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Reforming Canada's Disaster Assistance Programs

by

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Reforming Canada's Disaster Assistance Programs¹

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I. Introduction

The incidence and costs of natural disasters in Canada are rising. This trend raises a range of policy concerns. One question that arises is whether Canada's disaster financial assistance (DFA) programs need reform. These programs are delivered by the provincial governments, according to their own policies and standards, but are subsidized by the federal government under its disaster financial assistance arrangements (DFAA), which have been in force since 1970.² Both the provincial assistance, and the federal subsidy, can cause moral hazard resulting in real estate development in floodplains and other risky locations, and insufficient disaster mitigation. There are also effects via the deadweight cost of the higher taxes required to fund the DFA system.

The leading natural disasters in Canada, in terms of cost, are floods, storms and wildfire. The different kinds of disasters make varying calls on governments to rescue people, fight to contain or reduce damages, and to compensate households and firms for damage. In the compensation area, what governments do depends partly on the availability of private insurance. A key principle is that governments do not expect to compensate for damage if insurance is reasonably and readily available. In the past, while private insurance was readily available for storm and fire damage that was not true for overland flood insurance, so there was greater reliance on the DFA system to protect people from the financial impact of flooding than for most other disasters.

After 45 years with little change, the DFA landscape began to alter quickly in 2015. There have been three important developments. The first is that in 2015 the federal government tripled the damage thresholds that determine whether, and how much, assistance will be provided to the provinces. These thresholds, formerly unchanging over time in nominal terms, are now fixed in real terms. The second major change is that, also in 2015, private overland flood insurance was first offered to homeowners. At last report it is now provided by 16 Canadian insurance companies representing 77% of the market and is held by 34% of homeowners, although it is as yet unavailable in most high-risk areas (Insurance Bureau of Canada, 2019). And the third change is that governments are beginning to take more seriously the need to reduce the stock of housing in high risk flood zones.

In this context there are two key policy questions concerning disaster financial assistance that need to be addressed. The first is whether the federal government needs to make further adjustments to the DFAA system in order to keep its disaster related liabilities under control and to give the provinces stronger incentives to mitigate and adapt. The second is what can or

²Note that there is a distinction between the abbreviations "DFA" and "DFAA". In this paper "DFA" is used as an abbreviation for disaster financial assistance in general. Both DFA payments made by the provinces to individuals, farmers and small businesses, and DFAA payments made by the federal government to the provinces are part of the overall "DFA system".

should be done to provide flood insurance in high-risk areas and to encourage retreat from areas with high disaster risk in general.³ This paper considers both questions.

The remainder of the paper is organized as follows. The next section reviews the history and composition of natural disasters and their costs in Canada. The structure of the overall DFA system is described in the third section. The fourth and fifth sections discuss the efficiency and equity impacts of that system respectively. Policy proposals are discussed in the sixth section. A final section concludes.

II. History and Composition of Disasters in Canada

There has been no definitive study of the economic impact of natural disasters in Canada. The federal government maintains the Canadian Disaster Database (CDD), which provides information on over 1,000 disasters that have occurred since 1900. This database records the federal government's costs in the form of DFAA payments, and reports costs borne by lower levels of government. It also gives estimates of insurance payouts. Unfortunately, in some periods the DFAA data are not entirely reliable (Parliamentary Budget Officer, 2016a), and the data on the other cost components, although they appear to be the best available, may not be complete. The sizeable costs that are not covered by government or insurance are excluded.

This paper uses the PBO data for DFAA payments, which cover the period up to 2014, and CDD numbers for DFAA in 2015 and 2016. Insurance payouts are taken in most cases from Insurance Bureau of Canada (2019), whose data begin in 1983, but from the CDD for some smaller events not covered by the IBC. Provincial DFA payments are inferred from the federal DFAA paid according to the DFAA formula set out later. The expenses of government departments are taken from the CDD.

Table 1 shows how the average annual reported cost of disasters changed from 1983 to 2016. While there have been fluctuations there is an upward trend. In the period 2010-16 these annual recorded costs averaged \$3.1 billion in 2018 dollars. (In the remainder of the paper all cost figures will be given in 2018 dollars unless stated otherwise.) True costs for 2010-16 were likely significantly higher, in part because there is considerable damage that is either uninsured or ineligible for DFA. For example, estimates of the total cost of the 2013 Calgary area flooding both in the media and government sources are as high as \$5 - \$6 billion, while the recorded

³ There are related policy issues that are not discussed in this paper. Insurance Bureau of Canada (2019) and others have stressed that increased efforts by government to mitigate disaster risks are complementary with, or even necessary for the success of, approaches that would provide flood insurance in high risk areas. There is no doubt that this argument is correct, but recommending how such mitigation should proceed, or how much is required is beyond the scope of this paper.

costs were just \$3.4 billion.⁴ In addition there can be long lags in settling provincial claims for DFAA.

