



Risk Governance in Organizations: Future Perspectives

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(Hrsg./Eds.)

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Bibliografische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte Daten sind im Internet über <http://dnb.dnb.de> abrufbar

Impressum

Umschlag:

Tobias M. Scholz

Druck und Bindung:

UniPrint, Universität Siegen

Gedruckt auf alterungsbeständigem holz- und säurefreiem Papier

Siegen 2022: *universi* – Universitätsverlag Siegen
www.uni-siegen.de/universi

ISBN 978-3-96182-126-6

doi.org/10.25819/ubsi/10154

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What Can We Learn from Physical Climate Risks for Financial versus Operational Risk Management Trade-offs?

Moritz Wiedemann*

Introduction

One fifth (18 out of 89) of all global sectors with a combined 7.2 trillion U.S. dollar of debt have a high exposure to physical climate risks (Moody's 2020). Due to climate change and the already "locked in" warming, extreme weather events are projected to further increase. This rapidly growing risk manifests itself spatially very differently, but is increasingly important for firms, both small and large. Stein et al. (2019) highlight that risk governance aims to help firms adapt their "business model to changing risk landscapes to maintain the firm's sustainability and ongoing value creation." In this short article, I explore how physical climate risk, specifically wildfire risk in Portugal, affects small and large agricultural firms' profitability and how small and large firms manage the risk financially, that means through cash buffers or hedging via insuring, as well as operationally. From their risk exposure and management, I finish with impetus for risk governance.

Risk governance contributes to long-term value optimization of corporations (Stein/Wiedemann 2016). It is particularly relevant for today's open organizations. Physical climate risk captures this open dimension of today's organizations. Wildfires are one type of physical climate risk that have been highly eminent and damaging in recent years. The likelihood of wildfires and manifestation of wildfires does not only depend on firms' own actions, but also on the behaviour of their neighbours and the wider society in general. In Europe, Portugal has one of the highest forest fire risk rankings (EEA 2021). A particular extreme year in Portugal was 2017 with the Pedrógão Grande Fire. It is estimated to have caused economic losses of 1.06 billion euro, equivalent to 0.54 % of Portugal's GDP in 2017 (Aon Benfield 2017). This highlights the scale a single wildfire can have. Moreover, the World Wide Fund for Nature (WWF) described it as a new type of fire – extreme, uncontrollable, and lethal.

Wildfire risks are thus a prominent example of a changing risk and a risk that cannot be managed purely within a firm. Wildfires local impact may manifest itself through many ways, in particular asset destruction, labour force disruption, worsening air quality and changes in customer demand. As agricultural firms have large physical assets at risk, they are especially vulnerable to wildfires. I study

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wildfire risk and realisation empirically for Portuguese agricultural firms, a country and industry particularly exposed to wildfires, between 2006 and 2018. I combine burn scar maps and wildfire hazard maps from the Portuguese Institute of Nature Conservation and Forests with firm-level balance sheet data from the Portuguese Central Balance Sheet Data from the Bank of Portugal. I show that small agricultural firms compared to larger firms suffer financially more following the experience of a wildfire. Next, I show that small firms seem to have a more concentrated operational risk and a more precautionary financial risk management approach. Given these high-level stylized facts, I conclude by drawing some hypotheses on location specific risks, the relationship between financial and operational risk management and growth as a risk management tool and driver to set a development impetus for risk governance.

Wildfire impact on agricultural firms

Burn scar maps document the exact geographic location and area of a wildfire. I extend wildfire areas by a 20 % buffer zone relative to the radius of the wildfire to capture spillovers from wildfires. Larger wildfires have larger buffer zones catching their wider impact. I match the extended wildfire shapes to firms based on their 7-digit postcode. 7-digit postcodes identify the location of a firm at street level allowing me to precisely identify firms' exposure to wildfires. I thereby end up with a wildfire occurrence dummy ($Wildfire_{it}$), which is one if a firm was within at least one wildfire buffer extended zone in year t , and zero otherwise.

I run the following regression specification with log turnover plus 1, profit margin (net income over turnover) and log total assets plus 1 as dependent variable (y_{it}). Next to lagged firm level controls ($Controls_{it}$), namely log assets, fixed tangible assets to total assets and financial debt to total assets, I include firm (δ_i) and year (τ_t) fixed effects to identify the impact of wildfires within the same firm. To gauge the heterogeneous effect for different types of firms, I run this regression on all agricultural firms and then split the sample into large firms, small firms as well as small and young firms. Large firms are firms classified as medium or large under the European Commission guidelines. These firms have 50 or more employees and turnover or assets exceeding 10 million euros. Small firms are firms below these cut-offs, having dropped the smallest firms with less than 4 employees due to more noise in this group. I additionally define young firms as firms that were founded less than 5 years ago.

$$y_{it} = \alpha + \beta Wildfire_{it} + \gamma Controls_{it} + \delta_i + \tau_t + \epsilon_{it}$$

