

The thoughts and opinions expressed in this paper are those of the author and do not necessarily reflect the official policy or position of NORAD and USNORTHCOM, the Department of Defense, or the U.S. Government.

Topics in Economics of Defence

*NORAD Burden-Sharing #3
Aggregation technology of North American Defence*

Marion Agier
Student ID: 101096397
Defence Economics

Presented to Dr. Binyam Solomon
INAF 5901
April 27th 2020

Table of Contents

| | |
|---|-----------|
| INTRODUCTION | 2 |
| CLASSIFICATION OF PUBLIC GOODS | 3 |
| AGGREGATION TECHNOLOGY OF PUBLIC GOOD | 3 |
| NORTH AMERICAN DEFENCE | 4 |
| BALLISTIC MISSILE DEFENCE | 4 |
| NORTH WARNING SYSTEM | 6 |
| MARITIME APPROACHES | 6 |
| <i>Maritime Warning mission</i> | 6 |
| <i>The Fourth Age of NORAD</i> | 8 |
| NORTH AMERICAN DEFENCE: A ‘WEIGHTED SUM’ AGGREGATION OF PUBLIC GOODS | 8 |
| DEFENCE AGAINST HELP | 9 |
| CONCLUSION | 12 |
| ANNEX A: PUBLIC GOODS | 13 |
| INTERNATIONAL PUBLIC GOODS: ALTERNATIVE TYPES AND FINANCING POSSIBILITIES | 13 |
| ANNEX B: JOINT PRODUCT MODEL | 14 |
| ALTERNATIVE AGGREGATION TECHNOLOGIES OF PUBLIC SUPPLY | 14 |
| BIBLIOGRAPHY | 15 |

Introduction

During the Cold War days, it was difficult to gauge whether a missile was inbound for Los Angeles or Vancouver; however, as technology has advanced, detecting the trajectory of an inbound missile is possible, such that the United States is no longer compelled to Canada if it chooses not to. As a result, over time defence outputs such as Ballistic Missile Defence (BMD) transition from a pure public good to an impure public good, to an almost a private good. Free riding on BMD will start creating a lot of tension in the near future. Furthermore, Canada did not account for its contribution to the renewal of the North Warning System in its most recent defence policy statement, *Strong Secure Engaged*, and the Royal Canadian Navy is unable to protect Canada’s waters in the Arctic as the ice is thawing. The idea of adding a ‘Maritime control’ mission to NORAD’s existing mission of ‘Maritime warning’ will be very difficult and will put Canada in a difficult position, and as Canada’s geography goes back to being very important for the US, its sovereignty will be threatened. This paper uses concepts in defence economics to explore a possible theoretical model that best maximizes the public good aggregation for NORAD. Because the contributions of each ally are complements rather than substitutes since each ally has different incentives to contribute, NORAD burden-sharing follows a ‘Weighted Sum’ model.

Classification of Public Goods

There are four different types of goods in economics which can be classified based on excludability and rivalry: **private goods, public goods, common goods, and club goods.**

Private Good: *rival and excludable* (ex: pants, cars, food)

Public Good: *non-rival and non-excludable* (ex: global warming)

Common good: *rivalry but no excludability* (ex: ocean fisheries hunting game)

Club good: *no rivalry but excludability* (ex: Netflix membership, golf course)

Within the category of Public Goods, there is a sub-category called **Impure Public Goods**. They satisfy the definition of a pure public good to some extent, but not fully because of their partial *rivalry* or *partial excludability* (ex: highway)

Non-rivalry and non-excludability: A benefit that is *non-rival* means that the cost of someone consuming the good is zero (does not reduce the amount available for others). A good that is *non-excludable* means that it is very expensive, or impossible, to prevent others from consuming the good. The non-excludability of the good means that individuals have an incentive to use the good without contributing towards the cost. This may lead to the good not being provided at all unless the government provides it. Although traditionally confined to domestic public goods, the theory has been extended to analyse international public goods, which are characterized by ‘non-excludability’ and ‘non-rivalry’ between states as opposed to individuals.¹

Joint-product model: “Some public goods provide more than one type of benefit that can differ in terms of their non-rivalry and non-excludability.”² Todd Sandler developed the Joint Product Model, because contribution to the alliance can be used also for domestic purposes, which means there are *Private* and *Public* benefits.

Aggregation technology of Public Good³

Aggregation technology: “The way the supply of public goods is created by the individual efforts of different community members is known as public goods aggregation technologies. An aggregation technology classification scheme of public goods gives an important perspective on contributors’ incentives and so helps to explain how individual contributions determine the overall supply of a public good.”⁴

Summation: Public good level equals the sum of individual contributions. Contributions are substitutable. Because there is a lack of exclusion, free-riding is a problem.