Table 1 shows that recorded annual disaster costs were substantially higher in 2010-2016 than in the earlier periods. Since there was very costly flooding and wildfire in the period 2017 -2019 as well, disaster costs are clearly rising in Canada. However, the average annual cost of \$1.7 billion in the 1990s was almost as high a fraction of GDP then, at 13%, as the \$3.1 billion of 2010-2016, at 15%. So, one should be cautious in claiming that disaster costs are trending upward in relation to the size of the economy. It is possible for the frequency and severity of severe weather events and wildfires to increase in physical terms without disaster costs rising in relation to GDP if recently built structures and infrastructure are more secure, or due to other mitigation efforts.

Table 1 also shows that insurance payouts were the largest single component of recorded costs in all periods. For the 34 years from 1983 to 2016 as a whole, insurance covered 58% of the recorded costs. In contrast, federal DFAA and provincial DFA together amounted only to 21%, with a remaining 21% being spent by federal and provincial government departments and municipalities on their own disaster-related expenses. This means that about three quarters of the disaster compensation comes from private insurance rather than government.

While, overall, most disaster compensation comes from insurance, the burden on governments has been increasing strongly, helping to explain their heightened desire to control these expenses. Over 2010-2016 the federal government had disaster-related costs averaging \$718 million per year while provincial and municipal governments spent an average of \$260 million annually, for total government spending of \$978 million per year - - a billion dollars a year in round numbers. In comparison, over the previous ten years the average yearly government spending totalled just \$153 million. And the increase is not due to extreme events in just a year or two. Annual costs exceeded the highest yearly cost seen in the 2000-09 period in each of 2010, 2011, 2013 and 2016.

There has been a shift in the composition of disaster costs by type of event, as shown in Table 2. The most important event types are storms, flooding and wildfire. Hurricanes and tornadoes come next and there is an “other category” that includes e.g. droughts, heat waves, cold snaps, avalanches, epidemics and earthquakes. Over 1983 – 2016 as a whole, storms accounted for 47% of recorded costs, followed by floods (25%) and wildfire (16%). However, in recent years floods have moved into the lead and wildfire has caught up with storms. Over 2010 – 16 floods contributed 34% of recorded costs, storms 32% and wildfire 31%.

The increased importance of floods is important for government policy. That is because, until 2015, while home insurance covered most disasters, it did not cover overland flooding. (In contrast normal homeowner insurance covers sewer backup and other consequences of

⁴ See e.g. Bendiner et al. (2013), Environment Canada (2014) or City of Calgary (2019).

“pluvial flooding”, which is due to heavy precipitation that exceeds the capacity of drainage systems.) Hence, compensation for the cost of overland flooding was entirely in the hands of government. Since 2015 insurance has become available, but not in most areas with a high risk of flooding, which have an estimated 700,000 or more residential addresses.⁵ So, the shift in composition of disaster costs toward flooding is magnifying disaster assistance demands on the public purse.

While flood impacts on home owners cause understandable alarm and get a great deal of media attention, up to about 70% of disaster assistance in the case of floods is paid to provincial and local governments to help cover the costs of damage to public infrastructure. Only 5 to 15% of assistance is for residential flood damage according to Insurance Bureau of Canada (2019, p. 13).

An important feature of disasters is the costs imposed by extreme events. This aspect is illustrated in Tables 3 and 4, which give details on the top 10 disasters, by total recorded cost, in the period 1983 - 2016. Together these 10 disasters caused \$21.8 billion in reported damage, almost half of the \$46.4 billion total for all disasters over the period as a whole. Of the top 10 disasters, four were floods, two each were storms or droughts, one was a string of tornadoes, and one was the Fort McMurray wildfire of 2016. Significantly, six of the ten disasters occurred after the turn of the century and three in the final five years. Hence the frequency of the most extreme events appears to be rising. Also, note that the four floods on the list all occurred from the year 2000 onwards, illustrating the shift in disaster costs towards flooding.

Despite the rising importance of flooding, interestingly, the top two disasters in the 1983 – 2016 period were not floods. The Fort McMurray fire of 2016 was the second most costly disaster, with total recorded costs of \$4.4 billion. Only the 1998 ice storm, which was centred in the province of Quebec and hit Montreal particularly hard, had higher costs, at \$6.7 billion. (It also caused by far the largest number of fatalities, with 35 deaths.) That \$6.6 billion equalled 0.5% of Canada’s GDP in 1998.

It is possible that on a full accounting the 2013 flooding in the Calgary area would make it into the second position on the top 10 list, and that a few of the lowest ranked events might be displaced by floods. That is because, as we have seen, there was private insurance for fires, wind and rain damage, and sewers backing up. The coverage provided by the DFA system, which was effectively the only source of compensation for households facing overland flooding in 2013, was less complete than that available under private insurance for other hazards, as discussed below. As mentioned earlier, the true total damage from the 2013 Calgary area

⁵ A recent study found that of Canada’s 8.6 million residential addresses, 1.8 million were susceptible to some level of flooding (LexisNexis Risk Solutions, 2016). Of these about 500,000 faced fluvial floods with a 20-year return period and another 200,000 had a 50-year return period. McClearn (2019) reports that up to 10% of residences are in high risk areas.

flooding has been widely report to have been about \$5 - \$6 billion, that is almost double the \$3.4 billion in recorded costs shown in Table 3.

