Financial Protection against Natural Hazards: 
Recent Lessons from México 

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This paper reviews the Disaster Risk Financing strategy of the Mexican Government. It revisits and provides an explanation of FONDEN’s genesis and proposes a set of economic roles that the Trust fund plays, beyond its financing functions in the management of natural disasters in the country. This paper also offers an insight into the elements behind the construction of a more integral DRF strategy and extracts some lessons for other countries.

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México attests to the recently observed trend of increasing number of natural disasters occurring around the world. Its privileged location, which makes it a potential hub for trade among Asia, Europe, and the rest of the Americas, makes the country vulnerable to three broad types of natural hazards: 1) geophysical, such as earthquakes and volcanoes, 2) hydrometeorological, such as cyclones (tropical storms) on both the Pacific and the Atlantic oceans and floods, and 3) climatological, which include drought and frost.

This more frequent occurrence of natural disasters has been characterized by increasing economic losses and effects on the population, elements that, according to the World Bank...
According to Michel-Kerjan et al (2011), the escalating levels of economic losses resulting from natural disasters can be explained by several socioeconomic factors such as rapidly increasing population, higher degree of urbanization, and huge growth in the value of the assets at risk.

According to EM-DAT, during the period 1970-2011, cyclones, earthquakes, and floods are the three natural disasters that have caused the larger historical economic losses to the country. In fact, during this period, cyclones caused around 56.6 percent of the accumulated (real) economic losses associated with natural disasters; earthquakes generated 23.0 percent of those losses, and floods accounted for 13.1 percent of them.
From Figure 2B, three events stand out for their large effect on the Mexican economy: 1) Hurricane Wilma (2005), 2) the 1985 earthquake, and 3) Hurricane Alex (2010). The 7.8 on the Richter scale earthquake that occurred in 1985 generated economic losses that surpassed eight and a half billion (2011) dollars and affected more than two million people in México.\(^1\)

That event was a turning point that led to new policies for prevention and attention of natural disasters. All three of the governmental structures, municipal, state, and federal, made changes to update their management of natural hazards. Subnational governments adjusted building codes, particularly those in the center of the country, the area most exposed to earthquakes; in 1986 the federal government established the National System of Civil Protection (Sistema Nacional de Protección Civil, SINAPROC).

\(^1\)This magnitude is reported in World Bank (2012, p. 213). According to Swiss Re (2012) the magnitude of the earthquake was 8.1, and according to the World Bank Treasury (2011) it was 8.0. The source of the estimated damage is EM-DAT.
SINAPROC was established on at least three elements that can be useful in drawing lessons for other countries. First, Civil protection requires that the State protect the individual, his/her job, assets, and environment (including public infrastructure) in the face of the occurrence of a natural or human-made disaster; in that sense, society is “conserved” and “protected.” Second, Civil protection requires the participation of both public and private sectors and, on the public sector side, the intervention of the three governmental structures. Finally, Civil protection is an endeavor that requires the direction of the State, but at the same time it is has respect “individual liberties.”

I. The Natural Disaster Fund (FONDEN)

The operation of SINAPROC, of course, requires resources from the federal budget to design and coordinate the prevention strategies for facing natural hazards, to undertake and coordinate the attention measures when a natural disaster strikes, and to carry out and coordinate the necessary reconstruction programs to take the affected population to a state of nature closer to the one existing before the disaster’s occurrence.

A. Son of Natural and Financial Storms, the creation of FONDEN

What seems to be puzzling is the fact that after the creation of SINAPROC, a decade had to elapse for the creation of the Natural Disaster Fund (FONDEN) in 1996. I propose the following rationale as to why FONDEN was not created until so many years after the SINAPROC was established. According to EM-DAT, before the events occurred in 1993 and 1995 there were no other phenomena with

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2See the Decree that established SINAPROC’s basis, published on May 5, 1986, in the Diario Oficial de la Federación (the official magazine where all public acts of the federal government are published). http://dof.gob.mx.
an economic impact surpassing one billion (2011) dollars (see Figure 1B), which had to be managed by the federal government with its budget. Estimated damage in 1993 amounted to more than two billion and seven hundred million dollars and in 1995 it surpassed three billion and seven hundred million.3