Weighted Sum: Each country’s contribution can have a different additive impact. The weighting factor can differ by such characteristics as countries’ geographical location. Contributions are not easily substitutable.

¹ Alexander Betts, “Public Goods Theory and the Provision of Refugee Protection: The Role of the Joint-Product Model in Burden-Sharing Theory”, *Journal of Refugee Studies* Vol. 16, No. 3 2003

² Memedović, Olga. *Public Goods for Economic Development*. Vienna: United Nations Industrial Development Organization, 2008. https://www.unido.org/sites/default/files/2009-02/Public%20goods%20for%20economic%20development_sale_0.pdf, p.9

³ See Annex B

⁴ Ibid.

Best Shot: Only the largest effort determines the public good level. Free-riding is encouraged to avoid wasting resources.

Weakest Link: Only the smallest effort determines the public good level. No incentive to free-ride since the level of provision would be zero.

North American defence

Ballistic Missile Defence⁵

Ballistic missile defence (BMD) is separate from cruise missile defence. The flight trajectory of ballistic missiles usually takes them outside of the atmosphere, whereas cruise missiles are air-breathing weapon systems that always remain within the atmosphere. Therefore, the detection and engagement of cruise missiles requires very different measures than for ballistic missiles. NORAD is responsible for cruise missile defence, and USNORTHCOM is in command of BMD of the US. Since NORAD is a binational institution and USNORTHCOM is only American, cruise missile defence in North America is shared, but BMD is not. Moreover, the BMD set up by the US cannot engage cruise missiles. Because NORAD is engaged in the *detection* of ballistic missiles, the issue of Canada's participation in BMD is often raised in the NORAD context.⁶

Missile defense appears to be an *impure public good* because it has rivalry but partial excludability, as explained by Christopher Sands in the following extract:

Dr. Christopher Sands:

I would add that I think sometimes we imagine the missile defence system as infinite ammunition, and if a missile is coming in, we can just keep firing and knocking those missiles down. Even in the United States the reality is we have a *limited number of bullets in the gun*, if you will. We have a limited number of shots. Going back to my comment earlier, citing Professor Sokolsky's view that Canada is, at its best, an easy rider, we don't want a situation where the United States is investing to put in missile defences to protect Americans and Canadians, and *they have to make a choice*. If Canada doesn't participate in the system, and because Canada isn't adding bullets to the gun, the U.S. has to make a choice between protecting Los Angeles or Vancouver from a North Korean missile. What we need is for Canada to contribute in this way, so that it's able to hold up its own. With limited defence

⁵On a side note, Canada is not participating in BMD in North America, but is supporting BMD for allies in NATO indirectly. The initial cost of the missile defence system for NATO was set at \$1.1B with \$300M upgrades extra, shared between all 29 NATO members. Since the money goes into a common fund, it is hard to tell how much of the Canadian contributions goes to the specific missile defence system. The contribution from Canada is around \$78M towards alliance operations and \$60M to NATO investment programs. Canada cannot 'cherry-pick' what this money will be used for by the Alliance. The money spent on European BMD will have no benefit for Canadian security. (<https://www.cbc.ca/news/politics/nato-ballistic-missiles-1.4205701>)

⁶ House of Commons. 2016. *Canada and the Defence of North America NORAD and Aerial Readiness: Report of the Standing Committee on National Defence*. Ottawa: Standing Committee on National Defence. P.27
<https://www.ourcommons.ca/Content/Committee/421/NDDN/Reports/RP8406082/nddnrp02/nddnrp02-e.pdf>

resources, even with the U.S. defence budget, we're not investing foolishly, but getting the best defence we can by *sharing the burden* a little.⁷

From this extract, the words 'limited number of bullets in the gun' reinforces the *rival* aspect of missile defence as a good, and 'have to make a choice', its *partial excludability*, when it comes to engaging enemy ballistic missiles.

