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Enabling rapid financial response to disasters: Knotting and reknitting multiple paradoxes in inter-organizational systems

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INTRODUCTION

After [hurricane], it was so bad that the government could not even pay the public servants, and that created a lot of secondary problems ... even the police started looting ... Donors come to the rescue of those countries, but it takes quite a while. It takes three, six months, one year [...], and then you start renegotiating your debt schedule, and that also takes six months to a year, and in the meantime you're in default and ... (Development, Int).

In paradox theory, organizing is the process of working through persistent tensions between contradictory elements that are inescapably interdependent (Schad, Lewis, Raisch, & Smith, 2016: 10). These interdependent yet contradictory elements (or poles) are both ‘oppositional to one another yet [...] also synergistic’ (Smith & Lewis, 2011: 386). Because both poles are interdependent, effective organizing involves maintaining equilibrium, dynamically, through constant movement between paradoxical poles with strategies that both differentiate and integrate them. These processes of ‘dynamic equilibrium’, which are the foundational framework in paradox theorizing (Schad et al., 2016; Smith & Lewis, 2011), harness tensions and enable paradox-laden systems to survive and continuously improve (e.g. Smith, 2014).

Paradox scholarship has made much progress in explaining dynamic equilibrium, particularly examining how single paradoxes play out inside organizations (e.g., Jay, 2013; Smith, 2014; Smith & Besharov, 2019). However, we still know little about equilibrium in the context of the multiple paradoxes that typically characterize interorganizational systems (as argued by: Connelly, Zhang, & Faerman, 2008; Cunha & Putnam, 2019; Schad & Bansal, 2018; Tracey & Creed, 2017). Yet, this is a critical issue, as the most critical challenges facing humanity, such as climate change, poverty alleviation, or the extreme-weather disasters in our opening quote, are large scale and complex, and thus require interorganizational efforts in addressing them (Ferraro, Etzion, & Gehman, 2015).

In this study, we define dynamic equilibrium as mutually reinforcing balance among the multiple paradoxes of an interorganizational system. When the paradoxes are in dynamic equilibrium, the interorganizational system is able to pursue its goals whilst satisfying the interests of the participating organizations. For example, balancing the market goals of fair trade business schemes with the social goals of alleviating poverty in low-income communities and the different time horizons of profitability (short-term) and economic sustainability (long-term) that these goals entail for the different organizations involved (e.g. Nicholls & Huybrechts, 2016; Sharma & Bansal, 2017; Slawinski & Bansal, 2015). Yet interorganizational systems are prone to disequilibrium (Williams, Whiteman, & Parker, 2019), which we define as imbalance among the multiple paradoxes. This can happen, for example, when short-term horizons and economic interests are privileged, such that the pursuit of large-scale social issues loses salience for some actors (Jarzabkowski, Bednarek, Chalkias, & Cacciatori, 2019). When the paradoxes are in disequilibrium, the interorganizational system experiences crisis, as it becomes difficult to pursue its goals while also satisfying the interests of the participating organizations.

Since interorganizational systems are typically characterized by multiple paradoxes, we draw on the concept of ‘paradox knots’, which are defined as multiple co-occurring tensions that are inseparably entangled and interdependent (Sheep, Fairhurst, & Khazanchi, 2017). The construction of these knots – which we call paradox knotting – is important as these knots can either attenuate or amplify tensions within organizations and interorganizational systems. Yet, the processes by which actors knot paradoxes and the implications of such processes for dynamic equilibrium have not been studied. We, thus, use the notion of paradox knotting as a way to illuminate the processes of enabling dynamic equilibrium and averting disequilibrium.

We address this topic in the context of multi-country risk pools providing disaster-liquidity insurance to low-income countries. This novel form of insurance provides a rapid release of capital from global reinsurance markets, thus enabling participating countries to finance the immediate response to disasters. Timely availability of capital is essential to prevent the escalation of disaster, as our opening quote shows, and is ever-more critical as hurricanes, droughts, and floods increase in severity and frequency worldwide (World Economic Forum, 2020). Risk pools are a salient interorganizational system for our study because they comprise individual countries, each of which become members in the pool, coordinated by the risk-pool organization that they establish to manage their insurance needs. The pool is supported by development and humanitarian organizations, and its insurance products are underwritten by global reinsurance market actors. As we studied the multiple paradoxes that characterized these multi-country risk pools, we became increasingly aware of how organizational actors' interactions connected and balanced these paradoxes, leading us to focus on paradox knotting and its implications for dynamic equilibrium within our interorganizational context.

Drawing from a longitudinal qualitative study, our findings uncover three knotted paradoxes, market-development (Smith & Besharov, 2019), part-whole (Poole & Van de Ven, 1989), and temporal (short-long-term) (Slawinski & Bansal, 2015). We document the interactions through which organizational actors knot these paradoxes to maintain equilibrium; show how the clustering of poles from different paradoxes unravels the knots and generates disequilibrium; and map the interactions involved in reknitting paradoxical poles in response to disequilibrium. Our process study demonstrates that these dynamics of paradox knotting are key to maintaining equilibrium and reconstructing balance when disequilibrium ensues, and the system's viability is at risk. Thus, we show how knotting is key to maintain the viability of an interorganizational

system and, in our case, continue providing a market solution – rapid injection of capital – to a large-scale societal issue – rapid response to disasters.

We develop our findings into a process framework that explains the dynamics of paradox knotting within interorganizational systems (Hahn & Knight, 2021; Schad & Bansal, 2018). Our framework provides important new insights. First, we contribute to theorizing on paradox knotting by going beyond identifying the effects of paradox knots (Sheep et al., 2017), to specifying the interactional processes through which different types of knotting take place, and demonstrating the generative implications of such knotting for navigating between equilibrium and disequilibrium. Second, we contribute insights about dynamic equilibrium (Schad et al., 2016; Smith & Lewis, 2011) through surfacing a novel response to disequilibrium. Specifically, contrary to known responses to disequilibrium of reasserting a suppressed pole in order to restore balance within a paradox (e.g. Jarzabkowski, Lê, & Van de Ven, 2013; Jay, 2013; Smith & Besharov, 2019), we show how disequilibrium can be addressed through further emphasizing the dominant poles while generating new knots these between the newly dominant and the remaining poles. This reknitting generates a new mutually reinforcing balance across multiple paradoxes. Third, we further knowledge about the generative nature of working with disequilibrium (e.g. Cunha & Putnam, 2019; Putnam, Fairhurst, & Banghart, 2016) in terms of strengthening the viability of interorganizational systems. Finally, our study on the topical issue of financial solutions to disaster response in low-income countries provides paradox theory insights into how interorganizational actors can remain engaged in delivering solutions to grand challenges (e.g. George, Howard-Grenville, Joshi, & Tihanyi, 2016).

THEORETICAL FRAMING

Market-social Paradoxes: The Dynamic Equilibrium Framework

Using market mechanisms to address critical social issues, like responding to the immediate aftermath of disasters in low-income countries, raises paradoxes because of the divergent strategic priorities, temporalities, ways of organizing, and identities of the actors involved (Nicholls & Huybrechts, 2016; Sharma & Bansal, 2017; Smith & Besharov, 2019). The paradox literature has provided insights into these tensions and how to address them, including in relation to fair trade (Nicholls & Huybrechts, 2016), organizational sustainability (Hahn, Preuss, Pinkse, & Figge, 2014; Hengst, Jarzabkowski, Hoegl, & Muethel, 2020), climate change (Slawinski & Bansal, 2015), and poverty (Sharma & Bansal, 2017; Smith & Besharov, 2019).

While the market-social balance is difficult to achieve (Sharma & Bansal, 2017; Slawinski & Bansal, 2015), this literature shows that organizations can achieve a both/and approach through the processes of dynamic equilibrium (Jay, 2013; Smith & Besharov, 2019). Dynamic equilibrium entails moving between persistently contradictory poles to enable organizational survival and continuous improvement (Schad et al., 2016; Smith & Lewis, 2011). Organizational and actors' responses to paradox are critical in achieving dynamic equilibrium. Defensive responses, like suppression of one paradoxical pole or splitting the paradoxical poles, lead to vicious cycles and disequilibrium (Lewis, 2000). Integrative responses that oscillate between contradictory poles simultaneously or sequentially over time, support a virtuous cycle of dynamic equilibrium (e.g. Andriopoulos & Lewis, 2009; Gümüşay, Smets, & Morris, 2020; Jarzabkowski et al., 2013; Jay, 2013; Smith, 2014; Smith & Besharov, 2019) that is particularly effective in achieving dual market and social missions (Hengst et al., 2020; Jay, 2013). For example, Smith and Besharov (2019) explain how a hybrid organization seeking to alleviate poverty in Cambodia while making a profit, achieves dynamic equilibrium through oscillating meanings and practices between 'guardrails' that alert managers when they are getting unbalanced and privileging one pole. These integrative

responses allow organizations to achieve equilibrium between poles, so capturing the positive features of paradox, such as creativity, transformation, improved performance, and innovation (Andriopoulos & Lewis, 2009; Miron-Spektor, Gino, & Argote, 2011).

To further understand market approaches to large-scale social issues we need to lift our focus beyond intra-organizational approaches to examine interorganizational systems (Schad & Bansal, 2018; Smith & Lewis, 2011). This is because large-scale issues, also known as grand challenges, extend beyond a single organization or country, necessitating interactions between actors across interorganizational systems (Ferraro et al., 2015; Williams et al., 2019). Two studies outline how approaches to market-social paradoxes are constructed in the interactions between organizations. Sharma and Bansal (2017) explore working through market-social paradoxes within a dyadic relationship between a profit-making organization and an NGO. They show how a successful both-and, rather than an unsuccessful either-or, approach depends on parties engaging in iterative workarounds and contextual problem solving that accommodate each other's needs. Nicholls and Huybrechts (2016) study the relationship between a fair-trade organization and a corporate retailer, showing that power-asymmetries can be managed if both parties have a pre-existing hybrid logic that enables the co-creation of boundary-spanning logics, common rules, and a shared tolerance for conflict. These studies illustrate that the nature of the interactions between interorganizational actors is critical to generating dynamic equilibrium. Yet, studies of how market-social tensions are navigated across wider interorganizational systems, beyond a clearly defined dyad (e.g. a firm and an NGO), are still needed (Schad & Bansal, 2018; Smith & Tracey, 2016; Tracey & Creed, 2017). We, therefore, turn to the broader literature on paradox at the interorganizational level.

Interorganizational Paradoxes and Paradox Multiplicity

Paradoxes are rife in network organizations (Ospina & Saz-Carranza, 2010), network projects (DeFillippi & Sydow, 2016), alliances (Das & Teng, 2000; De Rond & Bouchikhi, 2004), supply chain networks (Schrage & Rasche, 2021; Wilhelm & Sydow, 2018), partnerships (Nicholls & Huybrechts, 2016; Sharma & Bansal, 2017), and relational cooperation between competitors (Gnyawali, Madhavan, He, & Bengtsson, 2016; Jarzabkowski & Bednarek, 2018; Raza-Ullah, Bengtsson, & Kock, 2014). Yet, frameworks that explain how organizations work through paradox cannot automatically be assumed to apply at the interorganizational level (as argued by: Connelly et al., 2008; Cunha & Putnam, 2019; Schad & Bansal, 2018; Tracey & Creed, 2017).

First, there is unique complexity in working through paradoxes in interorganizational systems (Nicholls & Huybrechts, 2016; Sharma & Bansal, 2017; Sharma, Bartunek, Buzzanell, Carmine et al, 2021). Even in clearly-defined partnerships, such as an alliance, collaboration is often temporary, forged between actors who are fundamentally competing, and who have options to end their interaction (De Rond & Bouchikhi, 2004). While moving towards system-wide goals, such as sustainable development (Howard-Grenville, Davis, Dyllick, Miller, Thau, & Tsui, 2019) or climate action (Schad & Bansal, 2018), there are few specific integration mechanisms to align contradictory views or compel participation among organizational actors (Huxham & Vangen, 2000). Further, the boundaries of who should participate can be blurred, and actual participation can fluctuate as organizations enter and exit the system (DeFillippi & Sydow, 2016; Ferraro et al., 2015; Hahn & Knight, 2021; Huxham & Beech, 2003; Ospina & Saz-Carranza, 2010; Schad & Bansal, 2018). This heightened likelihood of exit differs from the more tightly-defined, controllable boundaries of a single organization making decisions, adjusting, and engaging employees in both market and social goals (Smith & Besharov, 2019).

Second, paradox multiplicity defines interorganizational efforts (Connelly et al., 2008; De Rond & Bouchikhi, 2004; DeFillippi & Sydow, 2016; Huxham & Vangen, 2000). For example, alongside market and social paradoxes (Nicholls & Huybrechts, 2016; Sharma & Bansal, 2017), tensions frequently identified within interorganizational systems range from competition versus cooperation (Jarzabkowski & Bednarek, 2018; Wilhelm & Sydow, 2018) to local versus global (Tracey & Creed, 2017) to different national business systems (Schrage & Rasche, 2021). These multiple co-existing paradoxes shape organizational engagement within an interorganizational system. For example, Ospina and Saz-Carranza (2010) explain how leaders' management of a unity-diversity paradox and a confrontation-dialogue paradox shaped internally or externally-directed collaboration in an Immigration Policy Network. In their study of biotech alliances, De Rond and Bouchikhi (2004) uncover five dialectical tensions that impact projects: design and emergence, cooperation and competition, trust and vigilance, control and autonomy, expansion and contraction. However, while such studies recognize the co-presence of multiple tensions, these are treated individually. Arguably, though, studying interorganizational systems entails understanding not only each separate paradox but also how they entangle as they shift in and out of salience at different times in different parts of the system (Hahn & Knight, 2021; Schad & Bansal, 2018). Yet, how co-existing paradoxes are entangled, shape each other, and are managed by actors interacting within an interorganizational system remains unaddressed.