In that context, although before 1993 and 1995 there were periods of additional budgetary pressure, there were no catastrophic events requiring a huge amount of resources that implied a major reallocation (deviation) from other programs. For that cause, one can reasonably conclude that there were not extraordinary efforts on the federal government’s side to reallocate scarce resources and, given the budgetary restriction, there was no space to set up a special vehicle to finance SINAPROC either. This explanation needs still to account for two facts. One, Hurricane Gilbert (1988) had a large impact in México, generating an estimated damage of 620 million dollars, and two, the occurrence of a disaster of such dimensions did not lead to the creation of any financial mechanism to deal with it and its destructive consequences. There is an additional fiscal element missing in the argument, which made, I understand, necessary the update of the financial strategy to manage natural disasters. Here comes into play a key role the Mexican financial crisis that emerged at the end of 1994 and remained during 1995. In the latter year, the Mexican GDP accumulated a 7.2 percent fall (in real terms) so that potential budgetary resources that could be reallocated to the attention of natural disasters were even scarcer. The perfect storm, generated by the strike of natural disasters, in the middle of the most severe financial crisis México has ever faced, likely led the Ministry of Finance (Hacienda or SHCP) to realize that a special budgetary mechanism was needed for channeling a minimum amount of resources to reasonably manage catastrophic natural disasters.

3According to Bitrán (2001), in 1993 one of the most important disasters was Hurricanes Gert, and in 1995 the events with the larger impact were hurricanes Ismael, Opal, and Roxanne.
According to the Mexican Ministry of Interior (Gobernación), which is responsible for the operation of SINAPROC and FONDEN, the fund was the product of “… the government’s [concern] to increase [its] capacity to attend the damaged caused by natural phenomena without altering the public finances…” (see Hofliger Topete, 2011, p. 2), a statement that is in line with the proposed explanation for the genesis of FONDEN.

B. Facing Storms, FONDEN’s Functions

FONDEN is a financial vehicle with budgetary functions. FONDEN is actually a trust; the trustee bank is the National Bank for Public Infrastructure, BANOBRAS, one of the main State Owned Banks in México. As a budgetary entity, it has an allocation in the federal budget. FONDEN’s nature facilitates its budgetary operation, as well as the use and distribution of resources to carry out the disaster risk management strategy of the Mexican Government.

The Mexican Constitution establishes that the federal budget runs on an annual basis (see Article 74, IV). Except for investment expenditure, in general, no allocation of resources can be established for multiple years and, for that reason, non-spent resources in a given year have to be given back to the Mexican Treasury. Because it is a Trust fund, FONDEN has two important characteristics. First, it keeps non-spent resources for future use. This means the capacity to allocate resources in multiple years. Second, it isolates resources exclusively to manage the financial consequences caused by natural disasters.

FONDEN’s budget line allows it to concentrate in one entity, instead of several programs, resources for future distribution and, in case of need, it can receive reallocated resources from other budgetary programs.

A minimum annual budgetary allocation for FONDEN to face natural disasters is not mandatory for the Executive nor the Legislative branch in México.
Nevertheless, steps have been taken in that direction. In 2006 the Mexican Congress approved a new Federal Budget and Fiscal Responsibility Law. That Law mandates the Executive branch to include in the proposed economic program for the following fiscal year a minimum amount to face natural disasters (see Article 37). This allocation follows the rule in (I):

(I) Reserves in the Funds + Annual Allocation \( \geq 0.4 \) percent of programmable expenditure (around 900 million dollars for 2012)

where *Funds* refers to the budgetary vehicles with dedicated resources to face natural disasters.\(^4\) The mentioned Law also sets rules to distribute the extraordinary (exceeding) budgetary resources (coming from internal or oil revenues) to (among other uses) FONDEN when the Trust fund’s resources are not enough to face its needs (See Article 19, I).