Indeed, Dr James Fergusson explains, following Dr Sands comment, that legally, U.S. Northern Command, cannot be expected to save a Canadian city, unless its potential target may directly impact an American location (via the blast or radiation effect).⁸ To further support this position, missile defence is also classified as an *impure public good* in a table in Annex A.⁹

Joel Sokolsky provides a key element that explains why there is such a difference between the threats North America during the Cold War, and those it is currently encountering:

“A Soviet bomber detected over northern Canada could have been headed to either Vancouver or San Francisco. It was in the strong interest of the Americans to intercept it, in cooperation with their Canadian partner in NORAD, as early as possible. On the other hand, today's US missile defence system can assess the trajectory of incoming missiles; the defenders eventually will know what the targets are going to be before the impact. The American in command will have to choose whether to attempt to intercept”.¹⁰ The old 'involuntary guarantee of Canadian Security' does not apply to protection against missile strikes.¹¹

Clearly, BMD is not as a pure public good as was air missile defence during the Cold War, and that is due to the advancement of the technology that permits the United States to exclude Canada in a way that it was not possible before. In addition, the following extract clearly reinforces the rivalry aspect of BMD, given that there are only 34 interceptors available and that multiple shots may need to be fired to take down an incoming missile. In this case, some cities further north of the border may not be worth protecting based on the current system:

“Surely the Americans would not allow a missile to strike Vancouver, some might suggest. That is not quite as clear as it may seem—especially when one takes into consideration that the more “shots” the defence takes with its interceptors against an incoming missile the greater the chance of destroying it. For now, there are only going to be **34 interceptors available**. Depending upon the circumstances, then, saving Vancouver would come at the cost of decreasing the protection available for American cities. The USNORTHCOM commander might still give the order, if only because Vancouver is close to the US border. Such a decision would be in line with vague public statements made by US officials, indicating that the Canadian border areas would fall under the protection of the system. But the only way to provide a guaranteed level of protection for

⁷ House of Commons Standing Committee on National Defence (NDDN). 2016. Meeting 9. <https://www.ourcommons.ca/DocumentViewer/en/42-1/NDDN/meeting-9/evidence>

⁸ Ibid.

⁹ See Annex A

¹⁰ Jockel & Sokolsky. NORAD Does Not Need Saving. *International Journal*, 2015, p. 6

¹¹ Ibid.

Canada, especially for cities away from the border such as Edmonton, would be for Canada to join in the system.”¹²

In the light of this evidence, BMD appears to function more like an “impure” public good. BMD could even be classified as a private good, which means that the US could exclude Canada entirely - assuming the missile was not landing in the vicinity of the US border - if it wanted to because the new technology makes it possible to determine the exact trajectory of a missile.

North Warning System

The North Warning System (NWS) is a network of 47 unmanned radar stations (11 long range and 36 short range) located in the Arctic, from Labrador to Alaska. It was built as an early warning capability in the mid-1980s to protect North America’s exposed borders, and replace the DEW Line - established in the 1950s to protect North America against Soviet bombers during the Cold War. For the purpose of this paper, the exposed borders include coastal or land borders that are not contiguous to either country's land or coastal areas. The US paid for 100% of the DEW line, but is currently paying for 60% of the NWS’ upkeep.

Investment in the NWS was very much a question of sovereignty for Canada. “NORAD brought Americans the security they sought, while providing Canadians with assurance that the United States would not violate Canadian sovereignty. It also institutionalized a means for Canada to contribute to the formulation of continental defence and thus helped to legitimize full participation in a fundamentally unequal relationship.”¹³

NWS is at the end of its lifespan and is nearing obsolescence. The upgrade of the system is currently being negotiated, and Canada could pay \$4.4B the equivalent of 40% of the total cost of the upgrade. The benefit of the NWS, early warning, is completely *non-rival* and *non-excludable*, it is therefore a pure public good to both countries.

Maritime Approaches

Maritime Warning mission

As Andrea Charron mentioned, “NORAD is air-dominant in personnel and focus.... It is most concerned with defending North America against air-breathing threats. This means its maritime warning mission can be overlooked”.¹⁴ However, in 2006, NORAD did include Maritime Warning as a third mission, and therefore it is important to mention it in the context of NORAD. The current NWS is currently inadequate to identify the biggest threats to North American security: the new generation of air (ALCMs) and surface/submarine launched cruise missiles (SLCMs) that can be launched far outside of North American airspace into the Arctic.¹⁵

Considering that the exposed borders are currently covered solely by the nearly obsolete NWS, it is sensible to look at other means of maritime early warning in the North, such as those that can be provided by the RCN. The new class of ship that will be used for Northern operations

¹² Ibid.