Paradox Knots within Interorganizational Systems

We consider the relationship between multiple paradoxes at the interorganizational level by turning to the emerging research on paradox knots (Henriksen, Nielsen, Vikkelsø, Bévort, & Mogensen, 2021; Sheep et al., 2017). Paradox knots are multiple co-occurring tensions that are constructed as inseparably entangled and interdependent. Sheep et al. (2017: 481) argue that

paradox knots are a conceptual means to “study interrelationships among tensions rather than isolating them”, which they identify as largely absent from the paradox literature. They examine how discursive responses to multiple tensions that are knotted around two or more issues – such as finances, technological goals, parent company influences, and simultaneous goal implementation – shape innovation processes within an organization. Their framework makes two important points. First, it is processual as constructing and responding to tension knots at one moment sparks a chain of other paradoxical tensions, which then must be addressed (Schad et al., 2016). Second, responses to paradox knots have organizational consequences; either promoting innovative actions by attenuating tensions or justifying inaction by amplifying them. The extent of both-and discursive framing of the paradox knot is seen as central to attaining positive or negative outcomes. Sheep et al. (2017) view knots as entanglements that actors frame discursively, rather than focusing on the actions and interactions through which paradox knotting unfolds. Further study is thus needed into how – through what activities – multiple paradoxes are knotted in mutually-reinforcing or mutually-undermining ways.

Given the prevalence of multiple paradoxes (DeFillippi & Sydow, 2016; Huxham & Beech, 2003; Ospina & Saz-Carranza, 2010; Schad & Bansal, 2018), interorganizational systems provide a highly salient context for exploring how paradox knotting might support dynamic equilibrium. In addition, while much focus in paradox theorizing has been on achieving equilibrium, Sheep et al. (2017) call for future research to explore how paradox knotting might also be associated with disequilibrium and ‘far from equilibrium’ moments (Cunha & Putnam, 2019; Putnam et al., 2016; Sheep et al., 2017). We, therefore, argue that multiple co-existing paradoxes may also become knotted in ways that amplify tensions, generating disequilibrium (Sheep et al., 2017) that jeopardizes the viability of interorganizational systems (Williams et al., 2019). Given the dearth

of research into paradox knotting or the multiple paradoxes that characterize interorganizational systems, we take an exploratory approach, asking: ‘How does the knotting of multiple paradoxes enable, or undermine, dynamic equilibrium within interorganizational systems?’

METHODS

Research Context

In 2017 hurricanes hit the Caribbean, costing some countries over 200% of their GDP and damaging 95% of their housing stock (World Bank, 2017). As this suggests, extreme-weather disasters are devastating for low-income countries. Their impact is also increasing in the context of climate change and growing urbanization (Wallemacq & House, 2018). Our research focuses on an interorganizational system formed to provide a market solution to the development problem of providing a rapid capital injection to low-income countries, enabling them to finance urgent disaster response. Emergency capital to respond in the immediate aftermath of a disaster is crucial in averting escalating the crisis. For example, early response to drought can halve the number of livestock deaths and is fourteen times cheaper than the cost of replacing dead livestock as part of a slower aid-relief response (Hillier & Dempsey, 2012). Yet, low-income countries have limited financial reserves for immediate response. They are reliant on international development and humanitarian aid, which typically comes too late, taking weeks or even months to arrive (Clarke & Dercon, 2016), making the availability of rapid capital critical for addressing the challenge (Ferraro et al., 2015; George et al., 2016) of increase in disaster globally (World Economic Forum, 2020).

Empirically, our study focuses on a growing solution to provide rapid capital for immediate disaster response: disaster liquidity insurance delivered through multi-country risk-pooling schemes (commonly referred to as pools). First, disaster liquidity insurance is an innovation which,

unlike traditional insurance where the lengthy claims process is unsuited to immediate disaster response, involves pre-defined, contractually-agreed payment triggers based on the type and severity of the disaster. For example, if the relevant disaster is a hurricane, the triggers might be a specific wind speed recorded within a defined geographical location. When these triggers are met, immediate payouts are issued to help with urgent disaster response, such as restoring power supply or providing food and temporary shelter. Second, disaster liquidity insurance is delivered to low-income countries via risk pools. The premise is that these countries become members of the pool and buy a disaster liquidity product through the pool each year. Their individual country premiums are pooled to purchase commercial cover in the global reinsurance market, providing the capital to any country that suffers a disaster. From 2008 to 2020, these pools have enabled 78 payouts to 24 low-income countries in the immediate aftermath of a hurricane, flood, earthquake, or to respond to drought.

A pool is an interorganizational system that goes beyond simply its country members, involving different organizational actors with different interests (see Table 1). First, a pool is administered and coordinated by a risk pool organization, which we term the Network Administration Organization (NAO) (Provan & Kenis, 2008): “a dedicated organization responsible for coordinating the network or at least supporting such processes” (DeFillippi & Sydow, 2016: 7). The NAO cannot compel other organizations’ participation in the pool and operates primarily by coordinating interactions amongst other actors, as opposed to being a formal authority. Second, the governments of the low-income countries in a region are potential or active members of the pool. Third, international development actors, such as development banks (e.g. World Bank) and donor countries, provide technical, financial, and operational assistance to establish and support these pools. Fourth, disaster liquidity insurance products for country

members are purchased from global reinsurance market organizations, including reinsurers who provide the capital, and modelers and brokers who provide support functions. These market actors support the process by clarifying the risk, working out how to trade it, and supporting product development.

Insert Table 1 about here

Pools are made up of different country members in different regions. While each pool currently in existence is administered by their own specific NAO, they all have a structure similar to the one illustrated in Figure 1 and are supported by some of the same global development and reinsurance organizations. All interorganizational actors were important and are included in our understanding of the system, however, in this paper, we foreground the interactions between the NAO (with support from development and market organizations) and the member countries. These interactions are critical for understanding the dynamics of equilibrium in interorganizational contexts, as the pool's viability depends on countries remaining members and continuing to buy disaster liquidity products during each annual renewal cycle.

Insert Figure 1 about here

Data Collection

We followed the processes of providing disaster liquidity insurance via pools across multiple sites globally (Jarzabkowski, Bednarek, & Cabantous, 2015; Marcus, 1995). In such studies, the patterned processes or practices across the interorganizational domain constitute the 'case', focusing on the "set of interdependencies which link various stakeholders" (Gray, 1985: 911). We, therefore, studied the three main pools currently in existence as the focal interorganizational system, following the disaster response solution as it manifested across multiple sites, shaped by the interactions between the NAO and other key country and development actors. Data was

collected from 2016 to 2020, covering participants in Latin America, the Caribbean, Africa, the South Pacific, U.K., Europe, and the USA. To enable this global breath, all authors were immersed in the field. Fieldwork was both retrospective, as we collected data on processes and incidents that preceded 2016, and real-time as the pools kept evolving during the four years of data collection.

We triangulated our qualitative data across a range of actors and sources (Lincoln & Guba, 1985). First, we collected 135 audiotaped and transcribed interviews with 160 individuals that represented all the relevant types of actors in the interorganizational system. These included 34 interviews across three NAOs; 21 interviews with low-income countries (ministers, senior government officials, and country development liaison officials); 41 interviews with development actors (development banks and donor countries, particularly those who were the key country and NAO contacts); and 39 interviews with market actors working on products for, and providing capital to, the pools (reinsurers, brokers and modelers). Second, we conducted observations of interactions at 31 field-configuring events (Hardy & Maguire, 2010), such as conferences, workshops, and meetings about the solution. For example, we observed the NAOs and country members interacting at an international conference hosted by a development actor; sat in on closed conference sessions for specific regional groups; and observed country ministers giving keynote conference speeches about the effects of the pools in their countries. Each of these observations lasted from an hour to 3-days. We audio-taped and took rich fieldnotes of these observations, with time markers that enabled us to revisit specific sections of the audio-recording. We also attended and had informal meetings during a World Bank and Donor countries' disaster risk financing course for 35 government officials from 24 different countries, on which we wrote up on fieldnotes, including notes on informal interactions. Third, we collected 285 documents on specific local and global aspects of the solution, such as development reports, country reports, annual

reports, and communications from the three pools and their country members. These documents enabled us to assemble detailed histories of the pools, check and confirm facts, inform our observations, and validate the retrospective aspects of our interview data.

Data Analysis

Our analysis evolved in stages involving memos, team discussion, detailed chronologies (Langley, 1999), writing thick descriptions (Geertz, 2008), and in-depth NVivo coding to surface themes (Miles & Huberman, 1994).

Step 1: Detailed chronologies and thick descriptions. We first developed detailed chronologies of the pools. Using excel, we made extensive maps, including: all relevant disasters; all payouts made to countries; countries joining and leaving at each annual renewal; new initiatives or adaptations to existing initiatives, such as to products or training programs; new actors joining the system; and outcomes or issues arising from initiatives or events. This mapping gave us a solid grounding in the facts, which we then used as the basis for writing thick chronological descriptions of the pools. We often returned to both the thick descriptions and the excel tables as we conducted the following analyses.

Step 2: Paradoxes and paradox knot. We were alerted to paradoxical tensions within our data based on the analytic memos that each co-author made while in the field, which we shared and discussed. This inductive foundation for positioning our work in the paradox literature was further consolidated as the thick descriptions that we wrote were rich with tension. As we iterated with the paradox literature (Lewis, 2000; Smith & Lewis, 2011), our theoretical framing was confirmed. Using open coding in NVivo, we then identified the tensions. We had global insights into the paradoxes across our data that were not shared by all participants, as most were focused on their specific interests. Thus, we followed an emic approach, where we interpreted the

paradoxes as we looked across our data to understand the various tensions. This was complemented by an etic approach as many participants also referred to the tensions they experienced (Andriopoulos & Gotsi, 2017). Our analysis surfaced three main paradoxes that we labeled: *short- vs. long-term* (e.g. Slawinski & Bansal, 2015), *part vs. whole* (Poole & Van de Ven, 1989), and *market vs. development*, which is similar to the market vs. social paradox (e.g. Smith & Besharov, 2019). Next, we explored how the three paradoxes unfolded, which showed us that they were neither sequentially related nor segmented. Rather, they were entangled, and could neither be separated nor responded to in isolation. This prompted another iteration with theory which led us to identify these entanglements as *paradox knots* (Sheep et al., 2017), which then comprised the core focus for our ongoing analysis.

Step 3. Critical incidents and the iterative cycle within our data. We explored these paradoxes in different ways, in conjunction with our chronologies from Step 1. For instance, we segmented the data into ‘cases’ of pools (Eisenhardt, 1989). We also segmented the data chronologically into different phases as pools evolved over the years (Langley, 1999). Yet chronological and case segmentation did not offer any explanatory variation. Rather, we found a consistent and iterative cycle associated with change in how the paradox knot manifested across the entire dataset. Within this cycle, there were routine periods where the paradoxes appeared largely in balance and were knotted together. These periods were, however, interrupted by ‘critical incidents’, which we identified as points where tensions were exacerbated (Andriopoulos & Gotsi, 2017). These critical incidents took two main forms empirically, albeit with the same effects. First, annually at each product renewal when member countries can decide to leave the pool. Second, disasters that exacerbate tensions as different actors’ interests are not met, which also can lead to them deciding to leave the pool. Drawing upon dynamic equilibrium (Smith & Lewis, 2011), we

identified the routine periods where the paradoxes were balanced in a knot as periods of equilibrium, and critical incidents where the paradoxes were neither balanced nor connected to one another as periods of disequilibrium (Schad et al., 2016). We conceptualized this as an iterative cycle between equilibrium and disequilibrium.

We wrote additional thick descriptions (Geertz, 2008) of this interactive cycle, starting with descriptions of the critical incidents. Then we moved backwards and forwards in time, returning to our chronologies and thick descriptions from Step 1 to describe the process leading up to and then responding to those incidents. For instance, we looked at a critical incident of a major hurricane that resulted in dissatisfaction by countries about their payouts, then traced backwards to what those countries had purchased prior to the hurricane, and what happened to restore their confidence after the hurricane. This gave us a corpus of detailed descriptions of the process of going from the relatively routine periods of equilibrium, to the unbalancing critical incidents leading to disequilibrium, and then the process involved in restoring equilibrium.

We then analyzed these thick descriptions, which gave us key insights into how disequilibrium ensues during critical incidents. Specifically, all our critical incidents were associated with two poles from two different paradoxes becoming simultaneously salient and strongly entwined with one another. Namely, the short-term and part poles became the focus for actors, while the corresponding long and whole poles were neglected. We termed this heightened salience and entwining as short-term and part ‘clustering’. We found that clustering of specific poles generated imbalance in their respective paradoxes, leading to the paradox knot becoming unraveled and generating disequilibrium that jeopardized the viability of the interorganizational system as actors threatened to leave. Theoretically, therefore, we conceptualized paradox knot

unravelling, arising from the clustering of poles from different paradoxes, as a key dynamic in generating disequilibrium within an interorganizational system.