FONDEN’s Operating Rules\(^5\) indicate that FONDEN has three main instruments to carry out its financing functions (see Article 3):

- The FONDEN Program (the federal budget line) is the budgetary mechanism to make cash transfers to the Trust fund;
- The FONDEN Trust fund provides resources for reconstruction and to finance the acquisition of risk transfer instruments, and
- The Revolving Fund provides resources to attend to the emergency after the occurrence of a natural disaster. This fund can be financed by either one of the previous instruments.

\(^4\)Mainly FONDEN, but there is another Fund to cope with agricultural risks.

\(^5\)See the “Acuerdo por el que se emiten las Reglas Generales del Fondo de Desastres Naturales,” published in the Diario Oficial de la Federación on December 3, 2010. According to the Federal Budget and Fiscal Responsibility Law, Operating Rules govern the use of the resources in FONDEN (see Article 37).
With those instruments, FONDEN plays specific financing roles on the timeline of the occurrence of a disaster. In the **prevention phase**, it provides funds for the design of risk-transfer instruments. The Fund also provides resources to federal agencies and local governments after a natural disaster has occurred; in the **response phase**, it provides first aid supplies to cover the urgent needs of the population in the emergency zone and, in the **recovery and reconstruction phase**, funding for reconstruction of damaged Federal infrastructure, houses of low-income population, and damaged local infrastructure.

![Diagram of FONDEN's Financing Roles](image)

**Figure 3. FONDEN’s Financing Roles on the Time Line of the Occurrence of a Disaster.**

*Source: author’s, adapted from the World Bank.*

**C. Coping with Storms, FONDEN’s Economic Roles**

The main economic role of FONDEN is to solve coordination failures present in several phases on the time line of the occurrence of a disaster.⁶ Those coordination failures involve the different abovementioned stakeholders: the three governmental structures and the population. In the response phase, it provides the coordination between all governmental structures and the private sector. In the recovery reconstruction period, it forms a single queue to local governments and federal agencies to request for federal funds.

⁶Tyran (2007) presents several applied examples of coordination failures.
At the reaction to the occurrence of a natural catastrophe, there can exist an equilibrium in which suboptimal levels of efforts from the different orders of government is provided. This under-provision of efforts can be due, at least, for two reasons: there is no complete information about the dimension of the catastrophe or there is an expectation that the next order of government will react, based on the idea that such order has a larger amount of material and human resources to do so. For example, municipalities would expect that the state government could react and, in turn, the state government would wait for the federal government to intervene. Lack of complete information can also lead federal (state or municipal) agencies to suboptimal provision of efforts to react in face of the emergency. On the private sector side, an over-provision of the effort leading to inefficiencies (due to several agents acting in the same geographical area) could emerge as equilibrium.\textsuperscript{7}

In the response phase, by directing all response efforts and providing the relevant information, the federal government can help to solve those coordination failures. In that vein, FONDEN coordinates the efforts of the different stakeholders to cope with the emergency: first, FONDEN provides information and helps the geographical coordination of the three governmental structures for an optimal provision of their efforts; second, it also helps to coordinate the different administrative capacities of the federal agencies; third, FONDEN also facilitates the coordination between public and private sectors, and it complements (avoiding overlap) the efforts of both parties to gain efficiency.

In the recovery and reconstruction phase, FONDEN manages local governments’ and federal agencies’ requests for reconstruction funds. The vehicle avoids multiple windows to access to the federal budget and gives a global vision of the monetary amount of the damages. In that sense, FONDEN solves a sort of

\textsuperscript{7}See Qehaja (2208) for another example in coordination failures at the emergency stage.
the “problem of the commons,” which arises from the combination of two elements. First, none of the federal agencies (in charge of public infrastructure), municipalities, or state governments affected by the disaster is the “owner” of the federal budget. Second, after the strike of a natural catastrophe, each of the agencies and local governments compete for a share of the budget to face the reconstruction needs under its responsibility.

FONDEN also have several committees at different levels in charge of the valuation of the damages of the public infrastructure covered under the Trust Fund’s umbrella. That well-established valuation process keeps efficiency in the use of the budgetary resources: only actual damages are paid and the payments correspond closely to the effects caused by the natural disaster. This feature of FONDEN contributes to the best use of the resources devoted to reconstruction.

