Economics and Business Letters
13(4), 172-182, 2024

Transition climate risks and corporate risky asset holdings: evidence from US firms

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Received: 25 May 2024
Revised: 09 July 2024
Accepted: 20 July 2024

Abstract

Using data from US firms over 22 years, this paper shows that firms' risky asset holdings are negatively associated with their transition climate risks exposure. The evidence remains robust across model specifications and robustness checks, while is more pronounced for financially constrained firms. The findings are consistent with the precautionary motive framework and imply that firms need to reduce their risky asset holdings in the event of negative shocks of transition climate risks.

Keywords: risky asset holdings; transition climate risks, physical risks
JEL Classification Codes: Q54; G30; G32

1. Introduction

This paper investigates, to the best of our knowledge for the first time in the literature, the impact of transitional climate risk on risky asset holdings of US firms and provides evidence that firms with higher exposure to transitional climate risk substantially change their decisions to hold high risky assets. A great number of papers have focused on the impact of the physical risks associated with climate change risks (such physical risks are dealing with the damages to facilities, operations, and assets caused by climate change-induced hazards and conditions), paying far less attention to the potential implications of transition risks (they are associated with the losses resulting from a transition of production and consumption towards methods and products that are compatible with a net-zero economy). More specifically, transition risks are linked to the fact that the world is transitioning away from fossil fuels, which supports that there exists a declining

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Citation: Apergis, N. and I. Apergis (2024) Transition climate risks and corporate risky asset holdings: evidence from US firms, *Economics and Business Letters*, 13(4), 172-182. DOI: 10.17811/ebl.13.4.2024.172-182.

demand for fossil energy and a rising demand for clean energy (Nguyen and Phan, 2020). Those transition risks tend to generate stranded assets (Atanasova and Schwartz, 2020), while they substantially increase due to sudden and substantial changes in regulation. Therefore, it seems imperative to investigate the role of transition climate risks, especially for the corporate sector, because there are substantial concerns that firms may be underestimating their exposure to those risks. At the same time, evaluating firms' exposure to transition risks is challenging because it requires understanding their responses to policies that foster the process of transition. Furthermore, according to Zhang et al. (2024), the presence of certain types of climate risks can trigger substantial noise/volatility in stock prices, as well as firms' reaction in relevance to their financial decisions to such risks. This relevant literature asserts that extreme climate events and risks can motivate firms and economies to try harder to mitigate such risks by adopting certain policies and strategies, such as investing in green finance and renewable energy (Bardoscia et al., 2017; Arora and Mishra, 2021; Dogan et al., 2022).

The corporate finance literature has emphasized the importance of corporate cash holdings, while there are studies that document that firms also invest in risky financial assets, such as mutual funds, corporate debt, and equities. Firms' investment decisions are associated with financial portfolios that are significantly large, given that losses from such risky investments have no direct effect on firms' operating performance (Duchin et al., 2017; Chen and Duchin, 2022; Cardella et al., 2021). Duchin et al. (2017) provide evidence that risky financial assets represent more than 40% of S&P 500 firms' financial assets, which is puzzling since risky financial assets do not generate value for shareholders once the cost of capital is properly adjusted for the risk (Fama and French, 2010). The literature also identifies that firms' cash holdings underestimate the size of their financial portfolios, while risky financial asset holdings fail to protect them from adverse cash flow shocks, in cases where firms need their precautionary savings (Darmouni and Mota, 2020).

The literature has also documented evidence that climate risks impact decisions on corporate earnings, sales growth, cash and investment decisions, cash flows, capital structure, and the illiquidity of firms' productive capital (Delis et al., 2020; Brown et al., 2021; Javadi and Masum, 2021; Pankratz et al., 2023). However, emphasis was given on the physical component (natural disasters) of climate risk and not on transition risks (Batten et al., 2016; Hong et al., 2019; Huynh et al., 2020). As economies transition away from fossil energy, transition climate risks can generate stranded assets and increase firms' environmental liabilities, thus generating higher litigation risks and increased costs of external finance (Bolton and Kacperczyk, 2020; Chang et al., 2021).

Furthermore, recently the literature has also emphasized the risks associated with sustainable economic growth due to both natural resource depletion and ecological degradation and propelling the adoption of policies that ensure a balance between economic growth and environmental protection. Here the role of the establishment of green firms and industries is highly substantial and requires the adoption of certain green policies that minimize the risk of the transition process (Anzolin and Lebdioui, 2021; Amornkitvikai et al., 2024).