Step 4. Coding interactions. We delved deeper into this iterative cycle to understand *how* the paradoxes were knotted during routine periods (equilibrium), and *how* knotting was reestablished after the above clustering of poles generated unravelling (disequilibrium). We identified specific interactions between interorganizational actors that knotted the paradoxes together. Our focus was validated by others who have studied the social interactions through which distributed organizational actors arrive at collective action (e.g. Gray, Purdy, & Ansari, 2015; Jarzabkowski et al., 2015; Reinecke & Ansari, 2020). Such interactions incorporate a range of activities from direct interactions such as private and public meetings, letters, and emails, to indirect interactions, such as media communications. Our main criterion in identifying these interactions as relevant for our study is that they were purposefully targeted at consolidating the ongoing viability of the risk pool. While primarily coordinated by the NAO, such interactions involved multi-party interplay, negotiations and agreements. First, we generated a list of specific interactions, such as ‘agreeing drought product’ and ‘providing scholarships for a course on disaster reduction’. We then grouped these into 10 broader interactions, such as ‘collaborating across stakeholders’ and ‘agreeing to develop new elements to the solution’ (Miles & Huberman, 1994) (see Table 2, first- and second-order codes).

Insert Table 2 about here

Step 5: Interpreting the interactions. We then undertook a deeper thematic analysis of how the 10 interactions worked in knotting the paradoxes together. We found that they fell into two broad categories based on whether they were knotting paradoxes to maintain equilibrium or reknitting paradoxes to restore equilibrium following a lapse into disequilibrium caused by the

unravelling of the knots during a critical incident. In Table 2 we display the set of 10 interactions, grouped according to this thematic coding of their role in knotting or reknitting paradoxes.

First, we found that four interactions (Table 2, A1-A4) were involved in the ongoing knotting of paradoxes, which we defined as generating a mutually reinforcing cycle of balance across the three paradoxes. Our thematic analysis showed that this ongoing paradox knotting was oriented towards maintaining equilibrium in the face of an ever-present threat of disequilibrium. Second, we explored the interactions that took place, with great urgency, after a critical incident generated the unraveling of the paradox knot and a lapse into disequilibrium. We found that the various interactions served different purposes. Three interactions (Table 2, B1-3) were focused on knotting the market pole specifically to the clustered short-term and part poles. Three other interactions (Table 2, C1-3) were focused on knotting the development pole specifically to the clustered short-term and part poles. We, therefore, considered these six interactions as conceptually distinct from the ongoing knotting of balance across paradoxes that we had already identified because they knotted specific poles across paradoxes as a response to knot unravelling. We labeled their role as reknitting paradoxes, which we define as binding the specific pole of one paradox to the specific pole of another paradox in response to the paradox knot unravelling due to imbalance within the respective paradoxes. Having found the specific reknitting effects of these interactions, we then interrogated our data further to examine the wider implications of reknitting for the relationship between the three paradoxes. We found indirect effects, in which reknitting of the specific market and development poles to the short-term and part poles also indirectly restored balance in their respective temporal and part-whole paradoxes and ultimately across the paradox knot. This led us to a more complete picture of how interactions of reknitting paradoxes ultimately restore the mutually reinforcing balance within and across paradoxes, thus reinstating equilibrium.

Step 6: Implications of knotting and reknitting. Finally, we explored the implications of this iterative cycle of knotting and reknitting. First, we saw that reknitting interactions respond to gaps and problems in the pool that the critical incidents have exposed. These responses eventually refine the solution, in turn increasing its impact and relevance to the participants. Second, reknitting also leads to initiatives being carried forward from the period of the critical incident into more routine interactions, becoming an integral part of the pool. Thus, in our final interpretive leap (Langley, 1999), we saw the iterative cycling between equilibrium and disequilibrium as strengthening the solution at the heart of this interorganizational system.

Analytical quality. We ensured the rigor of this analysis in several ways. First, engaging closely with and getting feedback from our participants. For instance, we developed an industry report and presented at industry events in order to validate our understandings with participants (Lincoln & Guba, 1985). Second, as a team we played devil's advocate in pushing each other to justify ideas, themes and theorization, and engaging in constant team discussion and sharing of memos. Third, we involved a research assistant in the coding process who did not know the context, did not collect the data, and was not a paradox theorist. He worked closely with the team to undertake some of the NVivo coding, particularly in relation to the paradoxes and interactions, and more generally acted as an outsider to both the coding and our theorizing. Fourth, we utilized multiple data sources and engaged in several analytical steps, including during data collection. Finally, going back to the field after our initial analysis gave us a chance to 'test' our emerging patterns to see if they held across our dataset and whether alternative patterns or explanations were at play (Yin, 2017). Thus, ongoing data collection deepened our insights and confirmed and strengthened the emerging pattern.

FINDINGS

Our findings are in three parts. First, we explain how actors maintain equilibrium across multiple paradoxes in the face of the constant threat of disequilibrium. We show that this is achieved through ongoing paradox knotting interactions that generate a mutually reinforcing balance of poles within and across paradoxes. Second, we show the interactions through which actors engage in paradox reknitting to respond to disequilibrium when the knot unravels. Third, we explain how iterating between knotting to maintain equilibrium, and reknitting to respond to disequilibrium strengthens the solution over time.

Section 1: Knotting Paradoxes to Maintain Equilibrium

We briefly explain the need for balance in each paradox before showing how the three are knotted via interactions and the implications of this paradox knotting for maintaining equilibrium despite the continuous threat of disequilibrium.

Balance within each paradox. First, balance in the market-development paradox is central to the survival of the pool. Disaster liquidity products need to be viable in a global market, whilst also addressing low-income countries' and their development sponsors' goals of using these products to alleviate suffering in the aftermath of disaster. As a development actor explained: "It needs to be appealing to the businessman's [sic] interests around a sustainable profit motive, vis-à-vis government's role to see to the rights and protection of its citizens" (Development, Int). Hence, there are tensions in balancing the market viability of the pool with its development purpose.

Second, there is a part-whole paradox in ensuring the 'wholeness' of a multi-country risk pool through the participation of enough member countries (parts) to ensure a sufficiently diversified pool of risk. While risk pooling is dependent upon this whole, countries may leave the

pool if they consider that participating is not sufficiently in their individual country's interests, as explained by a government actor:

I sat in a room with all the experts and they're all saying positive things and I was thinking if these big countries come into this space [join pool], what happens to me, I'm small? [...] what happens to the capital base and the insurance products if a big customer like [Country A or Country B] comes into this space, how is going to impact me? Because if it's not going to provide the level of service I want, then ... (Country, Int)

While the individual needs of the different countries need to be met to ensure the wholeness of the pool, all interests of all members cannot be met simultaneously. There is, thus, an ongoing tension between the interests of the parts and the viability of the whole.

Third, there is a temporal paradox. Large-scale disasters, for example a Category 5 hurricane, have a low probability of occurrence. Yet, when they occur, losses may exceed a country's entire GDP, setting it back financially for decades. The infrequent nature of large-scale disasters and their dire economic consequences thus necessitate a long-term approach to disaster financing. Such long-term disaster cycles contrast with politicians' interests in prioritizing shorter-term investments that align with short-term election cycles: "The value proposition has to be very strong for a Minister to agree to spend every year something where the return on their premium may be by definition zero for every year when there is no disaster, which again is a very difficult political thing" (Market, Int). Hence, balance needs to be maintained between empowering country ministers to buy insurance for long-term disaster protection and their tendency to prioritize other short-term interests and thus not always renew a product at the annual renewal date.

Insert Figure 2 about here

These three paradoxes cannot be balanced in isolation. Rather, continuous interactions to knot the three individually-balanced paradoxes maintain the viability of the pool (see Figure 2).

The equilibrium achieved through knotting the paradoxes to ensure the ongoing viability of the pool can never be taken for granted. The annual renewal means that countries can easily leave, causing the entire pool to fall apart because the pool contains “a limited number of members, so your portfolio is extremely sensitive to countries moving in or out or changing their coverage” (Development Int). We found that paradox knotting is generated through a set of continuous interactions between the NAO and the country members, underpinned by background interactions with market, development and regional actors.

Paradox Knotting to maintain equilibrium across the paradoxes. We found four interactions involved in paradox knotting (see Table 2, A): Training on the interorganizational solution (A1); Reviewing and refining elements of the existing solution (A2); Collaborating across stakeholders (A3); and Communicating the solution (A4). We now explain how continuous knotting constructed a mutually reinforcing cycle across the three balanced paradoxes through an example of one of these types of interactions, *training on the interorganizational solution* (A1), which involved ongoing efforts to strengthen knowledge about and use of disaster risk planning. Further representative examples of both this type of interaction and the other three paradox knotting interactions are included in Table 3.

Insert Table 3 about here

To use the market-based solution to address their development goals (market-development balance), countries need to develop technical skills in disaster risk planning and management. As ministers and civil servants often lack depth in such skills, it is challenging for the NAO and development actors “to show the value of investing in preparedness and disaster risk reduction and risk finance, which is the whole point [...] to be able to get on to a sustainable pathway where countries will own this and will invest in this” (Development, Int).

Without these skills, an individual country (part) may not understand how the pool (whole) and its products (market) benefits its disaster response (development). This can mean that potential members do not join, and existing members leave the pool, threatening its part-whole balance. This threat is exacerbated by the short-term political interests accompanying an election or a change in government ministers. For example, newly appointed ministers who do not understand how the pool meets their country's interests can reverse existing policies, so affecting the long-term nature of the pool (temporal balance): "What's really challenging is that every time there's a change in government, in a senior person, that can put everything in question [...] you have a new Minister of Finance and [...] it's very complicated because they don't really understand; it takes some time to educate everyone to the product" (NAO, Int).

Mindful of this threat to the viability of the risk pool, at a routine stakeholder meeting, the NAO, development actors, and country members of a pool were considering ways to enhance countries' technical and financial skills. They decided to pilot a training initiative in one country administered by the NAO and funded by the development actors. As a civil servant explained, his country was eager to pilot the training to improve their disaster planning capabilities and better understand how to use the market products to support their disaster responses:

Many times, when we have a disaster, we rely on our own expertise ... But if we go through the [training] process we would have got some skills, we would have acquired some new information, we would have acquired some technical know-how to be able to, you know, act independently without being directed or dictated by others. So that is why we are going to follow it, not only because we want to transfer risk [using market products], but we also want to build the capacity of the government [to make decisions about disaster management for that country vis-à-vis its development goals]. (Country, Int)

Participants in the training pilot found it very helpful. First, it enabled them to evaluate their disaster response needs (development) and understand how membership in the risk pool

(whole) could support their financial response to such disasters (market). As one participant reflected: “The more training you have, the better you can apply this [...] Very, very helpful, now I can leverage all these skills and the expert knowledge that are developed from [the Pool training] and apply it in my day-to-day work in terms of disaster planning [...] and eventually that leads to the financial process” (Country, Int). It also widened understanding, as training included multiple departments across the civil service: “In a training session we have 30 people. So, you broaden the scope of understanding [about disaster response] across the government. So, you would have, for example, even agriculture, coming to the table in the training program” (NAO, Int).

Second, through their enhanced understanding of the market-development poles, civil servants could support government ministers in making decisions about their country-specific disaster risk management needs (part) and how these needs could be met through membership in the risk pool (whole). This helped surmount those ministers’ often short-term interests in deploying scarce budgets away from the annual renewal by explaining pool membership as a means of addressing the country’s long-term needs for a stable flow of disaster funding (balance in the temporal paradox). For example, a civil servant explained how they drew upon the technical expertise from the training program to influence their Finance Minister’s decision to renew the product: “When we went to sign off on the [Pool] insurance policy, the Minister for Finance would say he was not willing to sign off on the policy due to monetary constraints [short-term interests]. But I realized that he does not understand [...] parametric insurance [the market product]. So, I required technical expertise in order to address the Minister ... So, I asked for a meeting between myself, the Minister, my manager, and a member of my team”. The civil servant explains how they delivered a presentation to the Minister “to convince him” about how the market product worked to address their disaster management needs as a country [part knotted to market-

development] and why it was, therefore, a sound use of their annual budget [short-term] to remain in the pool [whole]. “And at the end of the day he said: ‘Oh yes, OK, I’m now seeing the difference, OK, bring the policy, I will sign’”. Reflecting in a satisfied way on his use of the training, he noted “Sometimes you require ... your technical expertise to be able to deal with a particular Ministry and ... you know, understanding the political context [for Ministerial decisions]” (Country, Int).

Thus, training provided an understanding of precisely how the market solution was meeting a country’s short- and long-term development interests. This increased countries’ commitment to the whole pool and the likelihood of renewing their policy each year, contributing to the long-term survival of the pool. Building from this pilot, the training scheme was formalized and rolled out across all members of the pool as an ongoing regional education program. Training became part of the continuous interactions that were critical in consolidating the pool as a means for member countries to use this market mechanism to finance their individual development goals. They better understood those goals as bound to the longer-term stability of the regional disaster response. As the CEO of the NAO reflected during one of the regular stakeholder meetings, the regional training program was central in embedding these multiple complex aspects of the pool: “You see we have become a whole community of stakeholders. It is not just an insurance company, providing insurance to clients. It is a lot more than this” (Obs).