FONDEN also invests in understanding and preparedness to face natural hazards, as well as in the development of strategies to optimize the federal resources for disaster risk management and disaster risk financing. In that vein, as part of its functions, the Trust fund has financed the development of studies to better assess natural hazards at the federal and the regional level. Among others, it has provided funding for the preparation of local risk atlases, studies on social and economic impacts of natural disasters, and studies to reallocate vulnerable population in risk zones to safer zones.

II. After Storms, Mexican Disaster Risk Financing Strategy

FONDEN has also devoted resources to the development of financial mechanisms that serve as an insurance for FONDEN’s resources. As a step in the direction to get financial protection for the Trust fund’s resources and thus to

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8Hardin (1968) introduced the epithet of “tragedy” to this problem and presented the classic-modern treatment of the problem.

9More details can be seen in Lobato Osorio (2011a) and Pérez Maldonado (2011).
minimize pressures on the federal budget in 2006, the Mexican Government, with the support of Swiss Re, placed the first catastrophic bond in Latin America, “Cat Mex.” This financial mechanism was a combination of a parametric reinsurance contract, for 290 million dollars, and a cat-bond, for 160 million dollars. Cat Mex covered three years, 2006-2009, of highly exposed zones against earthquake risk.

By the 2008, Mexican Government had started a strategy for Disaster Risk Financing (DRF), but that strategy needed a global vision (see Figure 4). Advances were significant, but there was no clear direction of the strategy for financial protection for FONDEN. The DRF strategy was lacking:

(i) A detailed inventory of the assets covered under FONDEN.

(ii) A risk analysis of the exposure of those assets to natural hazards and of the potential financial damage of the disasters on the assets.

(iii) A global strategy to financially protect FONDEN’s resources.

With all the advances, a top-down approach to building up a strategy for protecting FONDEN’s resources was set in place. The decision was the product of the advances and the circumstances faced at that moment: first, there was an instrument Cat Mex) for protection at the top risk layers; second, there was need for improvement since the first loss insurance lacked detailed information on assets covered, and third, there was a window of opportunity due to the fact that further development of financial protection at the top depended mainly on the
ministries of Interior (Gobernación) and Finance (Hacienda), who jointly direct the FONDEN Trust.

That approach required the Mexican Government to build up two main elements to develop risk-transfers mechanisms to protect FONDEN’s financial resources and with that pursue a global DRF strategy. As a result of the work conducted by Hacienda, with the support of UNAM (Mexico’s National University) and Agroasemex (the public insurance company), FONDEN constructed an inventory with detailed information of public assets (roads, hospitals, schools and water infrastructure), including their description, geographical location, and replacement value; also, it includes information on housing for low-income people. The Trust fund also developed a modeling system for earthquake and hurricane risks to determine the degree of vulnerability of the assets in the inventory to those risks. R-FONDEN, the system, also provides the technical elements for designing appropriate insurance schemes.

The database contains information on the five types of infrastructure that have suffered the larger damage due to natural disasters; its structure and contents were validated by Risk Management Solutions (RMS): 1) 136,575 roads and 7,287 bridges; 99,489 schools, 13,762 hospitals, water infrastructure, and 12 million housing units for low-income people. R-FONDEN also provides information about areas of highest exposure by type of asset and degree of vulnerability. The system returns estimates of expected losses by type of asset, risk, and region. RMS considers that the system agrees with international standards (Lobato Osorio, 2011b).

Based on those elements, for the layer of catastrophic risks, in October 2009, in partnership with the World Bank, Swiss Re and Goldman Sachs, Mexico issued “Multi Cat Mexico 2009.” Multi Cat provides protection from earthquake and

10A more detailed discussion on the inventory and R-FONDEN can be found in The World Bank (2012).

In the next step, with the purpose of providing protection to FONDEN in the risk layers beneath those covered by Multi Cat, the Mexican Government designed and placed an excess-of-loss type of insurance. The main objective of that new insurance product is to give financial protection to the federal budget in the event of a series of natural disasters of medium intensity that, in the aggregate, may imply resources for more than a billion dollars (see Figure 5).