¹³ Kim Richard Nossal, *The Imperatives of Canada’s Strategic Geography in Canadian Defence Policy in Theory and Practice*. 1st ed. 2020. Cham: Springer International Publishing, 2020, p. 15

¹⁴ <https://openparliament.ca/committees/national-defence/42-1/9/dr-andrea-charron-1/only/>

¹⁵ Charron & Fergusson, “Beyond NORAD and Modernization to North American Defence Evolution. Canadian Global Affairs Institute, 2017

https://www.cgai.ca/beyond_norad_and_modernization_to_north_american_defence_evolution

is the Arctic Offshore Patrol Ship (AOPS) class or Harry DeWolf class. These vessels are deliberately unarmed and employ a crew of 60. This extract summarizes the intended purpose of these ships and the context of their procurement:

“Because threats to the Canadian Arctic will likely fall in the safety and security categories, rather than defence, the RCN will never play a leading role in Arctic security. Rather, it will have to support other government departments and agencies in fulfilling their northern mandates. This is what the AOPS will be doing with their time.”¹⁶

It is clear that the AOPS have not been designed as an instrument for NORAD or as a Maritime Early Warning capability. As the ice is thawing, there will be more activity in the North such as increased exploration for natural resources and open shipping routes, as well as tourism. The Harry DeWolf class will be useful to support the Coast Guard with search & rescue operations, or the Canadian Border Services Agency with border protection, etc. The other class of ships are the Halifax-class frigate and the Kingston-class MDCV. Frigates, the only major warships currently in service, are not well suited to sail in arctic waters, and MCDVs are minor warships with limited capabilities.

Op Limpid is the CAF mission to detect threats to Canada’s security as early as possible. However, Op Limpid has not been active since October 2017. When the operation was active, the RCN sent up MCDVs. The MCDVs are now used for other operations such as Op Projection and Op Nanook, which are two missions highly focused on creating partnerships (Op Projection in Africa and Op Nanook with Indigenous Communities in the North).

This extract from Dr. Michael Byers, the Canada Research Chair in Global Politics and International Law at UBC, accurately summarizes the state of the Canadian Navy:

Dr. Michael Byers:

“[...] The Canadian navy is in serious trouble. It has no supply ships. It has no air defence destroyers. Its marine coastal patrol vessels have been deemed unworthy of a mid-life refit. The submarines are close to 30 years old and have spent most of their lives in refit and maintenance. On the navy, I could go on.”¹⁷

In short, Canada does not have the resources to monitor the maritime approaches coming from the North or to control its maritime domain with the Royal Canadian Navy alone, which means that it would be difficult to add a credible Maritime Defence (or Control) component to NORAD with a strong Canadian participation. With the evolution of the threats facing North America, this issue will likely resurface in future debates regarding NORAD modernization.

¹⁶ *Unarmed Warships: What Are the AOPS For?* Canadian Global Affairs Institute, 2018. https://www.cgai.ca/unarmed_warships_what_are_the_aops_for

¹⁷ NDDN. 2016. Meeting 11: <https://www.ourcommons.ca/DocumentViewer/en/42-1/NDDN/meeting-11/evidence>

The Fourth Age of NORAD

LGen St-Amand describes this current era as the fourth age of NORAD (the first being Soviet long-range aviation, the second, the first generation of cruise missiles that pushed NORAD further north, and the third, 9/11):¹⁸

LGen St Amand:

“We're now in the fourth age. The fourth age is the age of these advanced cruise missiles, with their very long range, which is challenging our ability to intercept and kill those vehicles before they can cause us harm. They can be launched now by our maritime platforms. Maritime avenues and maritime approaches are now a domain that is more prominent than ever before in terms of a threat to North America or a capability to reach North America. That is a big change”.¹⁹

The threats derived from the maritime domains are increasing with the evolution of technology, and there are some current debates regarding the possible integration of a Maritime defence into NORAD's mission.

North American defence: A 'Weighted Sum' aggregation of public goods

The United States' contribution to the public good of North American Defence includes BMD, and it cannot be substituted with Canada's contribution, which we will identify in later paragraphs. BMD in North America does not use a weakest link aggregator, because the level of provision is not determined by the weakest link's input - Canada in this case. In the weakest-link case, everyone has to match the smallest contribution. Free riding is not possible. In the case of NORAD, there are two players (Canada and the US), and the US is not matching Canada's contribution 60-40 for NWS. Additionally, the size of the U.S. Air Force and Navy is far greater than Canada's. The U.S. has more bases and personnel employed for NORAD as well. Since Canada is free-riding on the US for BMD, it cannot be a weakest-link scenario. Additionally, it would not be a waste of resources for Canada to participate in BMD. There are debates regarding potential Canadian involvement and many experts agree that “Canada's current non-participation in BMD is detrimental to the defence of North America”.²⁰ Therefore, BMD does not use a best shot aggregator either.