Some of the differences in who bears the costs of different disaster types can be seen in Table 4. Private insurance covered the full recorded costs of the tornadoes that hit Southern Ontario in 2010 and the 2013 Toronto pluvial flooding. It also covered 87% of the 2016 Fort McMurray wildfire costs and even 60% of the recorded costs of the 2013 Calgary area flooding - - an indication that although very few households had overland flood insurance at the time, that was not true for businesses, local governments and perhaps other organizations. Government came to the fore in the 2010 and 2011 floods on the Prairies and handled 100% of the recorded costs of the Prairie droughts of 1990 and 1992.

This review of disaster costs takes us only up to 2016, the last year for which recorded costs are readily available. The years 2017 – 2019 have seen many more disasters. Wildfire has been a serious problem, especially in the western provinces, in each year. And Spring flooding was very extensive and damaging in eastern Ontario, Quebec and New Brunswick in 2017 and 2019. Total insurance payouts for catastrophic losses were \$1,255.5 million in 2017 and a preliminary estimate for 2018 is \$2,066.4 million (Insurance Bureau of Canada, 2019), for an average of \$1,661.0 million - - less than the average of \$2,117.9 for 2010 – 16 but much higher than the \$498.8 million over 2000 - 09 (see Table 1).

III. The DFA System

The provinces have the responsibility to provide disaster financial assistance, but the federal government heavily subsidizes their DFA programs through its Disaster Financial Assistance Arrangements (DFAA) which were put in place in 1970. Table 5 shows the damage thresholds and amounts under the DFAA. Once a disaster is of any appreciable size the federal help begins to kick in. In a province like Manitoba or Saskatchewan, with about a million people, DFAA pays 90% of eligible damages above about \$16 million. For larger provinces a disaster would of course have to be more costly for federal help to be provided at the 90% rate. However, we saw in Table 1 that DFAA payments have been larger than the unreimbursed portion of DFA expenses borne by the provinces, so the thresholds are low in relative terms. The average subsidy rate over 1983 – 2016 as a whole was 78%.

As Table 5 shows, until 2015 the DFAA thresholds were fixed in nominal terms, and were about one third of the new thresholds that were announced at that time. The fact that the DFAA thresholds were held constant in nominal terms for such a long time means that the moral hazard created for the provinces by DFAA was getting worse year-by-year. The financial incentive for the provinces to mitigate or adapt was relatively weak and constantly getting weaker. This effect was transmitted to municipal governments as well, since they were assisted with their disaster costs by the provinces.

DFAA only defrays costs that are eligible for DFA payments in the provinces, but it has its own eligibility criteria, which could, in principle, result in a situation in which some provincial DFA payments were ineligible for federal subsidy. However, in practice, the provinces seem to be careful to ensure that their eligibility criteria are generally not more generous than those of the DFAA.

There are three principles of DFA eligibility that are especially significant. One is that that damage for which private insurance is “reasonably and readily” available is generally ineligible. Note that “reasonable” does not mean “affordable”. If insurance premiums reflect the degree of risk appropriately, the premiums are deemed reasonable, even if some home owners find them unaffordable.

Eligibility denial when insurance is reasonably and readily available is a problematic principle in the current flood context. Only about a third of home owners have flood insurance so far. Making matters worse, the majority of home owners located in flood zones do not know they are, according to a 2016 University of Waterloo survey that found 94% of such home owners did not know they were in a flood zone (Thistlethwaite et al., 2017).

In the event of a flood, will provincial politicians hold the line and insist that no financial assistance be provided to those for whom insurance was available? They could perhaps do so in a small flood, but in a major event affecting thousands of people, the impact on expected future voting could overcome them. This consideration leads to the question of whether we should aim to make flood insurance universal, or at least near-universal, in areas with a risk of flooding, which is discussed below.

A second key point about DFA eligibility is that only the essentials are eligible. For household contents this may mean that there is a list of eligible furniture and other consumer durables, with features like a limit on number (e.g. only one TV) and/or caps on the amount that can be claimed for individual items. (See e.g. Emergency Management BC, 2015 and Québec Ministère de la Sécurité publique, 2019 as well as Insurance Bureau of Canada, 2019, Appendix VIII.) There may also be a house-wide cap on claims for contents. Many items are ineligible - - for example jewelry, art, decorative objects, books, CDs, DVDs and recreational equipment. And there may be a deductible or co-pay. The idea is that a household, farm or small business should only receive the minimum compensation for it to restore its basic or essential functions. Thus DFA is very different from normal home insurance.⁶

A third important aspect is that the total amount of DFA that can be received for a house and its contents is generally capped. Only Alberta does not impose such a cap. Elsewhere the amounts are not overly generous. Until recently in the Atlantic provinces the cap was generally \$80,000. In 2019 the cap was \$160,000 in New Brunswick, which has the most flood damage in this region. As one went west the 2019 caps tended to rise, to \$200,000 in Quebec, \$250,000 in

⁶ Government officials and insurers sometimes emphasize this point by saying that DFA is “not insurance”. From an economic viewpoint, however, it *is* insurance, although of a partial and imperfect form.