The coverage was for a period of one year, effective since June 10th, 2011, and its renewal was contracted around mid June this year. The coverage protects all infrastructure under FONDEN protection and all perils outlined in FONDEN’s Rules. It is noteworthy to mention that the adjustment procedure is based on damage evaluations made by FONDEN.

The risk-transfer mechanisms implemented by México minimize the pressure on the federal budget when a disaster strikes, and they are an example of how governments can take advantage of the reinsurance and capital markets (insurance-linked securities, ILS) to optimize scarce budgetary funds, among others: there is no need to access capital markets to get reconstruction funds, under the pressure of repairing key infrastructure for the population; ex-ante mechanisms may lead

Figure 5. Illustration of the Excess-of-Loss Protection for FONDEN.

Source: author’s, adapted from the Mexican Ministry of Finance.
to cost savings compared to other alternatives; governments have no need for additional fiscal space, since the prime does not account as debt; the prime is accounted as current expenditure, and as a result, public financial stability may be improved.

Mexico has also worked in the design of new risk-transfer instruments for the lower-risk layers. The Mexican Government has invested time and resources to develop schemes that will protect the infrastructure that suffers major damage when a disaster occurs and it is not insured by the insurance market: this includes federal turnpikes, roads, and bridges. It has also worked on the design of risk-transfer schemes to protect housing for low-income population in the zones most exposed to hurricane and earthquake risks. The Mexican Government has also developed a second phase of its inventory and risk model to make FONDEN activities more efficient. The project plans to build dynamic information tools to provide the means to address the three phases of a natural disaster:

(i) Prevention. A risk-analysis module that will identify natural hazards and assess the vulnerability of infrastructure exposed to them and provide elements for prevention and mitigation plans.

(ii) Emergency. An early-alarm system module that will allow the selection of action plans and the estimation of human casualties and infrastructure damages.

(iii) Recovery. A payment-control module to follow up reconstruction efforts: i) validation of infrastructure in the existing inventory, ii) geo-referenced location of damages, and iii) monitoring and coordination of actions taken for reconstruction.

In summary, México has built up a global strategy to manage natural disasters. See Figure 6.
III. Main useful lessons for other countries from the Mexican experience

Figure 6. Illustration of the Current Mexican DRF.

Source: author’s, adapted from the Mexican Ministry of Finance

FONDEN shows how a centralized entity to manage natural disasters can help to solve coordination failures in the prevention, response, and recovery-reconstruction stages upon the occurrence of a disaster.

The use of such an entity can result in a more efficient use of the efforts of all stakeholders in the civil protection activities since it avoids overlaps; also, it allows for the management of the geographical and administrative capacities of different agencies. A central entity can help order budgetary requests from the federal agencies and subnational governments, giving a clear idea of the amount required. Finally, it also helps evaluating actual damages, contributing to optimize the funds for reconstruction purposes.

Mexican DRF strategy is an evidence of the importance of developing a risk-management strategy that is comprised of tools to manage deep uncertainty, assess risk and vulnerability, and make informed decisions to reduce risk and prepare for natural disasters. To develop such a strategy, the first step is to establish the fundamental databases necessary for risk assessments to make informed-decisions and value risk. Establishing mechanisms to easily communicate and share this data between all actors involved is the next step. These steps will enable better modeling and valuing of risk to answer the question of what are the hazards and their potential effects on the infrastructure and assets.
covered. All of these elements will better inform decision makers and will facilitate the development of risk financing and transfer mechanisms.

As seen, governments can benefit from using risk-transfer mechanisms to minimize pressures on their budgets that arise from the financial consequences of natural disasters; nevertheless, as Ghesquiere and Mahul (2010) point out, cost effectiveness has to be evaluated.

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[http://treasury.worldbank.org/bdm/pdf/Case_Study/Mexico_CatBond.pdf](http://treasury.worldbank.org/bdm/pdf/Case_Study/Mexico_CatBond.pdf)