Figure 1 plots the $Wildfire_{it}$ coefficient for the 12 individual regressions. The top panel “all firms” shows that the average agricultural firm on average has a 3.6 % lower turnover, a 3.3 % smaller profit margin and a 2.6 % drop in assets in the year of the wildfire. Only the decrease in profit margins is statistically significant at the 5 % level. The sample split into different firm types suggests that the overall effect is driven by the small firms. The coefficients may actually flip for large firms, but none are significant. Moreover, wildfires seem to have the relatively strongest impact on small and young firms. Turnover decreases on average by 5.1 % and profit margins by 5.5 % within this sample. To sum up, these correlations suggest that smaller firms and in particular small and young firms are most severely affected by the occurrence of a wildfire.

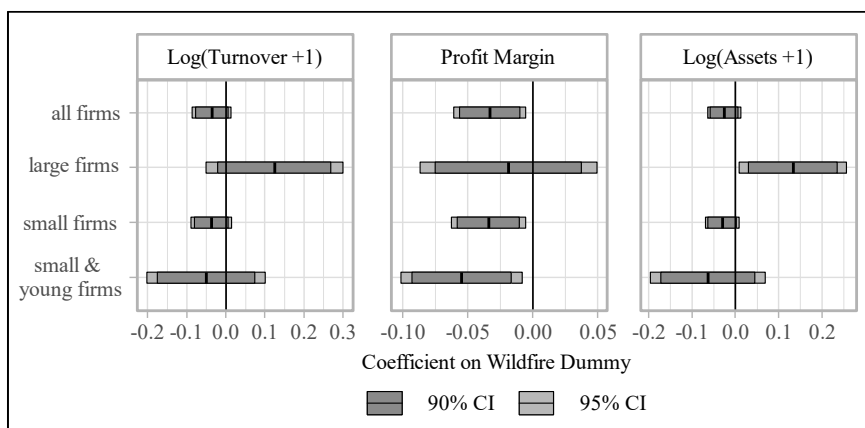


Figure 1: Financial Impact of Wildfire on Firms

Several factors may explain this pattern. Large firms may be more operationally and geographically diversified. This makes it less likely that a local extreme weather event substantially disrupts the business and affects profitability. Next, large firms may be more resilient to shocks through greater flexibility in their supply chain systems. They may have multiple suppliers and relationships that allow them to better respond to unexpected events. Furthermore, they may have greater access to external capital following wildfires that allow them to buffer unexpected capital shocks more easily. The opposite may hold for small and in particular small and young firms. Their business model and location are more likely to be concentrated and access to external capital may be restricted. Further, the risk-return trade-off may be different for small, in particular small and young firms, that are still growing. They may allocate more of their limited time to growth rather than risk management and may therefore be more exposed to these unexpected events. The firms’ financial respectively operational risk management may inform us to

some extent about which factors are particularly relevant within the agricultural firm setting.

Financial versus operational risk management across agricultural firms

To proxy financial risk management, I calculate cash levels relative to total assets and insurance payments relative to total assets, two prominent forms of corporate liquidity management techniques (Almeida et al. 2014). Both, higher cash levels and greater insurance payments, allow firms to transfer liquidity to unfavourable states in which external financing costs are high. They thus enable firms to have sufficient internal funds available to take advantage of investment opportunities in these states (Froot et al. 1993). Operational risk management against wildfires include amongst others clearing land from easily burnable material, investing in fire-resistant buildings/equipment, and operating multiple establishments. I focus on the number of establishments a firm has, as this substantially reduces the likelihood that all of a firm's operations are simultaneously affected. Further, it is empirically measurable.

I implicitly assume that wildfire risk is a key and material risk for agricultural firms and that managers actively pay attention to this risk. Portugal's high fire rating, the large economic impact of the 2017 Pedrógão Grande Fire and the 2017 introduced law to subsidize firms with wildfire damage all point towards the importance of wildfire risk. Hence, I think it is fair to assume that the financial and operational risk management measures are partly driven by wildfire risk differences, particularly in the subset of firms that are in areas with relatively high wildfire risk.

I collect annually updated wildfire hazard risk maps from 2012 to 2019 and average them. These government mandated maps combine information of past wildfires, slopes, and land covers to categorize burnable land into a hazard index ranging from 1 (low risk) to 5 (high risk) on a grid with 80 m resolution. Hazard indexes are only available for "burnable" land. This means that water and concrete land covers are not assigned a hazard index, as they cannot burn. I first calculate the average annual hazard score per municipality and then take an average per municipality across time. I only keep firms that are located in regions where the average municipality wildfire hazard level out of 5 levels is 3 or higher, that means with medium, high and very high exposure. For these firms, wildfire risk is most likely to play an important role in their risk management strategy and shape the relevant measures. I calculate average cash relative to assets, insurance payments relative to assets, and the number of firm establishments for each firm type, namely large, small and small and young firms.