Ontario, \$X in Manitoba, \$240,000 in Saskatchewan and \$300,000 in BC (Insurance Bureau of Canada, 2019, Appendix VIII).

The combination of ineligibility of nonessential items and caps on payouts means that DFA payments have a redistributive quality in most provinces. The result is that floods act roughly like a progressive wealth tax in the affected areas. This breaks down in the absence of caps, however. Concerns then begin to be raised about people who live in “million-dollar houses” receiving full compensation, as was seen in the Calgary area in 2013.

A final aspect of the DFA system is associated buyouts. Buyout amounts were ramped up in the spring of 2019 in New Brunswick and Quebec, the provinces that experienced the worst severe flooding at that time. Aside from the compulsory buyouts in Toronto’s ravines after Hurricane Hazel in 1954, buyouts of homes in high flood risk areas have been mostly voluntary in Canada. Takeup rates have unfortunately been low. After the 2013 Calgary area floods, for example, Alberta offered full compensation at pre-flood values for 254 homes. The offer was only taken up in about one third of cases (McGillivray, 2017). Those who did not accept the buyout have been told they will not be eligible for DFA in the future. In 2019 Quebec offered buyouts with a cap of \$200,000 for homes where the cumulative DFA payments reach \$100,000. Again, if the buyout was not accepted, it has been said that no further DFA will be provided. In New Brunswick buyouts of up to \$160,000 were offered in 2019 on homes that experienced flood damage equal to or exceeding 80% of their value.

LexisNexis Risk Solutions (2016) estimated that as many as 1.8 million Canadian residences are susceptible to flooding. It has been suggested that, across the country, about 100,000 homes are at such high risk that they should be bought out (McKenna, 2019). If compensation averaged \$200,000 this would cost \$20 billion. A careful cost-benefit analysis would be needed to determine if a buyout program on such a scale could be warranted.

IV. Efficiency Issues

What market failure could provide an efficiency rationale for the DFA system? The answer is a failure of one or more insurance markets. Before 2015 Canada was certainly missing overland flood insurance, but was it missing due to market failure or because it had been crowded out by the DFA system?

It is plausible that Canada’s lack of flood insurance was due, originally, to insurance market problems. Much initial settlement in Canada was along rivers, most of which normally flood in the spring. This alone could have meant that many houses and other structures located close to the rivers were uninsurable. Beyond that, adverse selection would have been more serious than it is now. Writing flood insurance requires good knowledge of flood risks, which would have been costly or impossible to obtain without accurate flood maps and reliable knowledge of flood return periods. With today’s technology the cost of generating accurate flood maps

has gone down. Perhaps tired of waiting for government to take advantage of that, the Canadian insurance industry has taken the opportunity to generate property-level flood risk data itself, which may be one reason why the logjam has been broken and so many insurers have recently begun to offer flood insurance in Canada.⁷ This implies that there may at one time have been a large welfare gain from DFA, but also that that gain has now declined.

Both the DFA coverage given to households and firms, and the DFAA coverage to the provinces charge no premiums, which is very unlike private insurance. This is similar to what we see in some areas of public insurance in Canada, notably health care. How does making insurance free affect efficiency? It makes it irrational for anyone not to accept coverage and therefore eliminates the adverse selection problem. On the other hand, it does nothing to reduce moral hazard and since it results in more people having insurance it may increase the welfare losses created by that problem. So, it is not clear whether providing free insurance increases or reduces welfare.⁸

While the DFA system does not provide full coverage for all disaster damage, it can be regarded as an (imperfect) public insurance scheme. Given that private insurance is unavailable in some cases, for example in very high-risk flood zones, it could theoretically provide an overall welfare gain. Determining whether that is the case would be very difficult, since it would require a full accounting not only for the costs of the system but for its benefits. The latter are difficult to assess since they are largely unobservable.

While the benefits of the DFA system would not be easy to assess, we can say something about the social costs. First, there is an excess burden imposed by the taxes that must be paid to fund the system. The 2016 PBO report forecasted that DFAA payments would average \$902 million in the period 2016-20 (Parliamentary Budget Officer, 2016a). In 2015 – 16, after the new DFAA schedule shown in Table 5 was adopted, provincial DFA payments averaged 31% of DFAA payments according to the Canadian Disaster Database. Hence, payments for the overall DFA system are currently expected to run at about \$1.2 billion per year. Dahlby and Ferede (2011) estimated that the weighted average marginal cost of funds for the federal government was \$1.26 per dollar of tax revenue.⁹ Since the DFAA expenditures are dominant we can use this figure to make a rough estimate of the excess burden of the taxes that must be levied to fund the DFA system. It would be $0.26 \times \$1.2 \text{ b} = \312 million .