The ongoing training scheme interactions are, therefore, one example of the various interactions (see Table 3) that facilitated knotting the paradoxes together in a mutually reinforcing way. Such knotting helped maintain equilibrium, increasing the viability of the pool in the context of an ongoing threat of potential disequilibrium.

Section 2: Reknotting to Recover from Disequilibrium

Despite these continuous efforts to maintain equilibrium, disequilibrium ensues whenever a critical incident occurs, such as a disaster within a region or at the annual renewals, at which members threaten to leave the pool. Critical incidents cause imbalance within and unravelling between the paradoxes that threaten the pool's viability, necessitating urgent interactions to reknit the paradoxes. We present a critical incident that challenges the stability of the pool to explain our two key findings. First, we unpack how, during this critical incident, the three paradoxes become imbalanced. Specifically, disequilibrium ensues when two of the poles of different paradoxes cluster together, generating an imbalance in their respective paradoxes and causing the wider paradox knot to unravel. Second, we show how interactions between the interorganizational actors, primarily the NAO and the member countries, to respond to disequilibrium reknit specific poles across the different paradoxes. Reknitting specific poles indirectly reestablishes balance within the respective paradoxes, so restoring equilibrium.

Paradoxes unraveling. In 20[XX], Hurricane Harper¹ swept through the region covered by the pool, causing several countries significant damage. Country A suffered a lot of damage to infrastructure and devastating loss of lives. Their product paid, rapidly providing several million USD. Yet, Country B, where the effects of the hurricane appeared less severe, received a higher payout and three other countries, which had also been severely affected by the hurricane, received no payout. For instance, Country C experienced losses with damages to the road network and other public infrastructure but no insurance payout: “There was some damage, but the policy didn’t trigger” (NAO, Int). This was all contractually aligned with the levels of protection each country had bought and the corresponding premiums they had paid. The varied payouts were therefore reassuring that the market nature of the pool was working: “It gave confidence to the market that

¹ Year and name of hurricane disguised to preserve anonymity of the pool and the countries.

this was a solid facility and that it wouldn't be triggered [outside the modeled projections]" (Market, Int).

However, the fact that payouts varied across countries caused consternation to pool members: "But the losses in [Country B] were not as devastating as what was seen in [Country A]. So, there was this discrepancy, people trying to understand how can you pay out more for a government like [Country B]?" (Development, Int). In response, individual countries prioritized their (part) needs for immediate post-disaster (short-term) payouts, causing a clustering of the short-term and partial interests of these countries. For example, the Finance Minister emphasized the short-term, partial interests of Country C, expressing doubts about paying premiums to the pool because they had not received a payout: "the Minister of Finance, who had been the champion for this, was up for re-election two weeks later. So, it was like the perfect storm ... because it didn't trigger and, so, we really had to handle that politically" (NAO, Int). Country C privileged their partial, short-term political interests by threatening to leave, which would demonstrate to their voters that they were in control of national budgets. As one Minister explained: "The moment [countries] buy it, they expect to get the payout. If they don't receive the payout after a disaster, they think that they have made a loss, it would have been better if they had invested that premium in other sectors" (Country, Int). This clustering of short-term and partial country interests resulted in the dominance of those poles and imbalance within their respective temporal and part-whole paradoxes.

This also generated imbalance in and unravelling from the market-development paradox. Specifically, due to their emphasis on short-term partial interests, countries saw the variation in payouts as a failure to deliver on their development needs, so unraveling the knot to the market-development paradox. Countries questioned the purpose of putting scarce resources into a market

solution that might not cover their development needs: “You’re bleeding money to pay for these products which you don’t see how they are addressing any of your vulnerability needs [...] So where is it going?” (Country, Int). Thus, the imbalance arising from some members’ focus on their short-term part interests further unbalanced the development-market paradox by discrediting the market solution as a means of addressing development goals. Hence, part-short clustering of the poles of two different paradoxes leads to disequilibrium as imbalance prevails across all three paradoxes and their prior knotting unravels (see Table 4 for further clustering examples).

Paradox Reknotting: Interactions to respond to disequilibrium. We found two broad types of interactions that enabled paradox reknotting in response to such disequilibrium. First, those involved in reknotting the market pole to countries’ part and short-term interests (Table 2, B) through interactions such as running different scenarios, such as modelled disaster scenarios (B1), agreeing to develop new elements to the solution, such as new products (B2), and expanding the solution’s appeal to new interorganizational actors, such as new countries (B3). Second, reknotting the development pole to countries’ part and short-term interests (Table 2, C) through interactions such as funding interorganizational actors’ individual projects, such as specific disaster risk management projects (C1), working around the solution’s conditions to provide benefits, such as issuing payouts to countries even when the products did not trigger (C2), and supporting interorganizational actors’ membership in the solution, such as financing countries’ premiums with donor funds (C3). Importantly, these interactions do not attempt to re-establish balance by asserting the neglected pole within the unbalanced paradoxes; that is, neither directly reinstating the whole nor the long-term element of those respective paradoxes. Rather, reknotting prioritized the short and part poles even further in an effort to address individual countries' specific and immediate needs.

We found all six of these reknitting interactions across different critical incidents. While at least one interaction for reknitting the market pole and the development pole to the short-term and part poles occurred in all critical incidents, not all six interactions unfolded in response to every critical incident. We now present the vignette of Hurricane Harper to illustrate two of these reknitting: specifically, running different scenarios after a disaster (Table 2, B1) and funding countries' individual disaster risk management projects (Table 2, C1). While we present these interactions separately, in practice they are entwined and simultaneous. Further representative examples of the full range of interactions on additional critical incidents are presented in Table 4.

Insert Table 4 about here

Running different scenarios (B1). Disequilibrium had ensued, endangering the pool's viability as countries that received smaller or no payouts threatened to leave (Development, Doc). Urgent action was needed. In response, the NAO, supported by the development sponsors, interacted with the country members in reknitting the paradoxes.

The NAO held urgent meetings with those countries with unmet expectations. Instead of emphasizing the long-term and whole elements of the pool, interactions revolved around addressing the short-term part interests of the countries. The NAO worked with them on modeling different scenarios (B1) of Hurricane Harper's effects in their country to re-assess what their actual part needs were, post-disaster, and discuss the types of actions that they could take to address those needs: "We have a discussion with each of our [country] members and we have a variety of options" (NAO, Int). These interactions exposed gaps in country members' understanding of how disaster insurance worked, specifically that their payouts are dependent not only on loss levels but also on the cover each country has decided to buy and thus the premium paid. Interactions over the modeled scenarios bolstered understanding of what countries could expect from the products

they had purchased in relation to the disaster they had actually experienced, and also gave them a basis for understanding their payouts relative to others in the pool. In doing so, they went some way towards restoring countries' confidence in and understanding of the market element of the pool.

For example, the modeled scenarios run with the government in Country C showed that they could refine their approach to risk planning to better meet their part-needs. Their existing approach had led Country C to purchase a product at a low cost that would only trigger under a very severe hurricane: "Unfortunately, the policy was not triggered but there was a reason for that. The government had actually selected a [level of product suitable only for very extreme disaster] with a lower premium" (NAO, Int). Prior to Harper, Country C felt such a remote trigger reflected their individual interests in the pool, as they had not wanted to pay a higher premium. However, in discussing the modeled scenarios in light of the actual damage they sustained after Hurricane Harper, they could see how they could have received a higher payout from the pool had they chosen a higher cover with, respectively, a higher premium - which they had considered but then discarded. After modeling these different scenarios "they understood that had they purchased that policy, they would have gotten what would have been the biggest payout from the [Pool]" (NAO Int). These modeled scenarios showed Country C government officials that their prior part interests in saving cash led to lower cover that had not served their current (short-term) part interests in getting a payout. However, after discussing the scenarios they were able to better meet their part-interests by adjusting their purchase at the next annual renewal (short-term).

Other countries that had not received a payout were also able to re-evaluate their outcomes. Considering the modeled scenarios, they realized that the effects of Harper had been relatively modest and within their immediate national budgets for disaster response. They thus understood

that their current approach met their part interests in not paying higher premiums. They also drew reassurance about the viability of the pool for their partial needs from scenario analyses that showed them what they would have been paid had Harper caused more damage in their countries. The increased understanding gained by running modeled scenarios also enabled countries to address any gap in their desired cover at the next renewal (short-term) to better meet their specific part interests in disaster response. Such immediate post-disaster interactions, thus, reknotted the market elements of the pool to these countries' specific part and short-term needs for a financial response to disaster. These reknotted interactions circumvented their initial short-term intention to withdraw from the pool:

The discussions we had after Hurricane [Harper] also made countries realize that a lot of them are underinsured. As a matter of fact, since the last event, a number of countries have actually increased their coverage. So, for example, [Country C] and [Country A] increased the amount of risk that they cover, so they can actually get a bigger payout. Well, I think [Country C] went up maybe more like closer to fifteen percent, you know. [Country A] also increased theirs as well, you know, around five/ten percent (NAO, Int).

Hence, some countries decided to stay in the pool next renewal, and to continue to buy the same amount of cover because it met their needs, while others decided to not only renew their annual policy but increase their cover.

Funding interorganizational actors' individual projects (C1). The knotting of the market pole to part and short-term interests did not happen in isolation. The NAO and the countries simultaneously interacted in knotting countries' development needs to their short-term and part interests. One way of interacting involved discovering and funding specific disaster risk management projects (Table 2, C1). Linked to the disaster scenarios modeled in B1 above, the NAO worked with the countries to uncover how, specifically, the disaster had affected them, such as through damage to particular infrastructure. In discovering problems that might make some

countries more prone to extreme losses and so, make the pool less effective for those countries, they were also able to identify immediate disaster risk management projects (C1) to make those countries more resilient. Based on this, development actors agreed to the NAO's use of some of the pool's operating capital, which they had sponsored, to fund these projects for countries whose expectations of the pool had not been met. Funding pressing infrastructure improvements was a way to meet, rapidly, the specific development needs of those countries, reknitting the development pole with the part-short poles. For example, these interactions identified key infrastructure development needs in Country A and Country C that were exposed by the hurricane: "Based on what we've done, this is an area we reckon as being a priority and looking at establishing some sort of resilience" (Development, Int). To meet these development needs in the short-term they agreed to fund the resilient reconstruction of a pivotal seawall in Country C: "[Country C], we assisted with building a seawall to increase resilience of surrounding communities and coastal areas, through a grant" (NAO, Int).

Similar grants for specific disaster risk management projects were also provided to two more countries after Hurricane Harper that year. Projects included the restoration of childcare facilities, flooded arable lands, and coastal defenses to support future disaster resilience for member countries that had been severely affected but had received no payout (NAO, Doc):

The grants were a response to the issue of you have events, they don't pay out, how am I benefitting. How do you make the solution more responsive? ... We are confronted with the reality that there needs to be a strengthening of the dialogue that's taking place in countries around development, but it was also very pragmatic about how do we demonstrate value to governments who are saying 'I'm paying all this premium, I have events, nothing happens'. Yes, I know that it's not supposed to trigger but how do we explain and justify this, right. (Development, Int)

These interactions thus met post-disaster (short-term) development needs for each country (part),

without jeopardizing the market pole since the projects were not funded through the insurance products.

Implications of reknitting paradoxes for restoring equilibrium. Interactions reknit the market and development poles to part and short-term interests in response to disequilibrium. They do so by directly addressing the clustered and dominant part and short poles rather than seeking to rebalance their respective paradoxes via shifting attention to their neglected poles. However, reknitting the market and development poles, individually, to these part and short-term interests also generates an indirect link with the whole and long-term poles that rebalances the respective paradoxes and so, the market-development paradox. Running the scenarios enabled better technical and financial understanding of how the market part of the solution met the countries' individual (part) needs, resulting in countries renewing their annual policy and even increasing their cover, so recommitting to the whole; in turn, this rebalanced the part-whole paradox and also enabled the fragile longer-term nature of the pool to be maintained at least for the next renewal. Similarly, funding the projects met the development needs of the individual countries in the short-term through delivering an immediate benefit from their pool membership in the form of better infrastructure. Indirectly this generated balance with the long-term goals of improving the financial response to disaster in the region, as these countries were now more robust to such disaster and also, more inclined to buy cover against future disasters. In short, interacting around the clustered part and short-term poles to reknit them to the market pole and the development pole ensured that partial and short-term interests were met sufficiently. This regenerated balance in the part-whole and the temporal paradoxes because, as the part short-term interests were addressed, membership of the whole as part of the market solution was seen as a way to achieve countries' development goals over the long-term. Interactions between the NAO and member countries thus reknitted the

paradoxes, ultimately restoring the mutually reinforcing balance of the paradox knot and restoring equilibrium.

Section 3: Iterating between Equilibrium and Disequilibrium Strengthens the Solution

The iterative cycles of knotting across balanced paradoxes to maintain equilibrium and reknitting across poles to respond to disequilibrium strengthens the solution over time. By strengthening, we mean that the market-development elements of the pool are refined and further embedded within countries and across a regional risk pool. We now explain paradox knotting and reknitting as the underpinning dynamics within which the solution is strengthened.

