quantifies the values that can be quantified and makes the trade-offs between the monetary and the non-monetary values transparent.

[41] The colours in the table reflect the different domains (natural environment etc).

domains, such as the gains and losses to animal welfare and the gains and losses to New Zealand's international reputation.

Within the financial and physical capital domain, the ban results in an ongoing net financial cost to wellbeing estimated to be $320m p.a. Net benefits to the natural environment and to social cohesion, assuming they are positive, would need to exceed the ongoing monetary costs of $320m p.a. for the ban to enhance overall national wellbeing.

This section concludes with a discussion of the wellbeing impacts of the ban in regards to distribution, resilience, productivity and sustainability.

7.1 Distribution

Distribution in the LSF refers to how our aggregate wealth and wellbeing are distributed across time, place and groups of people.

In Section 4, we found the ban to result in an ongoing reduction in national financial wellbeing of around $320m p.a. As mentioned, if this was distributed evenly across all New Zealand households, it equates to around $150 per household per year.

In reality, the wellbeing impacts of the ban will not be distributed evenly. Rather, they will be concentrated around rural communities, in particular felt by farming families and those engaged in rural goods and services industries.

As the farm-level analysis found, at the owner-operator farm level there is a net cost from the ban to around 1,058 to 2,923 farms who would have otherwise exported heifers. There are currently around 11,000 dairy farms in total in New Zealand, which suggests the ban will impact adversely on around one in ten to one in four owner-operator dairy farms. As noted in Section 4, the ban is likely to reduce the earnings of these farms by around $49,000 to $116,000 per farm per annum.

At the household level, this is a substantial loss in earnings (of between 14 to 32%) for these farms, which would have a corresponding substantial wellbeing impact in these communities.

As the short-term multiplier analysis indicates, removing this revenue impacts beyond the farms themselves, with effects felt by local suppliers of input goods and services (the wider agricultural economy).

Figure 5 below highlights the location of live export supplier farms to Austrex (NZ) to date.

Figure 5: Map of live export supplier farms

Source: Austrex (NZ)

As can be seen from Figure 5 above, Northland, Waikato, Hawke's Bay, Wairarapa, Canterbury and Otago are particularly represented in live-export supply. Though the economic cost of the ban will flow through the wider economy, members of rural communities in these regions are likely to feel the bulk of the wellbeing costs of this policy. The nature of wellbeing costs vary by individual and group, but could be expected to be evident in the health (physical and mental); housing; leisure and play; work, care and volunteering; and subjective wellbeing domains.

7.2 Resilience

Resilience refers to the ability of individuals, collectives, institutions, organisations and the environment to adopt to and absorb stresses and shocks.

Livestock exports currently provide farmers (predominantly in dairy farming) an alternate export income. This income provides a buffer to the volatility of the milk price, allowing farmers to spread risk and withstand milk-price shocks. Our analysis indicates that livestock exports reduce the break-even milk price for participating farmers by $0.31 to $0.73 / kgMS. Outside of livestock exports, owner-operator dairy farmers have few alternate ways to diversify the income they earn from their stock. As a result, the ban reduces the resilience of owner-operator dairy farmers to dairy-price volatility and to shocks in the dairy market.

7.3 Productivity

Productivity refers to how effectively New Zealanders' wealth is being used to generate wellbeing and things of economic value.

From this perspective, the ban limits New Zealand's ability to generate wellbeing and economic value from our livestock. Overseas demand exists for New Zealand cattle due to its high quality and the quality of the environment the stock are raised in. The ban reduces New Zealand's ability to leverage this wealth to generate export earnings.

The lost productivity from the ban is reflected in the loss of the premium that overseas customers are prepared to pay for livestock: the average domestic sale price for exported livestock is around $1,650 per head, versus around $800 otherwise, a premium of around 100%. In effect, the ban is directing the New Zealand economy into a lower productivity, lower financial wellbeing growth path.

7.4 Sustainability

Sustainability in the LSF refers to how well New Zealand is safeguarding its national wealth for the benefit of future generations. In the context of the ban, this could be considered from different perspectives.

On one hand, the ban inhibits the ability for future generations in the farming industry to generate wealth from this export. As noted in the discussion of resilience above, the ban also reduces farmers' ability to buffer against dairy-market volatility. From a farmer point of view, the ban could reduce the ability for the farming industries to prosper going forward.

Alternately, as discussed in Section 6 above, the ban could be considered from some perspectives as a safeguard for New Zealand's international reputation. By eliminating livestock exports by sea, the ban reduces the risk of a reputation-damaging event that could negatively impact on other animal-export industries.