⁷ A few years ago the Insurance Bureau of Canada hired two tech firms to create a national flood-risk model. JBA Risk Management assembled data on “snow cover, rainfall, historical river levels, land cover, terrain, and flooding across Canada to produce its own flood models and maps.” LexisNexis Risk Solutions wrote software that could use that data to allow underwriters to decide whether to offer insurance and what the premium should be. See McClearn (2019).

⁸ The adverse selection problem could also be eliminated without a public system by making insurance compulsory, the approach taken for example for car insurance. In the case of flood insurance this is unfortunately not a practical option since actuarially fair insurance would be unaffordable in our very high-risk flood zones.

⁹ See Dahlby (2008) for an explanation of the issues and methods involved in calculating the welfare costs of taxation.

In addition to this excess burden of taxes, there is clearly also a social cost in the form of the excess flood damage caused by the building in flood zones that would not have occurred in the absence of DFA. As Insurance Bureau of Canada (2015) says "...a significant portion of flood-related losses is directly attributable to under-investment in public infrastructure, poor asset management plans, obsolete building codes and ineffective land use planning." There are no available estimates of the excess flood damage caused in these ways, but the fact that about 700,000 homes in Canada are in high-risk flood zones and claims that up to 100,000 homes should be removed from those zones referred to earlier suggest the cost may be quite substantial. In the 2010-16 period flood damage accounted for a third of recorded disaster damage (Table 2), which was running at about \$3 billion per year. We have seen that the true total disaster damages may be up to two times that amount. Thus, total flood damage may have been in the range of \$1 - \$2 billion annually. If a significant portion of this total cost was unnecessary, as the Insurance Bureau of Canada and others have suggested, it appears likely that the excess damage from flooding due to the moral hazard created by DFA would be of the same order of magnitude as the estimated approximately \$300 million annual excess burden of taxes required to support the system.

V. Equity Issues

While efficiency aspects are important, equity aspects may be equally or more important here. There are both horizontal and vertical equity issues concerning the DFA system.

On the horizontal equity side, public disaster compensation implies a transfer from people who live in less risky to those in more risky areas. Concern about this redistribution may well be more acute among the public than efficiency concerns. A possible rejoinder is that the advantage of compensation can be expected to be capitalized in property values. It might be thought that the risk of disaster was not changing over time the true DFA beneficiaries would have been the owners when the DFA system was introduced, or those who built in the floodplain later. Many current owners would not be in either category, so may not truly benefit from DFA redistribution and could be viewed as undeserved losers if the system were abolished. Against this, with disaster risk currently apparently rising unexpectedly, the capitalized value of DFA compensation should also be increasing - - which could be regarded as an undeserved benefit to current owners that could be equitably withdrawn.

Also on the horizontal equity side, it can be pointed out that the provinces vary in the size of their DFAA claims. Thus, for example, Manitoba and Nova Scotia - - provinces with similar per capita income, benefit differentially from DFAA assistance since Manitoba has major rivers that flood frequently while Nova Scotia does not.¹⁰ However, to date, relatively little public concern

¹⁰ Over the period 1983-2016 as a whole, Manitoba received an annual average of \$27.19 per person in federal DFAA money while Nova Scotia received \$2.52. Another relevant comparison, within the Maritimes, is between Nova Scotia and New Brunswick, which like Manitoba has major rivers that flood frequently. New Brunswick's annual average per capita DFAA receipt was \$6.28 over 1983-2016.

seems to have been expressed about such imbalances, but with continued increases in DFAA outlay it would perhaps not be surprising if such concern also increased.

On vertical equity, we have noted that the non-eligibility of luxury assets and the caps on payouts in nine out of ten provinces mean that DFA is to some degree targeted at lower income property owners. As pointed out earlier, these features make the disasters roughly akin to progressive wealth taxes in the affected areas. Leaving aside the effects of disaster assistance, however, it is still often reported that lower income groups suffer more from flooding and other disasters than higher income groups, as in the cases of Hurricane Katrina in New Orleans in 2005 and Hurricane Sandy in New York in 2012 (Logan, 2006, and Cohen and Liboiron (2014)). This difference is partly due to the fact that lower income people may suffer more from the non-capital damages caused by disasters. Larger impacts for these groups can occur due to such problems as borrowing constraints, physical immobility, social isolation, lack of information or poor health (Ouahen et al., 2015a,b). The remedies for these problems lie partly in having high quality emergency services available to all. However, there is a DFA aspect too. Delay in disaster assistance payments is a common problem, and the delays tend to be longer for larger disasters due to the high volume of claims. For those who are borrowing constrained that is a major problem, while for wealthier people it is likely to be a less serious concern.

A further significant vertical equity aspect is that, in some areas, low income people are over-represented in flood zones. A historical settlement pattern in many towns and cities was for high income people to locate on high ground and for low income people to build in the floodplain. In addition some First Nations with relatively low income have reserves that are vulnerable to flooding (Patrick, 2018). However, the pattern of populations in flood zones being skewed toward lower income is not universal.¹¹ And this pattern has also tended to break down over time, because of improvements in transportation, communication, warnings and emergency response, which have made it much easier to escape bodily harm and certain other forms of damage in disasters. The amenity value of rivers has induced more wealthy people to build large homes in areas of flood risk. In the severe flooding seen in the Calgary area in 2013 and in Quebec and New Brunswick in 2017 and 2019 people from all income groups were affected.