This work is related to the corporate finance literature. First, a literature strand explores the size, properties, and the composition of firms' financial asset holdings (including cash) (Duchin et al., 2017; Darmouni and Mota, 2020; Chen and Duchin, 2021; Cardella et al., 2021). These studies highlight that firms' financial portfolios are significantly larger than those identified by the traditional measure of corporate cash holdings. Cardella et al. (2021) analyse the determinants of illiquid financial asset holdings, while Duchin et al. (2017) and Darmouni and Mota (2020) investigate the determinants of illiquid and risky financial asset holdings. Second, the paper touches the literature on corporate cash holdings. The explanation for holding cash is lying on the precautionary savings motive, according to which firms hold cash to protect against adverse cash flow shocks, especially in cases where other funding sources are excessively costly (Faulkender and Wang, 2006; Lins et al., 2010). Third, the paper is also related to the risk-management literature. This mechanism, recommended by Froot et al. (1993), asserts that firms base their risk management policies on smoothing cash holdings so to reduce expected financial distress costs or expected external financing costs.

2. Data and methodology

Annual data for US firms are obtained from Compustat, spanning the period 2000 to 2021. Their starting point is at 2000, given the availability of the Transition Risk Index (TRI) described below. Firms in regulated utility and financial industries are not considered; the same also holds for firms with missing or negative total assets, as well as for firms with property, plant, and equipment less than 5 million. Next, we merge this sample with the value of risky financial assets data scraped from the SEC 10-K filings by CIK and fiscal year.

The control variables include firm's size (total assets), R&D expenses over assets, market to book value, cash flows, leverage, dividend, net working capital, capital expenses, safe assets, and Tobin's q (Bates et al., 2009; Erickson and Whited, 2012; Duchin et al., 2017), which are also on an annual basis. The analysis also winsorizes variables in ratios at 1st and 99th percentiles to avoid potential outliers, and, thus, ends up with 22,440 observations (1,020 firms x 22 years).

Following Duchin et al. (2017), the analysis classifies safe assets related to cash, bank receivables, bank drafts, bank acceptances, deposits, checks, letters of credit, money orders, commercial papers, treasuries, and money market funds. Next, it classifies risky securities those that are not safe securities, such as stocks, while excluding financial assets related to restricted cash, pension plan assets, any liabilities, assets held for compensation, and hedging activities. Risky financial assets are scaled by lagged assets.

Finally, US transitional climate risk is measured as the point-in-time index, developed by Apel et al. (2023). They apply a rigorous approach for the approximation of changes in transition risks from climate-related news and divide the process into three parts: domain-specific vocabulary construction, topic identification, and sentiment classification. They use a language model which provides a domain-specific vocabulary from millions of news items. Their approach screens more than one hundred million news articles, while they choose a subset of the most relevant media outlets, such as Dow Jones Newswires, Reuters, BBC, WSJ, and CNN. Their approach includes articles that analyse the potential impact of transition risk on global stock portfolios. They also make use of dictionaries that account for the time-dependent relevance of terms, such as 'Climate Change'. Next, they train their sentiment model which predicts the impact of a news event on transition risk.

The analysis regresses corporate risky asset holdings (the dependent variable) on the TRI and certain controls (X) as:

$$risky\ assets_{it} = \alpha_i + b_1\, TRI_t + c'\, X_{it} + f_i + g_t + \varepsilon_{it} \qquad (1)$$

where α_i is a constant, f_i denotes fixed effects, g_t denotes year fixed effects, and ε_{it} is an i.i.d. error term. The panel General Method of Moments (GMM) method, developed by Arellano and Bover (1995) and Blundell and Bond (1998), has been used to obtain the necessary estimates to mitigate potential endogeneity arising from a possible joint determination of the size and composition of firms' financial portfolio (Duchin et al., 2017). Potential endogeneity could also arise from the case of reverse causality between risky assets and any of the control variables included in Equation (1).