Finally, as noted in Section 4, the ESSAM modelling indicates that the ban will reduce New Zealand's emissions of CO_2e by 500kt p.a.. From an environmental sustainability perspective, this aids in safeguarding the domestic environment. From a global perspective however, it is difficult to assess if the ban will increase or decrease global emissions. This will depend on where export markets like China alternatively source livestock, and the environmental standards in the particular market.

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Appendix 1: Living Standards Framework

The current New Zealand government standard for assessing the wellbeing impacts of a policy is the Treasury's Living Standards Framework (LSF). The 2021 LSF has three levels alongside a series of analytical prompts for consideration at each level.

Level 1: Individual and collective wellbeing

This level captures resources and aspects of our lives that are considered important to wellbeing at the individual, family, whānau and community level. The 12 domains are:

- Health
- Knowledge and skills
- Cultural capability and belonging
- Work, care and volunteering
- Engagement and voice
- Income, consumption and wealth
- Housing
- Environmental amenity
- Leisure and play
- Family and friends
- Safety
- Subjective wellbeing

Level 2: Institutions and governance

This level captures the role that political, economic, social and cultural institutions play in facilitating the wellbeing of individuals and collectives. Schools for example play a role in the wellbeing of children, as do marae in the wellbeing of tangata whenua. This level includes:

- Whanau, hapu and iwi
- Families and households
- Civil society
- Firms and markets
- Central and local government
- International connections

Level 3: The wealth of Aotearoa

This level captures the wealth of Aotearoa New Zealand. New Zealand's national wealth is captured under four areas:

- **Natural environment:** All aspects of the natural environment which support life and human activity, whether valued for spiritual, cultural or economic reasons
- **Human capability:** People's knowledge and physical and mental health
- **Social cohesion:** The willingness of diverse individuals and groups to trust and cooperate with each other in the interests of all, supported by shared intercultural norms and values
- **Financial and physical capital:** Tangible human-made assets, intangible knowledge-based assets (e.g., research and development, software and databases, arts and literature) and financial assets minus liabilities

Rather than falling under one of the three levels, culture is considered to play a role in all elements of the 2021 LSF.

Analytical prompts

The LSF includes four key criteria for consideration when analysing the impact of a policy on the three levels of wellbeing above. These are:

1. **Distribution:** How is our aggregate wealth and wellbeing distributed across time, place and groups of people?
2. **Resilience:** Do individuals, collectives, institutions, organisations and the environment have an ability to adapt to or absorb stresses and shocks?
3. **Productivity:** How effectively is our wealth being used to generate wellbeing and things of economic value?
4. **Sustainability:** How well are we safeguarding our national wealth for the benefit of future generations?

Each of these prompts is considered important in understanding trends in wellbeing, as well as the potential impacts of policy.

Appendix 2: Determination of multipliers

As noted in Section 4 of this report, there are two types of economic multipliers:

- Type I multipliers that measure the upstream or indirect production effects of a change in activity in one area of the economy; and
- Type 2 multipliers that measure the downstream or induced consumption effects arising from the change in activity.

Multipliers for the indirect production effects (Type 1) for New Zealand as a whole are calculated from standard input-output tables produced by Statistics New Zealand. Thus for a given increment to final demand (exports, consumption etc), we can determine the direct and indirect pattern of production needed to support that increment to final demand.

Consumption-induced multipliers (Type 2) are more complicated to determine as they require some assumptions about the links between the Production Account and the Income & Outlay Account in the national accounts. In particular a link between private consumption (mostly household spending) and income from wages and salaries needs to be established. Typically this is accomplished by treating inputs of labour as an intermediate input and then treating private consumption as the industry which produces labour. Enhancements to this approach include allowing for the distribution of operating surplus to households and for the leakage of household savings. This is the approach used here.

Other enhancements are theoretically possible:

- allowing for consumption financed from social welfare benefits;
- including the effects of government consumption, much of which, such as health, is actually consumed by individuals and paid for out of taxes;
- including the effect of new investment which may be needed to expand output and may be financed out of operating surplus; and
- acknowledging that exports may need to rise to finance the requirement for additional consumer imports.

Accounting for all of these effects is better accomplished with a multi-industry general equilibrium model such as the ESSAM model used in our medium-term analysis. Such models also ameliorate most of the other implicit assumptions that are commonly overlooked in the application of multipliers, by:

- not assuming that all factors of production are in excess supply;
- allowing for price changes (such as if a factor is in limited supply) which may lead producers to change inputs, thereby altering their production structure and hence the associated economic multipliers;
- not forcing average relationships to hold at the margin; and

automatically calculating net multiplier effects by reducing the gross effects to the extent that they pull resources out of other productive uses (an effect sometimes known as trade diversion).