An example of how settlement patterns have changed over time is provided by Greater Vancouver. European settlement in this area originally took place almost exclusively on high ground, the threat from Fraser River flooding being sufficient to deter all but farmers, fishermen and a few others from locating in the floodplain. It was only when the high ground

¹¹ When water transport was dominant, being further from a river was a significant disadvantage, and that needed to be weighed against flood risk when determining location of homes and businesses. The St. Lawrence, St. John and Red Rivers would seem to provide relevant historical examples. Also, it is interesting to note that it has been found in the UK that people with vulnerabilities are over-represented in ocean floodplains but not in river floodplains (Walker and Burningham, 2011).

was completely occupied and dikes had been built that largescale residential development began in the floodplain. Today about 20% of the population of Greater Vancouver lives in the floodplain, and there is relatively little difference, overall, in demographic or economic characteristics between the people living in the floodplain and those on higher ground (Davies and Black, 2020).

Finally, we may touch again on the inter-provincial insurance aspect of DFAA. Some of the provinces that benefit the most from the system have below average per capita income. But in recent years Alberta, the province with the highest per capita income, has also received much above average per capita DFAA benefits - - an annual amount of \$72 per person from 2010 to 2016, vs. a national average of \$17. However, over a longer horizon the picture is different. Over 1983 – 2016 as a whole, the three wealthiest provinces -- Alberta, British Columbia and Ontario - - with 61% of Canada’s population as of the year 2000, had average annual per capita DFAA payments of \$4.57. The remaining seven provinces had average annual per capita benefits of \$8.68. Hence, if anything, over the longer run the inter-provincial incidence of the DFAA system appears to have been progressive rather than regressive.

VI. Policy Proposals

As we have seen, a major policy issue with Canada’s DFA system is its moral hazard impacts. They are currently most important in the flood realm. What do other countries do in this area? They implement a wide variety of approaches. Insurance can be private or public, and voluntary or compulsory. Every possible combination of these options is in force somewhere.

In Europe, flood insurance is public and mandatory in France, while it is private and optional in Germany. In the UK it is private but there is some coordination between the insurers and government. Flood insurance is provided through normal home insurance in low risk areas. Under the Flood Re program, launched in 2016, insurance is also provided in high risk areas, which include about 2% of all homes (Association of British Insurers, 2019; Van Dijk, 2019). Flood Re is a not-for-profit scheme, run and financed by insurers, which will cover all but the most extreme floods – those with a return period of 200 years (for which government would presumably provide compensation). Effectively, low-risk households subsidize high-risk households under Flood Re, although premiums are higher in the high-risk areas.

The U.S. has its publicly funded but privately administered National Flood Insurance Program, targeted at high risk areas, but available to households outside those areas as well. NFIP coverage is mandatory for houses with a mortgage from a federally regulated lender located in a “special flood hazard area”. The latter are areas where the flood return period is rated at 100

years or less. About half the houses in SFHAs have NFIP coverage, while coverage is only about 1% elsewhere.¹²

In Canada the recent thrust has been to move from reliance on DFA to private flood insurance, and so far the latter has been left optional. It seems unlikely that the country will head in the direction of public flood insurance (i.e. with premiums), which is reasonable given that we have a fairly competitive market for home insurance. The open questions would appear to be whether politicians can be trusted to deny DFA to the uninsured in cases where flood insurance was reasonably and readily available, and what should be done in the high-risk areas where private insurers are unlikely to offer flood insurance without some assistance from government. A joint government-industry group, the National Working Group on Financial Risk of Flooding, began to study the latter question in 2018. While it has generated a major research report, Insurance Bureau of Canada (2019), as of the time of writing this group had not yet made its final recommendations.

There is an argument for trying to make flood insurance universal or near-universal in areas with flood risk. As we have seen, the provinces are moving in the direction of refusing DFA to the uninsured where flood insurance was available. The problem is that when there is a large flood, politicians may be tempted to break with the policy. Ensuring that flood insurance is universal, or nearly so, in flood zones would circumvent this problem. This could be achieved by requiring that all home insurance policies in these areas should cover overland flooding.¹³ While in Canada such regulation lies within provincial jurisdiction, the federal government could encourage the adoption of such a rule at the provincial level by refusing DFAA payments to householders without flood insurance and by negotiating a comprehensive agreement with the provinces under which it would provide assistance for disaster mitigation and the provinces would commit to certain insurance and other standards.

There remains the issue of what to do about high-risk areas.¹⁴ The problem in this case is that actuarially fair insurance may be so costly that many households would opt to do without. The experience in other countries, particularly the U.K. and the U.S., suggests that the solution is for flood insurance in high risk areas to be subsidized -- either by low risk policy holders, as in the U.K., or by government, as in the U.S. Subsidy by low- or no-risk policy holders seems dubious on horizontal equity grounds.