Critical incidents expose gaps and reknitting motivates refinement. Critical incidents expose gaps or problems in the pool and, through reknitting, prompt initiatives that address them, strengthening the pool. For example, in Section 2 we showed how Hurricane Harper exposed gaps in countries' understandings of how the products they purchased related to their risk profiles and identified problems in their infrastructure that made them more prone to certain losses. Reknitting poles helped countries deepen knowledge of their disaster profiles in order to understand what type of financial protection they needed, and take physical measures such as resilient construction of infrastructure to reduce some disaster exposure. The initiatives proposed as part of specified reknitting thus refined the details of the solution in ways that strengthened it (see Table 4 for more examples of initiatives that strengthen the solution).

Implementing initiatives is embedded into paradox knotting to maintain equilibrium. Initiatives that strengthen the pool emerge through reknitting of poles following critical incidents. Yet, as the proposed initiatives take time to implement, they are carried forward beyond the period of disequilibrium, intertwining with and becoming part of the interactions that sustain the continuous knotting across balanced paradoxes through which equilibrium is maintained. For

example, running modeled scenarios (interaction B1) following a critical incident such as Hurricane Harper stimulates interactions aimed at increasing countries' technical training in disaster risk planning (interaction A1) as part of continuously knotting balanced paradoxes to maintain the equilibrium that has been restored. As one country reflected on the interplay between the scenarios initiated in response to a drought disaster in their region and their subsequent embedding of these scenarios within their training: "It has brought about some changes in our own thinking and the way we are going to do business in the future. We have had droughts in the past but ... [training in] the [Pool] contingency plan has now reinforced our thinking and our planning" (Country, Int). Our data shows that this training and other initiatives, such as collaborating across stakeholders in the wider region (Table 2, A3) to improve data for modeling risk, or reviewing and refining elements of the existing solution such as existing products (Table 2, A2) often arise from urgent responses to disequilibrium and then become part of the habitual, embedded interactions that knot paradoxes together in a mutually reinforcing way, so maintaining equilibrium.

Iteration between knotting and reknitting. The iteration between knotting across multiple paradoxes and knotting across poles is not always direct. Critical incidents often mean setbacks, changes in the financial position of countries, or expose new problems in the solution as country risk profiles change and extreme-weather poses unanticipated needs for disaster response. Nonetheless, over time these iterative cycles generate greater depth in the solution and the range of disaster responses it can offer its country members. We found specific refinements that strengthened the solution via this dynamic cycle of knotting and reknitting, including: development of new products, such as excess rainfall, drought, agricultural and fisheries products; improved and new models for evaluating and planning for different types of disaster risk; increased building of resilient infrastructure as a better foundation for disaster risk management; and,

improved data and data sharing across regions. The NAO of one pool reflected on their evolution in responding to disasters and developing new products, such as one for excess rainfall:

We're developing new products. Much of these new products that we developed are based on the needs of member governments, reinsurance, donors ... I mean the whole notion of excess rainfall came about as a result, it was sort of pushed by a Minister of Finance in [Country] [...] And based on that and based on other stakeholders echoing the same sentiments, that product was put on the table and we sought to build that product. Also, products could come from donors and we, so, basically, we've been looking at the needs of all stakeholders. Then we are always in a process of improving products and the models that underpin these products, that's why we're offering new options (NAO, Int).

We find that iteration between responding to disequilibrium and maintaining equilibrium is a productive cycle within which the interorganizational pool is strengthened over time. The underpinning dynamic of knotting across paradoxes and reknitting across poles makes the pool better at addressing the problem for which it was developed and, potentially, adapting as the needs it addresses also evolve. We, therefore, argue that these interactions are the underlying generative process mechanisms through which the fine line between equilibrium and disequilibrium is maintained in interorganizational systems, and which refines and strengthens the solutions that these systems were established to develop.

DISCUSSION

Drawing on our findings, we develop a process framework (see Figure 3). Our framework shows paradox knotting (Sheep et al., 2017) across multiple paradoxes and reknitting across specific poles as the central dynamic in maintaining equilibrium and responding to disequilibrium within interorganizational systems that are characterized by multiple paradoxes (De Rond & Bouchikhi, 2004; DeFillippi & Sydow, 2016; Ospina & Saz-Carranza, 2010).

Insert Figure 3 about here

First, our framework clarifies that paradox knotting is central to maintaining dynamic equilibrium in interorganizational systems. Actors within the system interact in a continuous effort to knot the multiple paradoxes together – market-development (Smith & Besharov, 2019), part-whole (Poole & Van de Ven, 1989), and temporal (Slawinski & Bansal, 2015) in our case – to maintain equilibrium. We show that equilibrium – the state wherein multiple paradoxes are balanced such that the interorganizational system is viable – is constructed via knotting of multiple paradoxes into mutually reinforcing balance. Such paradox knotting interactions are not singular or one-of, but, rather, as indicated by our label $A_{1...n}$ in Figure 3, involve continuous and cumulative interactions between the key actors in the system in order to counteract the ever-present threat of disequilibrium.

Second, critical incidents generate disequilibrium because they cause these paradox knots to unravel. Across our cases, the short and part poles pulled together (Figure 3, $B_{1...n}$). This tight clustering of poles from different paradoxes generates imbalance within their original paradoxes and, in doing so, leads to the unravelling of the knot between paradoxes, throwing the viability of the interorganizational system into question.

Third, as disequilibrium threatens the viability of the interorganizational system, the multi-country risk pool in our case, inter-organizational actors respond by interacting to reknot poles across paradoxes ($C_{1...n}$). Contrary to the rebalancing efforts found in cases with single paradoxes (e.g. Jarzabkowski et al., 2013; Smith & Besharov, 2019), these interactions do not attempt to reassert balance by focusing directly on the neglected pole within the unbalanced paradoxes. That is, they do not focus on reasserting the whole element or the long-term element of those respective paradoxes in our case. Rather, interactions focus on reknitting the specific poles of a third paradox to each of the clustered poles specifically. This specific reknitting across poles, addresses the

demands that led to their dominant and unbalancing effects, such that these poles cease to cluster at the expense of the wider paradox knot. As poles are reknotted across the multiple paradoxes, they indirectly regenerate balance within individual paradoxes (Bednarek, Chalkias, & Jarzabkowski, 2021) and restore the mutually reinforcing knotting of the three paradoxes. Disequilibrium, caused by clustering of separate poles from different paradoxes, is thus averted by reknitting poles across paradoxes.

Finally, we argue that knotting across paradoxes and reknitting across poles are a generative dynamic enabling a productive iteration (Smith & Besharov, 2019) between equilibrium and disequilibrium. There is an iterative cycle between knotting and reknitting, as the initiatives raised in reknitting to recover from disequilibrium ($C_{1...n}$) are carried forward and embedded into the continuous knotting involved in maintaining equilibrium ($A_{1...n}$), as per the feedback loop from C to A. This ongoing iteration of knotting and reknitting refines and strengthens the solution in order to avert the threat of disequilibrium (via knotting across paradoxes) and to respond when it does ensue (via reknitting across specific poles). For example, in our case, new products and new ways of funding countries' development projects were initiated during reknitting and embedded during knotting, so strengthening the essential premise of delivering a financial solution to a development problem. These ongoing iterations between knotting and reknitting in delivering a complex solution via an interorganizational system are an important dynamic that extends understanding of the generative interplay between equilibrium and disequilibrium and comprises the basis for our contributions.

CONTRIBUTIONS

Our process model explains iterations between knotting and reknitting as the generative dynamics for navigating between equilibrium and disequilibrium within interorganizational systems

(DeFillippi & Sydow, 2016; Huxham & Beech, 2003; Schad & Bansal, 2018). This model forms the basis for our contributions to paradox knotting (Sheep et al., 2017), responses to paradox (e.g. Jarzabkowski et al., 2013; Jay, 2013; Smith & Besharov, 2019), and the generative power of disequilibrium (Schad et al., 2016; Smith & Lewis, 2011) in the context of paradox multiplicity. The large-scale, complex development issue that we address – ensuring a rapid financial response to disaster in low-income countries – also allows us to contribute paradox theoretical understandings to the processes of addressing grand challenges (e.g. George et al., 2016).

Expanding Understanding of Paradox Knotting

We extend the concept of paradox knots (Sheep et al., 2017) by explaining the interactional process through which knotting takes place; and the role of paradox knotting in the complex dynamics of maintaining equilibrium and responding to disequilibrium. First, existing studies show that multiple paradoxes can become knotted and that these knots either amplify or attenuate tensions (Sheep et al., 2017). Yet, despite the fact that knotted tensions can either undermine or enable key processes (e.g. Andriopoulos & Lewis, 2009; Slawinski & Bansal, 2015), we have little understanding of how paradox knotting actually occurs (Cunha & Putnam, 2019; Putnam et al., 2016), beyond their discursive construction (e.g. Sheep et al., 2017). We, therefore, extend understanding of paradox knots from individual's discourses to the interactional realm (Gray et al., 2015; Jarzabkowski, 2005; Reinecke & Ansari, 2020) by showing how social interactions among actors within an interorganizational system knot multiple paradoxes together. Our process analysis goes beyond characterizations of paradox knots (Henriksen et al., 2021) and their impact on organizational outcomes (Sheep et al., 2017) to explaining the interactional dynamics of paradox knotting. In doing so, we further specify the definition of paradox knotting as the construction of mutually reinforcing relationships across multiple balanced paradoxes through

interactions between actors (Figure 3, A). Our findings thus extend process understandings of the attenuation of multiple paradoxical tensions (Andriopoulos & Lewis, 2009; Jarzabkowski et al., 2013; Lüscher & Lewis, 2008) by positioning paradox knotting as the generative dynamic for maintaining equilibrium across multiple paradoxes.

Second, we also add understanding of how paradox knots amplify tensions (Sheep et al., 2017) and give rise to disequilibrium through the clustering of paradoxical poles. Our findings show that paradox knots have a propensity for individual poles from one paradox (e.g. temporal) to cluster to the pole of a different paradox (e.g. part-whole) within the knot. We thus extend the concept of knotted paradoxical tensions to include the notion of clustering between individual poles as one explanatory element of imbalance across paradox knots. Specifically, we show that clustering of two different paradoxical poles, wherein they become dominant and closely intertwined, generates imbalance not only within their respective paradoxes (e.g. Slawinski & Bansal, 2015) but also unravels the knotting of the multiple paradoxes (Figure 3, B). This insight into how paradox knots unravel extends understanding of the processes through which tensions within multiple paradoxes are amplified and give rise to negative consequences (see also Jarzabkowski et al., 2013; Lüscher & Lewis, 2008; Sheep et al., 2017; Slawinski & Bansal, 2015). By highlighting clustering of different poles as a specific feature of entanglement among multiple paradoxes that leads to the unravelling of paradox knots, we are able, for the first time, to specify the dynamics through which tensions across multiple paradoxes are amplified and give rise to disequilibrium within and across multiple paradoxes.

Reknotting across Specific Poles as a Novel Response Strategy for Imbalance

In explaining reknotting across poles as the generative dynamic for responding to the disequilibrium generated when clustered poles cause paradox knots to unravel, our framework

offers novel insights on responses to disequilibrium in the context of multiple paradoxes. In our study achieving dynamic equilibrium does not involve paying attention to the suppressed pole in order to rebalance a paradox (e.g. Jarzabkowski et al., 2013; Jay, 2013; Smith, 2014; Smith & Besharov, 2019); oscillation back to the underemphasized pole (Smith, 2014; Smith & Besharov, 2019); or focusing on achieving synergies to transcend the imbalanced polarities (Bednarek, Paroutis, & Sillince, 2017; Clegg, Cunha, & Cunha, 2002). Contrary to these existing insights about attending to the suppressed pole, we show the critical dynamics of further emphasizing and addressing the clustered and dominating poles by reknitting those poles to the poles of yet a third paradox. This reknitting between the dominant poles and each pole of the third paradox, enables balance to be restored within that third paradox. Indirectly, this reknitting then restores balance in the original paradoxes as the demands of the clustered poles (e.g. part-whole and short-long) are addressed and their dominance subsides. We suggest that this seemingly contradictory response of further emphasizing the dominant pole works due to a complex dynamic within the context of multiple paradoxes where reknitting across the poles of different paradoxes enables mutual reinforcement. Consequently, we add reknitting as a fundamentally new dynamic, in the context of multiple paradoxes, to the long-studied (e.g. Poole & Van de Ven, 1989) question of how to respond to paradox.