Appendix 3: ESSAM model structure and industries

This appendix details the key features of the Energy Substitution, Social Accounting Matrix (ESSAM) Model used in the medium-term general equilibrium analysis.

Production functions

These equations determine how much output can be produced with given amounts of inputs. For most industries a two-level standard translog specification is used which distinguishes four factors of production – capital, labour, materials and energy, with energy split into coal, oil, natural gas and electricity.

Intermediate demand

A composite commodity is defined which is made up of imperfectly substitutable domestic and imported components - where relevant. The share of each of these components is determined by the elasticity of substitution between them and by relative prices.

Price determination

The price of industry output is determined by the cost of factor inputs (labour and capital), domestic and imported intermediate inputs and tax payments (including tariffs). World prices are not affected by New Zealand purchases or sales abroad.

Consumption expenditure

This is divided into Government Consumption and Private Consumption. For the latter, eight household commodity categories are identified, and spending on these is modelled using price and income elasticities in an AIDS framework. An industry-by-commodity conversion matrix translates the demand for commodities into industry output requirements and also allows for import-domestic substitution.

Government Consumption is usually either a fixed proportion of GDP or is set exogenously. Where the budget balance is exogenous, either tax rates or transfer payments are assumed to be endogenous.

Stocks

The industry composition of stock change is set at the base-year mix, although variation is permitted in the import-domestic composition. Total stock change is exogenously set as a proportion of GDP, domestic absorption or some similar macroeconomic aggregate.

Investment

Industry investment is related to the rate of capital accumulation over the model's projection period as revealed by the demand for capital in the horizon year. Allowance is made for depreciation in a "putty-clay" model so that capital cannot be reallocated from one industry to another faster than the rate of depreciation in the source industry. Rental rates or the service price of capital (analogous to wage rates for labour) also affect capital formation. Investment by industry of demand is converted into investment by industry of supply using a capital input-output table. Again, import-domestic substitution is possible between sources of supply.

Exports

Exports are determined from overseas export demand functions in relation to world prices and domestic prices inclusive of possible export subsidies, adjusted by the exchange rate. It is also possible to set export quantities exogenously.

Supply-demand Identities

Supply-demand balances are required to clear all product markets. Domestic output must equate to the demand stemming from consumption, investment, stocks, exports and intermediate requirements.

Balance of payments

Receipts from exports plus net capital inflows (or borrowing) must be equal to payments for imports; each item being measured in domestic currency net of subsidies or tariffs.

Factor-market balance

In cases where total employment of a factor is exogenous, factor price relativities (for wages and rental rates) are usually fixed so that all factor prices adjust equi-proportionally to achieve the set target.

Income-expenditure Identity

Total expenditure on domestically consumed final demand must be equal to the income generated by labour, capital, taxation, tariffs, and net capital inflows. Similarly, income and expenditure flows must balance between the five sectors identified in the model – business, household, government, foreign and capital.

Industry classification

The 55 industries identified in the standard ESSAM model are defined below. Industries definitions are according to Australian and New Zealand Standard Industrial Classification (ANZSIC06).

Input-output table

The model is based on Statistics New Zealand's latest input-output table which relates to the year ended March 2020.