A concern with subsidizing insurance in high-risk areas is that the burden of the insurance premiums by itself will not be sufficient to induce optimal private mitigation in, or retreat from,

¹² See Sandink et al. (2016) for further details on NFIP, as well as on flood insurance in Europe, and in the UK prior to 2016.

¹³ Note that requiring all home insurance policies in flood zones should cover flooding does not guarantee universal coverage since it is not compulsory to have home insurance.

¹⁴ This issue could arise with hazards other than flood. Suppose, for example, that one builds a million-dollar home in a heavily forested area in the interior of BC in an area of high fire risk. Will there necessarily be an insurer who is willing to insure this house against wildfire?

those areas. Voluntary buyouts can compensate for this to an extent, but their low take-up rates in the past suggest they are not enough. Compulsory buyouts in some very high-risk areas are likely warranted. In addition, when insurance is first provided in high-risk areas the subsidy rates could be announced together with a schedule of future rates that would decline over time. This would allow affected householders to adjust gradually, and to do careful planning for future relocation where warranted.

A final important point is that the DFA system provides assistance not only to private agents, but to lower levels of government. Further reduction in DFAA rates may be necessary in order to reduce the moral hazard that prevents provinces and municipalities from taking all necessary and appropriate measures to mitigate disaster risk. Much can be done to reduce the likely costs of storms, wildfire and, especially, flooding. While federal support for such initiatives has been important in the past, and continues to be important, the provinces and municipalities should not wait for that support to take action.¹⁵ Enhanced flood protection measures, including stopping all real estate development in floodplains, and making improvements in dikes, dams, reservoirs and pumping stations are needed (Gertz et al., 2018; Insurance Bureau of Canada, 2019). The provinces are also responsible for disaster forecasting/warnings, which in some cases could be substantially improved. They can further assist through the dissemination of information about disaster risks to the public and the online provision of detailed flood maps and precise risk information based on geographic location.¹⁶

VII. Conclusion

This paper has outlined Canada's disaster financial assistance (DFA) system, which provides benefits through the provincial governments, and how it is underpinned by the federal government's Disaster Financial Assistance Arrangements (DFAA). It has also looked at the composition and history of natural disasters in Canada, pointing out that the most costly category is flooding, followed by storms and wildfire. The need for policy changes has been analyzed by considering the efficiency and equity issues created by the current system.

Canada's DFA landscape is in a process of change set off by the rising cost of natural disasters. In 2015 the federal government reduced its support for DFA by tripling the damage thresholds

¹⁵ Under the Flood Damage Reduction Program (FDRP), launched in 1975 and phased out in the late 1990s (a time of large cuts in government spending) there was strong federal-provincial cooperation in flood mitigation and related areas such as flood mapping (Minano et al., 2019). In recent years the federal government has again provided assistance for mitigation by the provinces, for example by allocating \$2 billion for a Disaster Mitigation and Adaptation Fund and another \$5 billion for "green infrastructure" projects in its 2017 budget. Those are positive developments, but it would be unfortunate if the prospect of further federal help reduced the sense of urgency for action at the provincial level.

¹⁶ The UK has a nationwide online facility that provides individuals with flood risk information at their location, on the basis of their postal code. That would be an attractive system to have in Canada, and perhaps could be instituted on a national basis if it received sufficient federal support.

for its graduated DFAA subsidies to the provinces. And in 2015 the insurance industry began to fill an important gap by introducing overland flood insurance for home owners. Today about a third of Canadian households have flood insurance. So we are already in transition to a new world in which private insurance will take on an even larger role than at present, and government assistance to households, farmers and small businesses will become less important in providing disaster compensation. This is a key reform. However, there remains an important issue of how properties located in high-risk areas will be dealt with. And there are broader issues related to the need to increase incentives for provinces and municipalities to raise protection not only against floods but wildfire and other natural hazards

The federal government and insurers have been in consultation concerning the development of flood insurance for properties in high-risk areas. This initiative is taking place at a time when there have been increased efforts by provincial governments to induce retreat from such locations through enhanced voluntary buyouts. The suggestion made in this paper is that overland flood insurance should be a required component of home insurance in all areas susceptible to flooding. In high-risk areas the flood insurance component should be subsidized. Generous rates of subsidy should be announced at the start, with a further announcement of a schedule according to which those rates would be gradually reduced in the future. Along with the use of voluntary buyouts, and mandatory buyouts for some properties in very high-risk areas, this approach would encourage the adjustments that are necessary to get flooding costs, and the burden of the taxes that must be paid to fund DFA, further under control.

Replacing DFA compensation by insurance for individuals, farmers and small business is a necessary reform, but as we have argued will not solve all problems. Another important component of the DFA system is assistance to lower levels of government. Further reduction in DFAA rates may be necessary in order to reduce the moral hazard that prevents provinces and municipalities from making all necessary disaster mitigation efforts. There is a lot that provinces and municipalities can and should do, but continued high rates of assistance may suppress their impetus to take sufficient action.