These averages may give a first overview on how the different types of firms manage wildfire risk. Figure 2 highlights an interesting pattern for the three firm types. It seems that large firms, if anything, take fewer precautions through financial risk management. They have a lower average cash to assets ratio and a lower insurance payment to assets ratio. Small and young firms have the highest ratios in both. Clearly, several factors other than wildfire risk affect these ratios. Opler et al. (1999) for example suggest that a firm's target level of cash increases with its growth opportunities as well as the riskiness of its cash flows and decreases with its access to capital markets. Greater wildfire risks make firms' cash flows riskier and explains the hedging demand. While it is difficult to say something on wildfire risk in isolation, the pattern suggests that small firms prepare for this risk in advance and have cash buffers and insurances to respond to these idiosyncratic shocks.

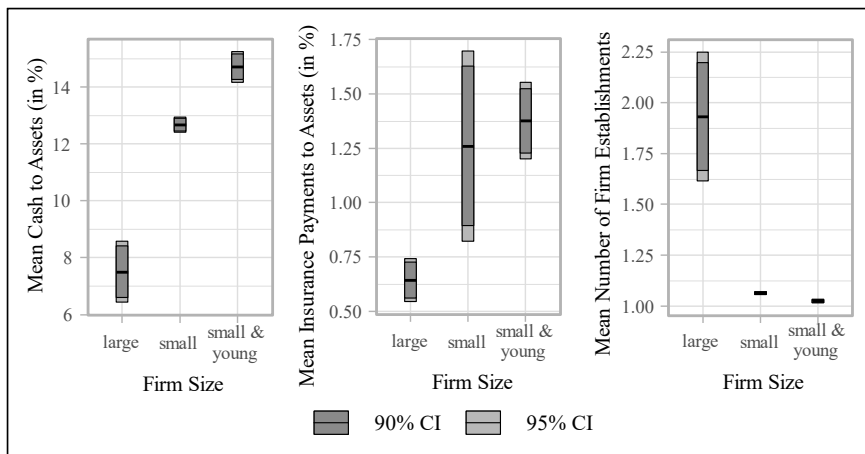


Figure 2: Risk management averages by firm size

Further, we can also see that the average large firm has more establishments than the average small firm. Large firms on average have two establishments, while small firms only have one establishment. This suggests that large firms are operationally more diversified, which should substantially reduce the impact of local risks, such as wildfire risks. Small firms are unlikely to have the scale to operate more than one establishment and are geographically concentrated.

Development impetus for risk governance

I show that small, particularly small and young, firms are most exposed to wildfires relative to large firms. I also show that at first sight small firms do not seem underprepared for wildfire risks with their financial risk management relative to large firms. If anything, small firms seem to have a more precautionary financial risk management approach. However, small firms are not geographically diversified and typically only have one establishment. This concentrates operational risk and exposure to wildfire shocks. In combination, one may conclude that financial risk management can only to some extent compromise for operational risk management for large, infrequent shocks, such as wildfires.

What does this suggest in terms of risk governance? Long-term operational choices, such as location, may create important path dependency with long-term effects on a firm's risk profile. These are high profile choices that are costly to alter later on. Stein et al. (2019) highlight that risk governance aims to help firms to adapt their "business model to changing risk landscapes to maintain the firm's sustainability and ongoing value creation". For choices with large sunk costs, such as the location, risk governance may already play an important role in the start-up decision of a firm.

Further, firms can outgrow geographically concentrated risks by operating multiple establishments. At the extreme scale, conglomerates, such as Siemens with its main divisions industry, energy, healthcare, and infrastructure and cities or Samsung with business lines from electronic manufacturing to ship construction and food processing, not only diversify across locations, but also business lines. In this sense, firm growth may act as a risk management tool. However, growth in itself carries risks as well. In agriculture growth likely requires large investments, as the business is not easily scalable. Rapid growth may be particularly risky, as it can hide risks. Risk governance may help to make such trade-offs more explicit and can therefore help to address these challenges.

Finally, it highlights that financial risk management and operational risk management go hand in hand. Both play an important role and neither seem to be able to substitute the other fully. Certainly, financial risk management techniques alone are insufficient to protect small firms from wildfire impacts at least in the short-term. This highlights risk governance important role in the operative governance of risks from the top to align the different value drivers within the firm.

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Dieser Band feiert „10 Jahre Siegener Risk-Governance-Forschung“: 50 Autorinnen und Autoren reflektieren die Risk Governance in Organisationen vor dem Hintergrund ihrer eigenen Erfahrungen und formulieren einen „Entwicklungsimpuls für die Risk Governance“.

This publication celebrates “10 years of Siegen risk governance research”: 50 authors reflect on risk governance against the background of their own experiences, and formulate a “development impetus for risk governance.”

ISBN 978-3-96182-126-6

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