Knotting and Reknitting as Generative Dynamics between Equilibrium and Disequilibrium

Our framework extends knowledge on the generative power of disequilibrium (Cunha & Putnam, 2019; Putnam et al., 2016; Williams et al., 2019) by placing paradox knotting and reknitting at the heart of maintaining equilibrium and responding to disequilibrium. First, we extend and clarify definitions of disequilibrium; moving beyond notions within paradox theory of disequilibrium as a generalized sense of chaos/disorder (Cunha & Putnam, 2019) and imbalance (Sheep et al., 2017)

to specifying the conditions of knot unravelling that lead to disequilibrium threatening the viability of the interorganizational system. Generally, within paradox theorizing, disequilibrium is implicitly inferred rather than actively defined or empirically explored (Cunha & Putnam, 2019; Putnam et al., 2016; Sheep et al., 2017). We demonstrate that in the context of the multiple paradoxes that characterize interorganizational systems (De Rond & Bouchikhi, 2004; DeFillippi & Sydow, 2016) disequilibrium has three specific characteristics. First, imbalance within individual paradoxes in the paradox knot, such as in our study the short-term and the part dominating at the expense of the long-term and the whole. Second, this imbalance causes unravelling across the paradox knot as the dominant (and in our case clustered) poles impede any mutually reinforcing knotting across multiple paradoxes. For example, in our case, the market-development paradox was no longer seen as reinforcing the short-term or partial interests of the member countries. Third, this imbalance and unravelling is associated with a specific form of chaos (Cunha & Putnam, 2019); a threat to the viability of the interorganizational system. For instance, in our case vital stakeholders questioned their on-going participation in the interorganizational system. We, therefore, provide a concrete, empirically-grounded characterization of disequilibrium that specifies analytically between how it plays out amongst multiple paradoxes and also connects that specification to the implications of disequilibrium for the interorganizational system.

Second, we conceptualize the iterations between knotting across paradoxes to maintain equilibrium and reknitting across specific poles to respond to disequilibrium as generative in ensuring the ongoing viability of interorganizational systems characterized by multiple paradoxes. This explanation extends existing considerations of disequilibrium as potentially destructive and to be avoided. Prior studies (Cunha & Putnam, 2019; Putnam et al., 2016; Sheep et al., 2017) have

called for research into how disequilibrium may provide novel options for addressing tensions (Williams et al., 2019). Our study responds by demonstrating the generative nature of working iteratively through disequilibrium and equilibrium. We show how continuous knotting to avert the persistent threat of disequilibrium, and reknitting to respond to lapses into disequilibrium enable gaps and problems within the focal interorganizational system to be exposed and addressed. The interactions involved in addressing these gaps and problems over time serve to strengthen the viability of the interorganizational system and evolve the purpose for which it was formed. Prior studies have painted the pursuit of equilibrium as a way to realize the positive features of paradox (Andriopoulos & Lewis, 2009; Bednarek et al., 2017; Smith, 2014) and avoid its negative and disequilibrating features, such as paralysis of change efforts (Jarzabkowski et al., 2013). However, our process framework shows that as disequilibrium intensifies so do the efforts to re-equilibrate and with them the opportunities to reinforce and adapt the mechanisms through which the interorganizational system remains viable in addressing and evolving its purpose. We, therefore, show that the ever-present threat of, and lapses into, disequilibrium provokes generative dynamics (Williams et al., 2019) that help to realize the positive features of paradox, such as strengthening the viability of the interorganizational system and enabling its evolution.

Paradoxical Dynamics of Grand Challenges

Finally, based on our empirical context, our framework contributes to the burgeoning literature on grand challenges (George et al., 2016), explaining how a solution to a grand challenge evolves and is strengthened through paradox (re)knotting. Our concepts of paradox knotting and reknitting explain how the interorganizational systems that are necessary to address grand challenges can work with the multiple paradoxes to which they are prone (Jarzabkowski et al., 2019) and maintain their viability in implementing an evolving solution over time. Interorganizational collaboration

in delivering business solutions with social impact (e.g. Williams et al., 2019), such as connecting wealthy retail markets with products from low-income communities to alleviate poverty (Nicholls & Huybrechts, 2016; Sharma & Bansal, 2017), are notoriously difficult to sustain as viable solutions to grand challenges (Ferraro et al., 2015). We contribute paradox knotting and reknitting as important generative dynamics through which such interorganizational collaborations can work through multiple paradoxical tensions (Sharma & Bansal, 2017; Slawinski & Bansal, 2015), using periods of disequilibrium productively in order to improve those solutions. Furthermore, by knotting and re-knotting paradoxes over time – rather than ignoring or seeking to dispel tension – the solutions to a grand challenge can gain traction and develop as both the interorganizational system and its purpose evolve.

CONCLUSIONS

Boundary Conditions and Limitations

This study has focused on paradox knotting within an interorganizational system seeking to ensure rapid capital flow to low-income countries during the crucial immediate post-disaster response phase. Our insights regarding paradox knotting provide grounds for research in other interorganizational systems characterized by multiple paradoxes. We studied multiple paradoxes within an explicitly distributed interorganizational context (DeFillippi & Sydow, 2016) in which participation is not compulsory (Huxham & Vangen, 2000). We expect that our findings on how paradox knotting and reknitting enable navigation of the boundary between equilibrium and disequilibrium will be relevant to similar contexts where actors' collaboration is motivated by whether participation in that system meets their shifting interests over time. In particular, future research might examine whether the specific clustering of short-term and partial interests that led to disequilibrium in our study is a feature of such interorganizational systems in which

organizational actors can choose to privilege their own immediate interests over those of the longer-term collective. As interorganizational systems are increasingly important in the pursuit of grand societal challenges, such as the Sustainable Development Goals (Schad & Bansal, 2018), or the World Business Council for Sustainable Development (Williams et al., 2019), we hope that our framework will provide useful grounds for research into how such systems evolve. By contrast, studies of paradoxes unfolding within interorganizational systems where more structures exist, for instance, networks around a central organization (e.g. Wilhelm & Sydow, 2018) or a smaller number of actors coalescing around specific projects (e.g. De Rond & Bouchikhi, 2004), or in supply chains (e.g. Schrage & Rasche, 2021) might result in different dynamics. As studies of paradox at the interorganizational level remain nascent, further studies of paradox knotting within varied types of interorganizational systems hold much promise to further the insights developed here. Finally, as multiple paradoxes are not limited to interorganizational contexts, future research might also explore the dynamics of paradox knotting and reknitting in organizational contexts. In particular, research might actively identify the co-presence of multiple paradoxes inside organizations, the organizational characteristics within which those paradoxes are entangled, and, importantly, the processual dynamics through which paradox knotting and reknitting shape organizational outcomes over time.

At the same time, our work has specific boundary conditions. First, we have provided a detailed longitudinal study based on intensive personal engagement with the phenomena, and this has allowed us to uncover interactions and dynamics that would have been otherwise difficult to access. Yet, this also means that we have been able to document the dynamics of paradox knotting and disequilibrium only over the relatively short period of our engagement. Further research might explore the paradoxical dynamics and paradox multiplicity of grand challenges historically over

long time periods (Andriopoulos & Gotsi, 2017). This could include insight into how interorganizational systems seeking to provide different solutions or adapt solutions to different local contexts inform one another; zooming out to look at the interactions between interorganizational systems in addressing grand challenges. Second, our fieldwork has enabled us to identify the iteration between equilibrium and disequilibrium and the resultant ongoing evolution of the solution. For instance, the development of new products that better meet the needs of member countries. Yet, not all such evolutionary paths might be so benign. Again, longer-term historical studies could provide further insight into how the dynamics we identify expand, shift, and even reverse (Cunha & Putnam, 2019), and when and how adaptation might become dysfunctional to the longer-term purpose. Conversely, it can also show what mechanisms and conditions can shape the evolving definition of a grand challenge or even how some grand challenges might become genuinely tractable (George et al., 2016). Finally, we examined a context with three specific and entangled market-development, part-whole, and temporal paradoxes. Future research might examine how variation in paradox multiplicity might shape the dynamics of paradox knotting and its relationship with (dis)equilibrium (Putnam et al., 2016).

Practical Implications

Large-scale disasters are increasingly prevalent (World Economic Forum, 2020), as witnessed during the timespan of writing this paper where catastrophic bushfires in Australia and California, devastating flooding in the UK and Australia, drought across much of Southern Africa, and a pandemic affecting the entire globe all occurred. Our study addresses an important problem for management scholars (George et al., 2016), with practical implications for the construction of viable interorganizational systems that can generate potential solutions to such disasters. We show that the governments of different countries can work together, and with development

organizations, on solutions for responding to disasters in ways that satisfy both their own partial interests and wider regional ones. Further, we emphasize that the inevitable tensions and lapses into disequilibrium arising from those tensions need not destroy such interorganizational solutions. Rather, our study shows that such solutions are difficult, require constant interactions to knot and reknot paradoxes, and that progress is not linear. Nonetheless, they provide a basis for action that can be incrementally refined and strengthened via attention to knotting together the tensions involved, as participating actors learn more about both the challenges, and how the solution and their purposes in working together can evolve. We, therefore, hope that our study, despite the messiness that such interorganizational collaborations involve, provides optimism that we can find ways to address the increasing threat of disaster facing society, as well as an initial indication of the practical mechanisms through which this can be achieved.

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Figure 1. Research context: The interorganizational system of risk pools