Table 1: Mean Annual Reported Disaster Expenses, Canada, 1980 – 2016, millions of 2018 \$s

Years	Federal DFAA Payments	Other Federal Expenses	Provincial DFA Payments	Other Provincial & Municipal Expenses	Insurance Payouts	Total Expenses
1983-89	\$33.8 (14.8%)	\$0.0 (0.0%)	\$33.3 (14.5%)	\$0.2 (0.1%)	\$161.7 (70.6%)	\$228.9 (100.0%)
1990-99	212.0 (12.8%)	215.3 (13.0%)	57.7 (3.5%)	559.0 (33.8%)	609.8 (36.8%)	1,655.6 (100.0%)
2000-09	109.0 (16.7%)	0.0 (0.0%)	40.8 (6.3%)	3.4 (0.5%)	498.8 (76.5%)	651.9 (100.0%)
2010-16	594.5 (19.2%)	123.8 (4.0%)	129.8 (4.2%)	130.3 (4.2%)	2,117.9 (68.4%)	3,096.3 (100.0%)
1983-2016	223.8 (16.4%)	88.8 (6.5%)	62.5 (4.6%)	192.3 (14.1%)	795.4 (58.3%)	1,363.3 (100.0%)

Source: Constructed using Parliamentary Budget Officer (2016b) data for Federal DFAA payments over 1983-2014, own imputations for Provincial DFA, Insurance Bureau of Canada (2019) data for insurance payouts in large disasters and the Canadian Disaster Database for other expenses including insurance payouts in small disasters not covered by the IBC data and federal DFAA payments in 2015 and 2016.

Table 2: Composition of Recorded Disaster Expenses by Event Type, Canada, 1980 – 2016 (%)

Years	Flooding	Storms	Wildfire	Hurricanes & Tornadoes	Other
1983-89	19.4%	31.8%	0.9%	43.7%	4.3%
1990-99	15.1	66.7	1.2	4.2	12.8
2000-09	19.0	51.4	8.9	19.7	1.0
2010-16	33.8	31.5	30.7	3.5	0.5
1983-2016	24.5	47.0	16.0	7.3	5.1

Source: See Table 1.

Table 3: Top Ten Canadian Disasters by Total Reported Cost, 1980 – 2016

Rank	Event Type	Place	Start Date	Deaths	Reported Cost 2018\$ (millions)	Number of Evacuees
1	Ice Storm	Ontario, Quebec and New Brunswick	1998 JAN	35	6,680.3	17,800
2	Wildfire	Fort McMurray AB	2016 APR	2	4,471.4	90,000
3	Flood	Southern Alberta	2013 JUNE	4	3,362.4	100,000
4	Storms	Calgary AB	1991 SEPT	0	1,367.7	0
5	Flood	Southern Alberta and Saskatchewan	2010 JUNE	0	1,271.1	2,065
6	Pluvial Flood	Toronto ON	2013 JULY	0	1,024.2	0
7	Drought	Prairie Provinces	1990 JAN	0	990.1	0
8	Flood	Assiniboine, Souris, Roseau and Red Rivers MB & SK	2011 APR	0	956.3	2,543
9	Drought	Prairie Provinces	1992 JAN	0	922.0	0
10	Tornado	Southern Ontario	2005 AUG	0	779.7	0

Source: See Table 1.

Table 4: Top Ten Canadian Disasters 1980-2016: Composition of Reported Cost

Event Type	Place	Year	Composition of Reported Cost (%)					
			Federal DFAA	Other Federal	Provinc'l DFA	Other Prov./Munic'l	Insurance	
1	Ice Storm	Ont., Que., N.B.	1998	14.6	3.6	2.6	44.5	34.4
2	Wildfire	Fort McMurray AB	2016	10.9	0.0	1.9	0.0	87.2
3	Flood	Southern Alberta	2013	43.2	0.0	5.1	0.0	59.6
4	Storms	Calgary AB	1991	0.0	0.0	0.0	59.6	40.4
5	Flood	S. Alberta and Saskatchewan	2010	8.2	67.6	1.9	18.6	3.8
6	Flood	Toronto ON	2013	0.0	0.0	0.0	0.0	100.0
7	Drought	Prairie Provinces	1990	0.0	64.9	0.0	35.1	0.0
8	Flood	Manitoba & Saskatchewan rivers	2011	89.5	0.0	10.5	0.0	0.0
9	Drought	Prairie Provinces	1992	0.0	100.0	0.0	0.0	0.0
10	Tornado	S. Ontario	2005	0.0	0.0	0.0	0.0	100.0

Source: See Table 1.

Table 5: DFAA Subsidy Rates by Provincial Per Capita Total Expense Ranges

Federal Subsidy as % of eligible provincial expenses	Provincial per capita total expense ranges	
	Before Feb. 1, 2015	2019
0	< \$1	< \$3.19
50%	\$1 to \$3	\$3.19 to \$9.58
75%	\$3 to \$5	\$9.58 to \$15.97
90%	>\$5	>\$15.97

Source: <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/rcvr-dsstrs/gdlns-dsstr-ssstnc/index-en.aspx>

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