The aggregator used in this context, North American defence, is either summation or weighted sum. In summation, the contributions from each ally are perfect substitutes. It is not the case for NORAD since the contributions are complementary. Complementary contributions where substitution is limited is the definition of a “weighted sum” aggregation of technology. In a weighted sum situation, free-ridership is still rampant because there is a strong incentive for another ally country to expect that the ally facing the bigger threat will take on defence for the allies nearby since there could be impacts on its own security. Because the ballistic missile threat is greater to the US than to Canada, the US has more incentives to contribute BMD to the public good of North American defence. As previously discussed, weighted sum implies that some

¹⁸NDDN. 2016. Meeting 8: <https://www.ourcommons.ca/DocumentViewer/en/42-1/NDDN/meeting-8/evidence>

¹⁹ Ibid.

²⁰NDDN. 2016. Meeting 9: <https://www.ourcommons.ca/DocumentViewer/en/42-1/NDDN/meeting-9/evidence>

participants receive greater private benefits and thus have greater incentives to contribute.²¹ If the countries with the highest incentives are also the richest, there could be an exploitation hypothesis problem which leads to sub-optimality because the poorer countries will simply free-ride since they do not have the incentive or the means. To maximize optimality, we would need to "identify the weight assigned to individual contributors to understand incentives for achieving aggregate level of supply".²²

Canada agreed to pay for 40% of the NWS after a series of negotiations in 1985. By looking at the geography of North America, the majority of the NWS is on Canadian territory (roughly 5/6 – the remaining 1/6 being in Alaska). Canada has therefore a strong incentive to contribute to its own defence, to protect its sovereignty and its own territory. Prior to 1980, the US had a strategic interest in making sure that Northern Canada was not exposed, but after 1980, new threats of missiles reduced the importance of air defence and less need for an upgraded system. The value of Canada's geography was diminished, which led to more negotiation with Canada for the construction of the North Warning System to modernize North American Air Defence. The weight became heavier for Canada, and the cost sharing formula went from 0%-100% to 40%-60% (Canada-US). According to James Fergusson, the 40% of the NWS is an asymmetric contribution:

“Regardless, it is time for the government, Global Affairs, National Defence, and the public to realize that we cannot free-ride on the American missile defence system, and we cannot expect that an asymmetric contribution, such as offering to pay for the modernization of the north warning system, will result in a U.S. missile defence guarantee.”²³

Additionally, the navy is not in a position to have a major impact on North American defence, be it by early warning or maritime control.

Defence Against Help

According to Joseph Jockel, the Canadian government would be faced with objections for a Canadian participation in a Maritime control mission, including the circumstances in which the government would allow naval assets to be used in preventive attacks. Jockel's argument is that the US will not wait for Canada's contribution to establish such a mission, because it has the means to do so on its own without NORAD:

“The US government, in considering giving NORAD a maritime defence role, will undoubtedly consider the possibility that the Canadian government might, when asked to assign naval forces to a NORAD operation, place conditions on their use that would be unacceptable to the U.S. Yet, this should not be a reason enough not to go along with such NORAD enhancement, for the U.S. always would retain the option to conduct an operation entirely with its own force under USNORTHCOM”.²⁴

²¹ See Annexe B

²² Memedović. *Public Goods for Economic Development*. Vienna: UNIDO, 2008, p. 10

²³ <https://www.ourcommons.ca/DocumentViewer/en/42-1/NDDN/meeting-11/evidence>

²⁴ Leuprecht, Christian., Joel J. Sokolsky, and Thomas. Hughes. *North American Strategic Defense in the 21st Century: Security and Sovereignty in an Uncertain World* 1st ed. 2018. Cham: Springer International Publishing, 2018. P.15

In not having an acceptable and reliable naval force, Canada would likely force the US to take unilateral actions at the detriment of Canadian sovereignty. As Canada's geography increases in importance for the US with the thawing of the Arctic waters, Canada may no longer be able to borrow US power while "defending against help".

In Ørvik's seminal article, there are three defence options for a small state that is unable to resist the attack of a neighboring state: 1. To increase the state's 'own power'; 2. To acquire 'borrowed power', or 3. Make do with no or inadequate power (symbolic defence).

When the smaller states need to borrow power, it also needs a 'defense against help' strategy that involves the smaller state building enough military power to defend itself against opponents of the larger power, while simultaneously ensuring that it is not a threat to its larger neighbor. It also needs to make sure it doesn't become a vulnerable point of attack so to need 'help' against the large neighbor's enemies, or an obstacle to the larger state's self-defence to protect its sovereignty. There are three conditions that could determine the success of this strategy, including the *strategic importance of the smaller state*, and the *credibility of its defence posture*, which are important conditions in the case of Canada – the greater the strategic importance, the greater the defence against help will need to be, along with credibility. According to this strategy, Canada has to articulate security policies according to threats to both Canada and the United States equally.²⁵ As Ørvik puts it, the 'Defence against help' situation is like two families sharing a duplex:

“The one on its southern side is better off than the other. He can easily foot the bills for maintenance and insurance. The one on the northern side has a smaller income, diverging priorities and may neglect the upkeep. If his side of the roof, which shelters them both, is about to fall down, it will be in the best interest for the other to offer his help. If the offer is rejected a serious conflict might develop where repairs could be made over the other's protests, but still in the interest of both. Most Canadians, as proud and independent people, would try not to get into situations where our role would be that of the passive bystander, sourly watching his home being repaired at the neighbor's expense because he had neglected its maintenance and refused to pay his share. If we persist in our neglect, we should not complain over US 'help' to maintain our North American duplex.”²⁶

In this metaphor, the two allies are illustrating a 'weakest link' model of alliance, where free-riding is relevant only because the rich ally is "trying to shore up the poor allies' defenses"²⁷. Canada wants to avoid this scenario to preserve its sovereignty and independence.

In Ch.2 of *Canadian Defence Policy*, Dr. Nossal explains that the difficulties of establishing sovereignty over Canada stems from its huge land mass. The 2005 *International Policy Statement* acknowledged that increased American interest in homeland security meant that "Canada's geography is, from an American viewpoint, destined to regain the importance it lost after the end of the cold war"²⁸, which would mean that Canada's defence against help strategy

²⁵ Nossal, Roussel, & Paquin, *The Politics of Canadian Foreign Policy* Fourth edition. Montréal [Quebec: McGill-Queens University Press, 2015, p.28

²⁶ Ørvik. 1984. Canadian security and 'defence against help. *Survival*, p.31

²⁷ Sandler, Todd. "HIRSHLEIFER'S SOCIAL COMPOSITION FUNCTION IN DEFENSE ECONOMICS." *Defence and Peace Economics* 17, no. 6 (December 1, 2006), p. 652. <http://www.tandfonline.com/doi/abs/10.1080/10242690601025583>.

²⁸ Nossal, *The Imperatives of Canada's Strategic Geography in Canadian Defence Policy in Theory and Practice*. 1st ed. 2020. Cham: Springer International Publishing, 2020, p. 21

has greater chances of being unsuccessful and the credibility of its defence posture needs to be heightened.

However, according to Charron & Fergusson, Ørvik's 'Defence against help' concept is the wrong theory to describe Canada's strategy because: 1. Canada is not neutral and has always relied upon other countries, first the UK, and then the US; 2. The United States has never provided unwanted defence help in Canada, and Canada's defence decisions are not motivated to avoid unwanted help, and on the contrary, Canada is only too pleased to borrow help;²⁹ 3. The two countries eliminated defence plans against each other by the 1930s.³⁰ Their argument is establishing that Canada is not defending against help, but 'hoping 'for help in cases such as BMD, which is the reverse of 'defence against help'³¹.

These arguments could be challenged by saying that 1. The non-alignment is a condition of success for the strategy, not a condition to categorize the model properly; 2. Canada has invested in the NWS in the 1985s to basically 'defend against help' and protect its sovereignty and 3. The elimination of defence plans does not play a role in this particular situation, because as Ørvik explains in his article from 1986, Canada and Finland have different relationships with their respective large neighbor:

"The Finns have indeed a 'defence against help' situation, but on terms that are completely different from ours. The situation which they face is the product of two military defeats inflicted on them by a country which for centuries has been their arch-enemy and whose political system, values and institutions are diametrically different to and incompatible with those of the Finns. Apart from a corresponding disparity in strength, the Finland-Soviet dyad has hardly any resemblance to the situation Canada holds vis-a-vis the United States".³²

In a weighted sum model, geography plays a major role with regards to the different incentives to contribute for each ally. I would argue that it is Canada's major incentive to contribute in the current 'Weighted Sum model' based on geographical location and proximity to the threat, which in case the threat is either the United States' wrath or unwanted help. Otherwise, Canada would completely free ride on the US without providing any contribution if it could, but would then become the weak link of a 'Weakest link' model, threaten the US, and force them to violate Canada's independence by 'shoring up the weak defence'.