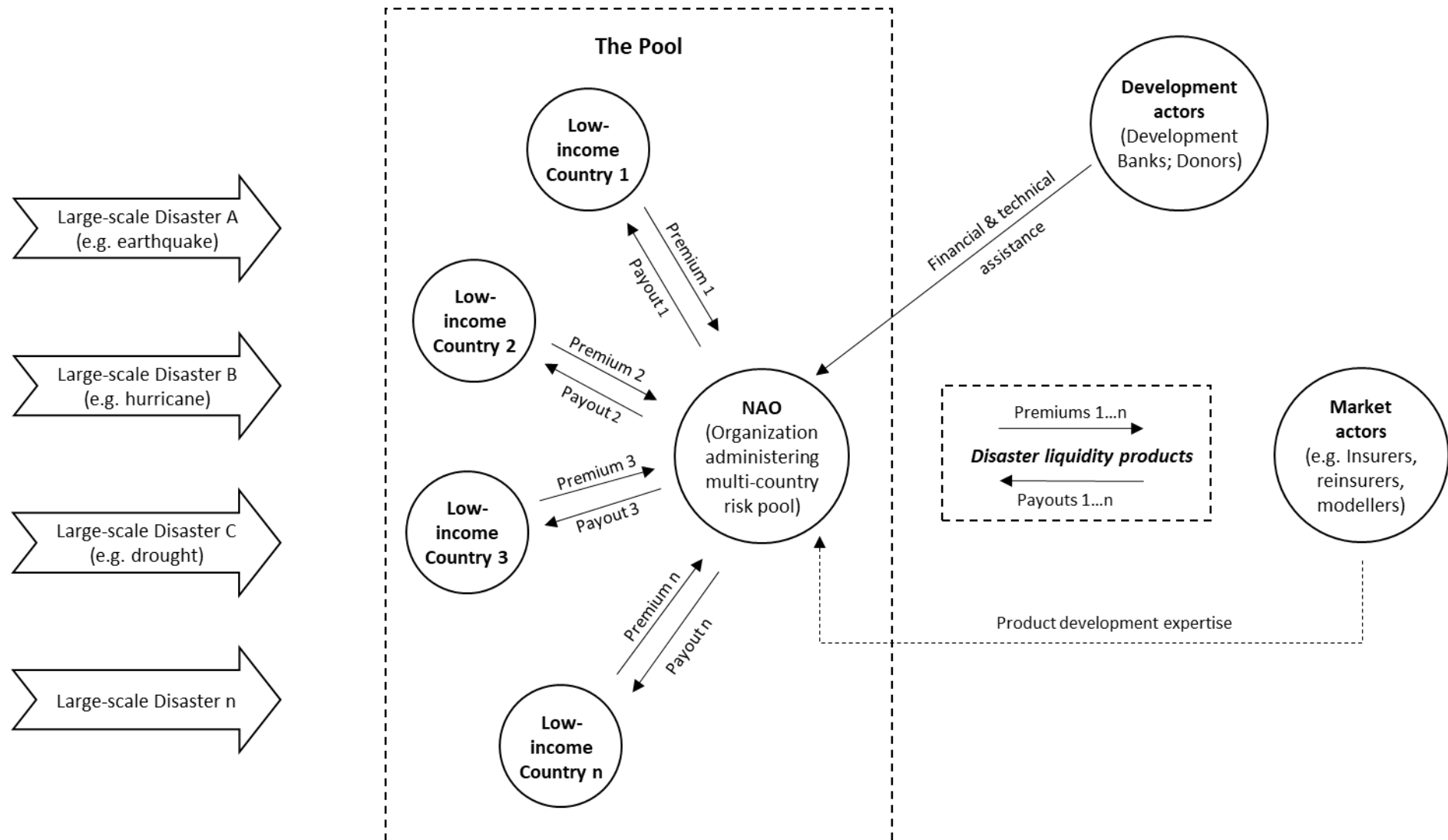


Figure 2. Paradox knot

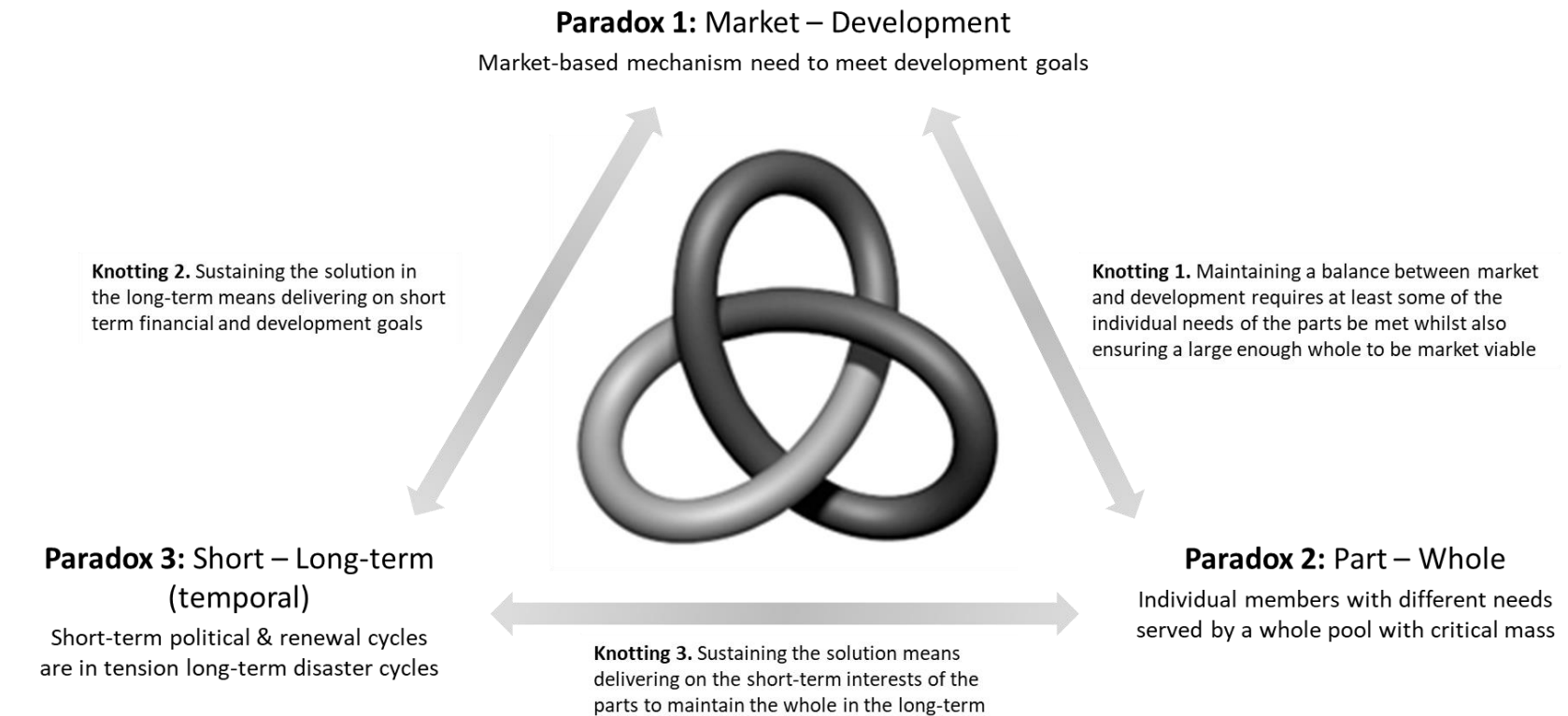


Figure 3. The generative dynamics of paradox knotting and reknottng for equilibrium and disequilibrium

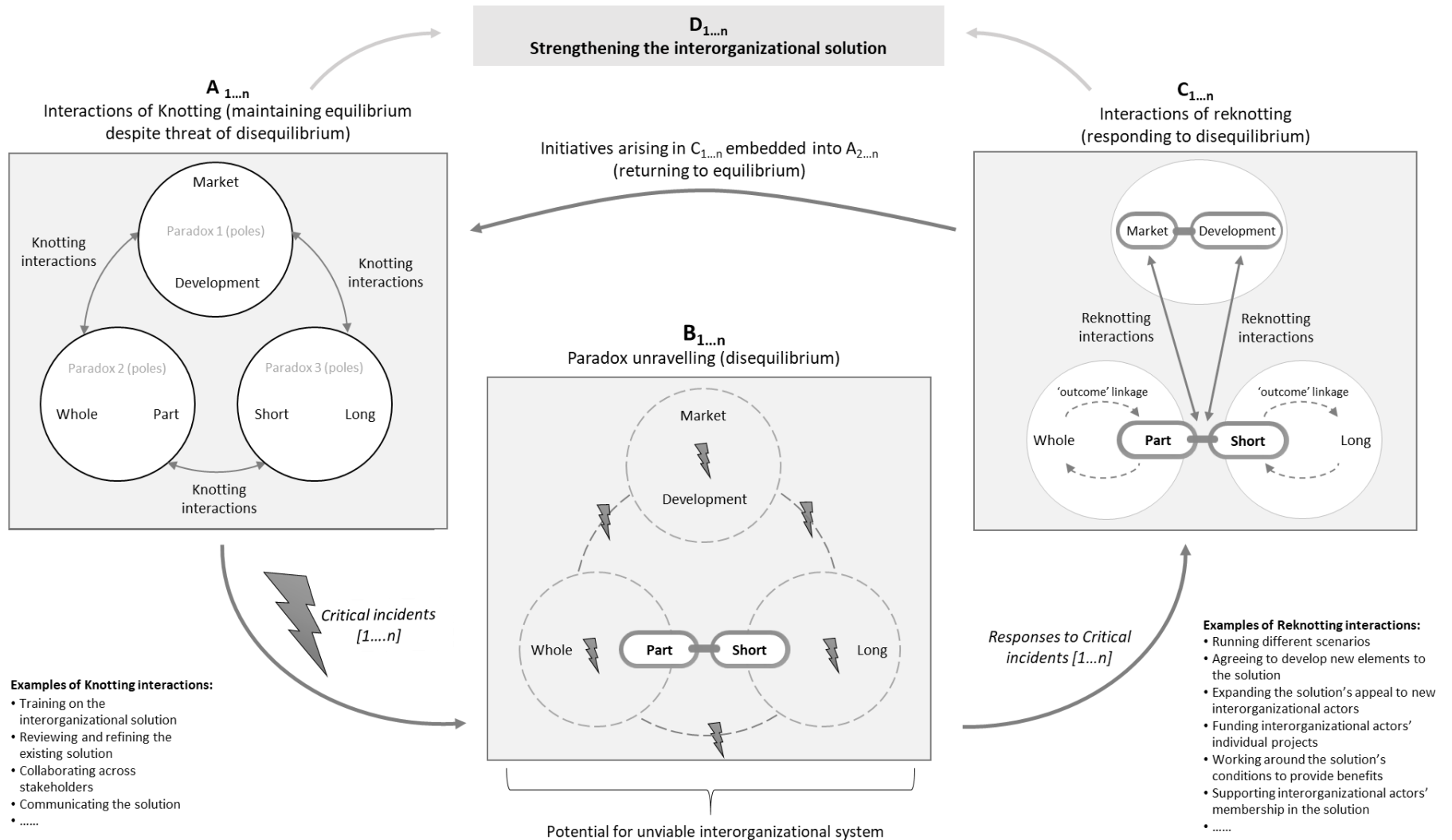


Table 1. Actors in the interorganizational system

	Who they are	Role	Objectives and key issues
NAO	The Network Administrative Organization (NAO) is the formal organization that administers the multi-country risk pool. There are multiple pools emerging globally.	Administer the offering of disaster liquidity products to member countries. Increase the buying power of participating countries by presenting them as a single buying block on the market. Bring into the pool as many low-income countries as possible in a geographical region.	Support financial response to disasters for countries via disaster liquidity products. Ensure viability over the long-term by maintaining a large enough membership and buying protection against different types of disasters. Enable countries to develop disaster risk management capabilities.
Low-income Countries	Governments of low-income countries in need of emergency funds for early response to disaster. Includes multiple ministries (e.g. finance, agriculture, disaster management).	Can choose to become members of a risk pool and buy disaster liquidity products. These products require the payment of a premium in exchange for which, should a disaster occur and meet predefined conditions, an agreed payout is released.	Balance engagement in the pool against other demands on their limited budgets (e.g. paying a premium for an event that might not occur versus other priorities). Often lack the technical competencies to purchase disaster liquidity products themselves.
Market actors	Insurance, reinsurance & other financial firms like hedge funds investing in disaster liquidity products.	Provide the capital used in disaster liquidity products. May also provide some technical and commercial expertise to design and price disaster liquidity products.	Key concern is profitability. Risk diversification: strong preference for pools with several member countries (not individual countries) buying products for a wide range of disasters. Adequate capital reserves to ensure solvency when issuing payouts: need for regular premiums on a yearly basis. Products must conform to risk models.
	Brokers match buyers/sellers of disaster liquidity products. Modelling firms producing the models used to estimate premiums and losses from natural disasters.	Brokers advise the buyers of disaster liquidity products. Brokers and modelers help design and price products, in particular in relation to the parameters or indices of disaster severity that trigger the payouts.	
Development Actors	Development banks (e.g. World Bank) provide financial and/or technical assistance for development purposes. Donor countries (e.g. USA, UK, Japan) support and invest in the pools through their aid budgets.	Development banks help to set up the risk pools and provide ongoing technical expertise and funding in disaster risk management and risk financing. Donor countries fund the set up and operation of NAO, and their disaster liquidity products.	Key concern for development banks and donor countries is development. Development banks also have a specific role in ensuring that low-income countries continue developing economically & socially and reduce reliance on international and humanitarian aid.

Table 2. Coding and thematic analysis

Themes	Interactions ²	First order data
Interactions of Paradox Knotting (to maintain equilibrium)		
A. Knotting balance within and across paradoxes	A1. Training on the interorganizational solution (<i>e.g. disaster risk planning</i>)	<ul style="list-style-type: none"> - Regional scholarship program for [Region] nationals on disaster risk management - Disaster risk reduction workshops from Development Bank - Annual disaster risk financing workshop within countries with government stakeholders - Scholarships for university course on disaster reduction - Professional education certificate course in fundamentals of disaster risk financing
	A2. Reviewing and refining elements of the existing solution (<i>e.g. insurance models and products</i>)	<ul style="list-style-type: none"> - Increasing accuracy of the real-time rainfall estimates - Incorporating additional exposure data for infrastructure - Assimilating meteorological observations such as pressure and humidity in hazard models - Modify product trigger that accounts for soil saturation - Introduce new level of claims beyond which the product triggers payouts for countries
	A3. Collaborating across stakeholders (<i>in the wider region</i>)	<ul style="list-style-type: none"> - Working with local meteorological organizations on satellite imaging - Regional knowledge building on disaster financing through collaboration (MoUs) with regional disaster risk management organizations such as [Region] Community Climate Change Centre, [Region] Institute for Meteorology and Hydrology, and UN Economic Commission for [Region]. - Pool collaborating with a non-profit insurance agency, a research institution, and the Environment Ministry of an EU country in researching the feasibility of two new policies - Work with regional disaster emergency management agencies and member countries on the expansion and awareness of the solution and preparedness
	A4. Communicating the solution (<i>e.g. the pool and its work</i>)	<ul style="list-style-type: none"> - Issuing press releases when payouts are made - Developing quarterly newsletters with success stories and new initiatives - Development and market actors, as well as Pools, participating as keynote speakers in disaster risk management and insurance workshops - Country members delivering talks to fellow countries

² In the parenthesis we have context-specific information to help the reader better understand the interactions within the context they are used

Interactions of Paradox Reknottting (all interactions occurring in the aftermath of critical incidents to respond to disequilibrium)		
B. Reknottting the market pole to the part and short-term poles	B1. Running different scenarios (<i>e.g. modelling different scenarios after a disaster</i>)	<ul style="list-style-type: none"> - Dividing Country K in two areas with different exposure and vulnerability to earthquake - Using different data on crop types and their performance under different farming practices for Countries H and J - Recalculating payouts if Country F had bought a different level of cover for tropical cyclone - Recalculating premium costs and payouts for Country Y if they were to buy the rainfall product at the next renewal
	B2. Agreeing to develop new elements to the solution (<i>e.g. products for country members</i>)	<ul style="list-style-type: none"> - Agreeing a rainfall product - Agreeing a fisheries product - Agreeing a humanitarian/government partnership product - Agreeing a product for private utility companies
	B3. Expanding the solution's appeal to new interorganizational actors (<i>e.g. introduce existing products to new countries</i>)	<ul style="list-style-type: none"> - Introducing drought product to [Country A] - Agreeing with 4 countries from the neighboring region to be offered the pool's products - Introducing rainfall product to two countries in the region [Country A] and [Country B] - Agreeing with two more countries in the region to sign a membership agreement and buy the hurricane and earthquake products
C. Reknottting the development pole to the part and short-term poles	C1. Funding interorganizational actors' individual projects (<i>e.g. countries' specific disaster risk management projects</i>)	<ul style="list-style-type: none"> - Supporting the rehabilitation of childcare facilities - Funding soil conservation of flooded arable lands around a river - Funding the construction of coastal defenses - Funding a conservation agriculture project to improve the resilience of crop production
	C2. Working around the solution's conditions to provide benefits (<i>e.g. issuing payouts to countries without products triggering</i>)	<ul style="list-style-type: none"> - Issuing a payout to [Country X] after Hurricane Jose didn't trigger the rainfall product - Issuing payouts to [Country Y] and [Country Z] after a drought didn't trigger the drought product - Issuing payout to [Country E] after Hurricane [Name] didn't trigger the tropical cyclone product
	C3. Supporting interorganizational actors' membership in the solution (<i>e.g. financing countries' premiums with development/ donor funds</i>)	<ul style="list-style-type: none"> - [Region] Development Bank offered low-interest long-term loans to support the premiums of six countries in the region during the time of regional economic recession - An international development institution financed half of the premiums of two countries in the region, due to fiscal constraints caused by disasters. - The [Country] International Development Agency financed half the premium and funded the other half for poorest country in the region.