	Abbr.	Description
1	HFRG	Horticulture and fruit growing
2	SBLC	Sheep, beef, livestock and cropping
3	DAIF	Dairy and cattle farming
4	OTHF	Other farming
5	SAHF	Services to agriculture, hunting and trapping
6	FOLO	Forestry and logging
7	FISH	Fishing
8	COAL	Coal mining
9	OIGA	Oil and gas extraction, production & distribution
10	OMIN	Other mining and quarrying
11	MEAT	Meat manufacturing
12	DAIR	Dairy manufacturing
13	OFOD	Other food manufacturing
14	BEVT	Beverage, malt and tobacco manufacturing
15	TCFL	Textiles and apparel manufacturing
16	WOOD	Wood product manufacturing
17	PAPR	Paper and paper product manufacturing
18	PRNT	Printing, publishing and recorded media
19	PETR	Petroleum refining, product manufacturing
20	CHEM	Other industrial chemical manufacturing
21	FERT	Fertiliser
22	RBPL	Rubber, plastic and other chemical product manufacturing
23	NMMP	Non-metallic mineral product manufacturing
24	BASM	Basic metal manufacturing
25	FABM	Structural, sheet and fabricated metal product manufacturing
26	MAEQ	Machinery and other equipment manufacturing
27	OMFG	Furniture and other manufacturing
28	EGEN	Electricity generation
29	EDIS	Electricity transmission and distribution
30	WATS	Water supply
31	WAST	Sewerage, drainage and waste disposal services
32	CONS	Construction
33	TRDE	Wholesale and retail trade
34	ACCR	Accommodation, restaurants and bars
35	ROAD	Road transport
36	RAIL	Rail transport
37	WATR	Water transport
38	AIRS	Air Transport
39	TRNS	Transport services
40	PUBI	Publication and broadcasting
41	COMM	Communication services
42	FIIN	Finance and insurance
43	HIRE	Hiring and rental services
44	REES	Real estate services
45	OWND	Ownership of owner-occupied dwellings
46	SPBS	Scientific research and computer services
47	OBUS	Other business services
48	GOVC	Central government administration and defence
49	GOVL	Local government administration
50	SCHL	Pre-school, primary and secondary education
51	OEDU	Other education
52	MEDC	Medical and care services
53	CULT	Cultural and recreational services
54	REPM	Repairs and maintenance
55	PERS	Personal services

Appendix 4: Some key features and assumptions in the ESSAM model

Table 11 below identifies some of the key features and outputs of the ESSAM model.

Table 11: Key features and outputs of the ESSAM model

Key features	Key outputs
• 55 industry groups, as detailed in the table in Appendix 3 • Substitution between inputs into production - labour, capital, materials, energy • Four energy types: coal, oil, gas and electricity, between which substitution is also allowed • Substitution between goods and services used by households • Social accounting matrix (SAM) for tracking financial flows between households, government, business and the rest of the world	• GDP, private consumption, exports and imports, employment, etc. • Demand for goods and services by industry, government, households and the rest of the world • Industry data on output, employment, exports etc. • Import-domestic shares • Fiscal effects

Assumptions

Consistent with generally accepted modelling practice the model is subject to a number of macroeconomic closure rules[42]. The assumptions in the model are set out in Table 12 below.

Table 12: Assumptions in the ESSAM model

Assumption	Implication
The current account balance is fixed as a percentage of GDP	This means for example that if New Zealand needs to purchase international emissions units to meet an emissions reduction target, that liability cannot be met simply by borrowing more from offshore with indefinitely deferred repayment
The post-tax rate of return on investment is unchanged between scenarios.	This acknowledges that New Zealand is part of the international capital market and ensures consistency with the preceding closure rule.
Any change in the demand for labour is reflected in changes in wage rates, not changes in total employment.	This prevents the long-run level of total employment being driven by what happens to live animal exports rather than by the forces of labour supply and demand, and the skills of the workforce. Over time, education and training programmes respond to a different set of market demands so that those entering the labour force acquire the necessary skills.
The fiscal balance is fixed across scenarios.	This means for example that if the government needs to purchase overseas emission units it must ensure that it has matching income. If it earns insufficient income from the sale of domestic emission units (because of free allocation for example) it would have to adjust tax rates. Personal income taxation as represented by household effective income tax rates are the default equilibrating mechanism.

[42] Closure rules relate to aspects of the model that we wish to set exogenously, usually because they are determined outside the model system. For example, they may reflect government policy or institutional arrangements. Or we may wish to hold certain variables constant to assist our understanding of how the economy adjusts to an economic shock.

Appendix 5: Reconciling the farm-level analysis with the macroeconomic analysis

The farm-level analysis estimates lost EBIT from the ban of $123m to $143m p.a. in aggregate. That is about a third less than the estimate of the loss in value added from the macro-economic analysis provided in Table 6 of $188m. The difference is attributable to a number of factors:

- the loss in value in the macro-economic analysis includes the lost EBIT plus the loss in value generated by the exporters;
- the lost EBIT excludes any allowance for changes in wages and salaries or in depreciation of capital assets on the farm;
- the farm-level analysis uses the middle 50% of dairy farms for its estimation. It is possible that this 50% is not typical of farms that sell live animals for export;
- live-animal exports include some animals from beef farms, not just dairy farms; and
- the input-output table is too aggregated to capture second-order differences in value-added per unit of sales between live-animal exports and normal dairy and beef-farming operations.

Hence we are unconcerned by the difference. The difference is small in relation to forecasts of the value of live-animal exports (around $382m p.a.) under the proposed Gold Standard – the counterfactual.