In Charron & Fergusson's argument, Ørvik's theory will come to fruition if the US demands more assistance beyond what Canada is willing to contribute, and it looks like the relationship is headed that way. The model of 'Defence against help' applied before, and will apply again for as long as Canada continues to treat defence as "voluntary or discretionary."³³ Indeed, I would agree that Canada does not apply it for a prescriptive defence policy purpose because "Canada's strategic geography provides so much safety and security that Canadians can (and do) happily spend as little on defence as they can get away with"³⁴. However, next time, when the US

²⁹ Charron & Fergusson. Canada and Defence Against Help: The Wrong Theory for the Wrong Country at the Wrong Time, in *Canadian Defence Policy in Theory and Practice*. 1st ed. 2020. Cham: Springer, International Publishing, 2020, p. 107

³⁰ Ibid. p. 104

³¹ Ibid. p. 108

³² Ørvik, Canadian security and 'defence against help. *Survival*, 1984, p. 30

³³ Nossal, *The Imperatives of Canada's Strategic Geography*, 2020, p. 21

³⁴ Ibid.

sees Canada as a vulnerability to the defence of North America, it will not be enough to simply fund one initiative like Canada did with the NWS in 1985s.

Conclusion

To conclude, Canada's contribution to North American defence is not much more than the 40% portion of the NWS cost-sharing formula. Indeed, Canada is not part of the BMD system, which is entirely funded and operated by the US, and the Royal Canadian Navy has limited capability in the Arctic. In a weighted sum public good aggregation technology, the contributions from different players are non-substitutable and incentives for contribution are different. In the case of North American defence, Canada and the US have a different assessment of the most dangerous threats and their contributions correspond accordingly. Because the NWS is a pure public good, Canada had an incentive to free ride on the US, but did not because it was also a threat to its own sovereignty since the majority of the system is on Canadian territory. Instead, Canada used this contribution to justify free-riding on the Americans for the rest of North American defence, including BMD, because most Canadian cities are close to the American borders and would benefit from the protection. Canada contributes because of 'defence against help' strategy, which means that Canada does not want the US to threaten its sovereignty. The US contributes because they have felt threatened by a myriad of elements since the beginning of the Cold War, starting with the soviet bombers in the first age of NORAD. Canada basically borrows the US defence while making sure the country is doing just enough to satisfy its desire to protect its sovereignty. The North Warning System was the 'defence against help' of the 1980s, but today's strategy should be a strong and credible naval force to detect, deter and defend against threats to North America in the Arctic.

Annex A: Public Goods

International Public Goods: Alternative Types and Financing Possibilities³⁵

| Good Type | Examples | Financing Possibilities | Remarks |
|--|---|---|--|
| Pure public | <ul style="list-style-type: none"> · curbing global warming · basic research · limiting spread of disease · augmenting ozone shield | Usually must rely on some kind of public-sector push based on an ability-to-pay charge. Financing coordinated by a supranational organization using some international taxation or fee arrangement. A leader nation or nations might exist if sufficient net benefits can be derived. | There are neutrality worries since voluntary contributions will be crowded out by collective contributions. Partial cooperation faces free-riding offsets unless there is sufficient participation. Enforcement mechanism is necessary. |
| Impurely public with some rivalry but no exclusion | <ul style="list-style-type: none"> · ocean fisheries · controlling pests · curbing organized crime · alleviating acid rain | Must again rely on supranational organization and some international collection arrangement. Rivalry may motivate more independent behavior in contrast to purely public goods. | More private incentives to contribute. Rivalry lessens neutrality concerns, but a push from the public sector is still required. |
| Impurely public with some exclusion | <ul style="list-style-type: none"> · missile defense system · disaster relief aid · extension services · information dissemination | Exclusion promotes voluntary financing and club-like structures. For these goods, the public sector may be needed for coaxing and facilitating eventual private-sector provision. There may exist an entrepreneurial or leader nation to market the good. | Since exclusion is not complete, some suboptimality would remain. Question is whether this residual suboptimality warrants any intervention or official inducements. |
| Club good | <ul style="list-style-type: none"> · transnational parks · INTELSAT · remote-sensing services · canals, waterways | Charge each use according to crowding that results. Nonpayers are excluded. Toll per use is equal to marginal crowding costs so as to internalize the congestion externality. Taste differences can be reflected by tolls paid on total visits. Nations with a greater demand visit more often and pay more than those with a smaller demand. | Can result in an efficient outcome. Clubs limit transaction costs. Full financing is dependent on scale economies, the form of the congestion functions, and other considerations (e.g., competitiveness of factor or output markets). No public coaxing needed. |
| Joint products | <ul style="list-style-type: none"> · foreign aid · tropical forests · peacekeeping · defense spending among allies | As nation-specific private benefits and club good benefits become more prevalent among the joint products, markets and club arrangements can be used to finance the good with greater efficiency. As the share of excludable benefits increases, payments can be increasingly based on benefits received. | Ratio of excludable to total benefits is the essential consideration. As ratio approaches one, markets and clubs work more fully. Institutional arrangements can foster these excludable benefits. |

³⁵ Todd Sandler, "On Financial Global and International Public Goods", *University of Southern California*, July 2001, Table 1. International Public Goods: Alternative Types and Financing Possibilities