Table 3. Interactions of paradoxes knotting³ to maintain equilibrium

Vignette 1: Developing forecasting systems	Knotting explanation
<p>Interaction A2. NAO engaged country members, with help of market and development actors, in continuous <u>reviewing and refining elements of the existing solution</u> (e.g. insurance models) [A2], from which a forecasting capability was developed: “The model update was developed to stimulate real time results and create risk profiles, so countries can decide about what products to purchase next year” (NAO, Doc). This “enhance[d] product pricing, estimating, in real time, the modelled losses and computing payouts” (NAO, Doc) [M] and supported early disaster response: “a real time forecasting system that will help them forward deploy emergency supplies” (Development, Int) [D].</p> <p>A2 cont. The new forecasting system also assisted with immediate real-time forecasting [S] that benefits, and is specific to, each country [P]: “via the early warning component you can understand whether you are likely to have a severe drought and you can get prepared in advance. You can plan in advance what I’m going to use the payout for. So, there are a lot of benefits” (Country Int.). These country benefits knot to the pool’s ability to support its members as a whole [W] in long-term disaster planning [L] that sustains annual renewal of membership: “It is about how do you balance a short-term desire to say OK, get countries on board, with a longer-term strategy of building understanding of risk management and really embedding this into their system.” (Development, Int).</p>	<p>Knotting market-development & temporal paradoxes. The revised model strengthens the balance between the market [M] interests to improve pricing and loss calculations, and the development [D] interests to improve disaster preparedness; also balancing the temporal paradox through forecasting future disasters [L] & providing real-time disaster response [S]</p> <p>Further knotting of paradoxes. Interaction A2 further knots balance in the development-market paradox with balance in the temporal paradox (short [S] and long [L] term) and part [P]-whole [W] paradox.</p>
<p>Interaction A3. <u>Collaborating across stakeholders</u> [A3] further developed the forecasting system: “We can work together building capacity of countries or their stakeholders in a particular area, [...] Like [Region] Emergency Management Agency, for example, we’ve been working with them on things [...] so building the regional capacity in the area” (NAO, Int) [D] [W]. This enabled better decision making on what products [M] were best for different countries [P] according to their location in the region: “it’s an informed choice and the risk manager will try to advise us, and we eventually make the decision on what kind of coverage” (Country, Int).</p> <p>A3 cont. This collaboration [A3] further supported the immediate [S] needs of countries [P] as regional actors helped to improve countries’ development planning [D] and product buying [M]. Increased regional capabilities in using forecasting systems showed countries how staying in the pool [W] and buying the financial product [M] year-after-year [L] served their development needs [D]: “we’re working with the governments and others, such as [Development Bank] to, find sustainable ways such as the early warnings system to ensure we have countries in the pool year-on-year. For those countries that have been with us for two/three years, we [...] really make sure that they don’t leave.” (NAO, Int).</p>	<p>Further knotting of paradoxes. Regional approach further strengthens the balance between the market [M] and development [D], supporting part [P]-whole [W] decision making on specific products for different countries across the pool.</p> <p>Further knotting of paradoxes. Interaction A3 involves the paradox knotting of temporal paradox (short [S] and long [L] term) and part [P]-whole [W] with market [M]-development [D] use of products</p>

³ We use roman numerals for the paradox poles: [M] market; [D] development; [S] short-term; [L] long-term; [P] part; [W] whole.

Vignette 2: Contingency planning	Knotting explanation
<p>Interaction A1. As part of <u>training on the interorganizational solution</u> [A1], the NAO worked with countries on contingency planning [D] for using any future payouts from modelled losses [M]. “The [Pool] provides training to our local experts regarding all the [modelled] components that require customization and then they provide training for contingency planning” (Country, Int). This help countries plan [L] how they will use payouts [M] to respond immediately [S] to a specific disaster in their country [P]; for example, to source and distribute food to affected people: “what are the requirements [for food] which has been crop yield data, you know, big crop germination and performance. So, it has to be based on a model, for instance, we did the drought index [in contingency planning]” (Country Int). Being a pool member [W] meant that they were eligible for training that enabled each country [P] to tailor the contingency plan to their specific disaster management needs.</p> <p>A1 cont. Contingency planning further developed understanding of the whole pool financial benefits [W-M]: “we have had floods in the past but no planning processes for a particular flood. But the [Pool] contingency plan has now reinforced our thinking and our planning, and that’s what was very helpful; [...] Especially the response cost part of it, which was missing, but now with the contingency plan, we really had to figure out the costs” (Country, Int). Figuring out the cost of their development needs [D] enabled them to make decisions about the disaster response products offered by the Pool [W] and how to include these in their long-term contingency plan [L].</p>	<p>Knotting the paradoxes Interaction A1 knots market [M]-development [D] to long-term [L] planning for short-term [S] disaster response, so ensuring disaster response addresses countries’ specific part needs from membership of the pool [S].</p> <p>Further knotting of paradoxes. Interaction A1 further and simultaneously knotted market-development [M-D] with the long-term [L] planning to meet countries part needs [P] through membership of the whole [W].</p>
<p>Interaction A4. The NAO and development actors were also <u>communicating the solution</u> (the pool and its work) [A4] on contingency planning within countries to ensure ongoing development input into funding the <u>training program</u> [A1]. “It was about promoting [Pool’s] work to the region and to the world. [Development Bank] was very keen on promoting what [Pool] had done [...] [Development actor] then financed an impact evaluation of the contingency planning [L]. That came up with positive results, basically demonstrating that all this hype about strengthening country future planning is true; it does support rapid disaster response [S]” (Development, Int). In countries, they also developed concrete success stories of how the program worked in specific cases [P]: “‘three years ago there was a flood and it cost you this.’ When you have those concrete figures, it’s really clear to explain to a Minister that you can better plan your finances [M] to boost recovery [D] if you have those tools [the Pool offers]” (NAO, Int) to help retain and increase country members use of planning and of pool membership [W].</p>	<p>Further knotting of paradoxes. Interaction A4 and Interaction A1 knotted together all paradoxes. Paradoxes were knotted as helping countries with long-term [L] planning did help their short-term [S] disaster responses and support decisions on how products (market [M]) could serve their specific (part [P]) development [D] needs and increase their retention in the pool (whole [W]).</p>

Table 4. Interactions of paradoxes reknitting

Vignette 1: Varied payouts after Hurricane [Karo]	Reknitting explanation
<p>Critical Incident. Hurricane [Karo] struck causing varied payouts amongst countries. Some countries [P] who were unhappy about their payouts in the immediate aftermath of Hurricane Karo [S] threatened to leave the pool: “The payout we got in relation to what [Country L] has received [...] when you consider the extent of the disaster [...] it was far more significant in the case of [Country M]” (Country, Int). These countries felt the pool [W] and its market products [M] had not served their development interests [D] and had no long-term value [L] for them in remaining members.</p>	<p>Disequilibrium as poles Cluster & Knot Unravels. Part [P] & short-term [S] poles cluster and paradox knots unravel as whole [W] and long-term [L] de-emphasized, unbalancing these paradoxes and unravelling from market-development which also becomes unbalanced [M-D].</p>
<p>Interaction B2. This exposed a gap in existing products: “We realized that while the hurricane product accounted for wind and storm surges, it did not for flooding. So [Country M] really didn't get compensated for any rain-related losses” (NAO, Int). The specific [P] and urgent [S] post-flooding losses sustained by these countries needed addressing. The NAO, supported by the development actors, therefore engaged in interactions with the countries to <u>agree to develop new elements to the solution</u> [B2]: “A lot of the losses were [...] related to rainwater. So, we sought to develop a new product”. The rapid interaction enabled them to address the identified gap in these countries' specific needs [P] via a new financial product focused on flooding [M] and so temper their immediate reaction which had been to leave the pool [S].</p>	<p>Reknitting market pole to clustered short-term and part poles. New product to be offered via the market [M], addresses a specific need of those countries (part [P]), so immediately addressing their (short-term [S]) demands for a response.</p>
<p>Interaction C3. While some countries welcomed the agreement for a rainfall product, others could not afford it [P]: “if we could afford it, we probably would take it, you know, if we had more resources we probably would” (Country, Int). The NAO interacted with both the development sponsors and the member countries in <u>supporting interorganizational actors' membership in the solution</u> [C3] for the next renewal [S]: “All governments face constraints [...] Premium discounting is a way to build resilience before disasters, it's a great carrot to get people to be involved” (NAO, Int). The interaction enabled them to address the development gap regarding flooding [D] and help them remain in the pool [W] despite their inability to purchase the product via a strictly market transaction.</p>	<p>Reknitting development pole to short-term and part poles and indirectly linking part to whole. Interaction C3 addressed the development needs [D] of specific countries (part [P]) at the very next renewal [S], so reknitting the development pole in terms of their need to recover from flooding [D] with the part [P]-short [S] poles; this also countered short-term defection [S] from the whole pool [W]</p>
<p>Strengthening solution. <u>Agreeing to develop new flooding products</u> [B2] resulted in countries renewing their annual policy and buying the new product, some with <u>initial premium support</u> [C3]: “This is going to continue very, very long-term [L]. Once you develop new products that really are relevant and available, and countries start buying them [M-D]” (NAO, Int). Covering the immediate post-disaster needs for individual countries, individually, enabled renewed commitment to the whole pool [W] and strengthened the solution by expanding the set of financial products that can cover broader development needs [M-D].</p>	<p>Indirect links to long-term and whole poles restore balance and reknitting of all paradoxes. Support for long-term goals [L] of improving financial disaster response [M-D], as countries became more inclined to commit to the pool (whole [W]) since the market products met their development needs [M-D].</p>

Vignette 2: No payouts after the Wakanda drought	Reknotting explanation
<p>Critical Incident. The product did not trigger for the drought that severely impacted Country Z. As the season progressed, the Prime Minister declared a state of emergency: people were starving and food prices rising. Country Z’s interests [P] in receiving a payout to deal with drought relief were pressing as the impact of the drought was escalating [S]. Country Z, unable to meet its development needs [D], lost confidence in the product [M] and wanted to withdraw from the pool [W]: “In [Country Z], interest in the products has dampened. Many government officials expressed frustration at having spent money for a policy that did not appear to have served the country” (Development, Doc).</p>	<p>Disequilibrium as poles Cluster & Knot Unravels. Part [P] & short-term [S] poles cluster and paradox knots unravel as long-term [P] and whole poles [W] deemphasized, unbalancing these paradoxes and unravelling from market-development which also becomes unbalanced [M-D].</p>
<p>Interaction C2. The assumptions behind the model were found to include inaccurate data about the type of seed farmers used. “On this basis, the [NAO], supported by the [Development Actor] decided to allocate the payout that would have been made on the contract” (Market, Int), essentially <u>working around the solution’s conditions to provide benefits</u> [C2]. This exceptional payout was a short-term bolster [S] that covered the specific development needs of Country Z [P]. The NAO defended this focus on development [D]: “we’re trying to help better manage risk and build resilience and not sell insurance products, and boost the market” (NAO, Int).</p>	<p>Reknotting development pole to part and short-term poles. Interaction C2 focused on emphasizing development objectives [D] to meet the short-term [S], and exceptional post-disaster needs of Country Z only (part [P]).</p>
<p>Interaction B3. Other countries that were not members were also impacted by the drought. The NAO and development actors interacted with these additional countries [P] <u>expanding the solution’s appeal to new interorganizational actors</u> [B3]: “The [region] countries got quite an exposure to drought. So, we’ve been discussing with them about buying this drought product that would provide them with the cover they need that makes sense to them financially” (NAO, Int). This interaction tied the market mechanism [M] to the needs of these countries [P]. Due to the drought’s impact these countries had immediate political appetite [S] for a product to demonstrate to their constituents that they were planning for future droughts [L]: “They’re buying a [drought] product [...] there are lot of reasons why a Ministry of Finance at some point may decide to go for it, political reasons and time horizon” (Development, Int).</p>	<p>Reknotting market pole to part and short-term poles. Interaction B3 focused on emphasizing how the market mechanism [M] could cover the short-term political needs [S] of some drought impacted countries (part [P]). This reknotting process generated indirect links to the long-term development planning of these countries [L]</p>
<p>Strengthening solution. Addressing these needs helped these countries see the relevance of the pool [W] and purchase of market products [M] for their individual [P] disaster planning needs [D], while the country that received a payout [M] could pay for immediate [S] disaster relief [D]. These interactions eventually strengthened the whole pool [W] and its long-term objectives [L]: “We look at, how do you deepen insurance market [M] and how do you provide financial protection for government [D] It’s all part of the same whole, how do I reduce the impact of shocks on government balance sheet and the communities” (NAO, Int).</p>	<p>Indirect links to long-term and whole pole restore balance and reknotting of all paradoxes. Knotting development [D] & market [M] poles, individually, to part [P] & short-term [S] interests, generates an indirect link that rebalances the whole [W] and long-term [L] poles</p>

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