Annex B: Joint Product Model

Alternative Aggregation Technologies of Public Supply³⁶

| Supply technology | Examples | Strategic considerations | Institutional implications |
|---|--|--|--|
| Summation: public good level equals sum of individual contributions | -curbing air pollution -reducing global warming -cataloguing species | Characterized often by Prisoner's Dilemma or chicken game form. In the former, there are strong incentives to free ride and not contribute; in the latter, there is an incentive on behalf of the richest to inhibit dire consequences. | In an assistance context, there is a need for a multilateral organization or rich nation to assume leadership and to provide the public good. Cannot typically rely on voluntary action at the national level. |
| Weakest-link: only the smallest effort determines the public good level | -containing river blindness -maintaining the integrity of networks -limiting the spread of insurrections | Assurance games where matching behavior characterizes the equilibria. Actions and/or contracts are self-enforcing. Well-endowed players have an incentive to assist those less well-off. | Multilateral agencies can channel funds and direct actions to raise public good levels to acceptable standards. Capacity building required in poor countries. Rich countries may contribute the public good directly to increase levels in poorer countries. Partnerships apply. |
| Best-shot: only the largest effort determines the public good level | -finding a cure for AIDS -neutralizing a pest -engineering the next green -revolution | Coordination games where only a single provider is required. Problem of identifying this agent if there are two or more candidates – this is where coordination is needed. For development concerns, problems arise when best-endowed nation derives little benefit from the action. | Put supply efforts where the prospects and resources are the greatest for success. Multilateral organizations or a leader nation can serve to coalesce and focus resources and efforts. Partnerships among various participants can circumvent collective action problems. |
| Weighted-sum: each country's contribution can have a different additive impact | -cleanup of sulfur emissions -monitoring the planet from different vantages -controlling a pest | Weighted sum implies that some participants receive greater private benefits and thus have greater inducements to contribute. Captures pure public and private good representations as special cases. A host of alternative game forms. | Multilateral organizations need to support efforts among only those nations with less country-specific benefits. Collect and provide information on the weight matrix to encourage independent financing. |

³⁶ Todd Sandler, "On Financial Global and International Public Goods", *University of Southern California*, July 2001, Table 2. Alternative Aggregation Technologies of Public Supply

Bibliography

House of Commons. 2016. *Canada and the Defence of North America NORAD and Aerial Readiness: Report of the Standing Committee on National Defence*. Ottawa: Standing Committee on National Defence.

House of Commons. 2017. *Readiness of Canada's Naval Forces*. Ottawa: NDDN

Jockel, Joseph T. 2007. *Canada in NORAD, 1957–2007: A History*. Montréal and Kingston: McGill-Queen's University Press.

Jockel, Joseph T, and Joel J Sokolsky. 2015. NORAD Does Not Need Saving. *International Journal* 70.2, 188–195.

Nossal, K. R. et al. 2015. *The politics of Canadian foreign policy*. Fourth edition. Montréal Quebec: McGill-Queens University Press.

Charron Andrea & Fergusson, James. 2017. Beyond NORAD and Modernization to North American Defence Evolution. Canadian Global Affairs Institute.

Anon. 2018. Unarmed Warships: What are the AOPS for? Canadian Global Affairs Institute.

Leuprecht, C. et al. 2018. *North American Strategic Defense in the 21st Century: Security and Sovereignty in an Uncertain World*. 1st ed. Springer International Publishing.

Ørvik, Nils. 1973. Defence Against Help: A Strategy for Small States. *Survival* 15:5, 228–231.

Ørvik, Nils. 1984. Canadian security and 'defence against help. *Survival* 15:5, 26:1, 26-31.

Lagassé, Philippe. 2010. Nils Ørvik's 'Defence Against Help': The Descriptive Appeal of a Prescriptive Strategy. *International Journal* 65 (2): 436–474.

Juneau, T. et al. 2020. *Canadian Defence Policy in Theory and Practice*. 1st ed. Springer International Publishing.

Betts, Alexander. Public Goods Theory and the Provision of Refugee Protection: The Role of the Joint-Product Model in Burden-Sharing Theory. *Journal of Refugee Studies* Vol. 16, No. 3, 2003.

Sandler, Todd. 2001. *On Financial Global and International Public Goods*. University of Southern California.

Memedović, O. 2008. *Public goods for economic development*. Vienna: United Nations Industrial Development Organization.

Sandler, T. 2006. HIRSHLEIFER'S SOCIAL COMPOSITION FUNCTION IN DEFENSE ECONOMICS. *Defence and Peace Economics*. 17 (6), 645–655.