3. Empirical analysis: baseline results

The baseline results are reported in Table 1, which has three columns. The first column reports the bivariate results, the second column repeats the analysis by using all financial controls, and the third column includes specific macrofinance variables, such as private credit-to-GDP ratio, the Consumer Price Index (CPI), GDP per capita, and stock market capitalization (Kalcheva and Lins, 2007). The macrofinance data are obtained from the Eikon database. Standard errors have been clustered based on firms, as well as on time (Petersen, 2009). The results indicate that transition climate risks have a negative impact on corporate risky asset holdings. According to these estimates, transition climate risks generate stranded assets, thus increasing the cost of external financing, as well as the illiquidity of productive capital (Atanasova and Schwartz, 2020). As a result, firms tend to reduce their risky asset holdings, which provides evidence in favor of US firms' motivation of precautionary actions (Bolton et al., 2013).

In terms of the remaining controls, the findings are corroborated by the relevant literature. For instance, there is a statistically positive significant relationship between firm size and risky asset holdings, as well as a statistically significant negative link between firms' risky financial assets and the proxy for precautionary savings needs (cash flow, R&D expenses, and market-to-book ratios). Finally, all four macrofinance variables exert a positive impact on corporate risky asset holdings.

Table 1. Baseline results: Dependent variable = corporate risky assets over physical capital

Variable	(1)	(2)	(3)
TRI	-0.439***	-0.408***	-0.396***
	[0.00]	[0.00]	[0.00]
Firm's size (total assets)		0.063***	0.058***
		[0.00]	[0.00]
R&D expenses over assets		-1.252***	-1.228***
		[0.00]	[0.00]
Market to book value		-0.038*	-0.031*
		[0.06]	[0.07]
Cash flows		0.347***	0.324***
		[0.00]	[0.00]
Leverage		-0.294***	-0.268***
		[0.00]	[0.00]
Dividend		-0.011	-0.006
		[0.25]	[0.32]
Net working capital		-0.329***	-0.301***
		[0.00]	[0.00]
Capital expenses		0.672***	0.635***
		[0.00]	[0.00]
Safe assets		-0.483***	-0.452***
		[0.00]	[0.00]
Tobin's q		2.418**	2.251**
		[0.02]	[0.03]
Constant	0.031	0.017	0.013
	[0.29]	[0.33]	[0.39]
Credit-to-GDP			0.015***
			[0.00]
CPI			0.042***
			[0.00]
GDP per capita			0.018***
			[0.00]
Market capitalization			0.051***
			[0.00]
Diagnostics			
Adjusted R^2	0.39	0.86	0.90
AR(1)	[0.00]	[0.00]	[0.00]
AR(2)	[0.36]	[0.41]	[0.46]
Hansen test	[0.44]	[0.42]	[0.45]
Difference Hansen test	[0.47]	[0.46]	[0.49]
Instruments	3	23	31
Firm fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
No. of obs. Firms' data	22,440	22,440	22,440

Notes: Figures in brackets denote p-values. ***: p≤0.01; **: p≤0.05; *: p≤0.10.

Based on a recommendation by the referee, we also construct a sample of firms which experience negative changes in their Returns of Assets (ROA) by using the delta method (DeMiguel et al., 2009) which provides standard errors using numerical gradients. To this end, we considered those firms what experienced negative ROAs at some points over the time span and we ended up with 960 firms or 21,120 observations. The new results are shown in Table 1a with a focus on the primary results due to space constraints. The new findings seem to provide support to those in Table 1.

Table 1a. Baseline results: Dependent variable = corporate risky assets over physical capital, while errors have been obtained through the delta method

Variable	(1)	(2)	(3)
TRI	-0.364***	-0.342***	-0.335***
	[0.00]	[0.00]	[0.00]
Diagnostics			
Adjusted R^2	0.35	0.80	0.83
AR(1)	[0.00]	[0.00]	[0.00]
AR(2)	[0.31]	[0.37]	[0.42]
Hansen test	[0.40]	[0.36]	[0.38]
Difference Hansen test	[0.42]	[0.40]	[0.41]
Instruments	4	25	35
Firm fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
No. of obs. Firms' data	21,120	21,120	21,120

Notes: Figures in brackets denote p-values. ***: p≤0.01.

4. Robustness checks

A study by Adrian et al. (2022) indicates that physical and transition risks are intertwined, while papers by Andersson et al. (2020) and Batten et al. (2020) also recognize that feedback loops between these climate risks exist. Therefore, this part of the analysis adds two alternative measures of the physical risk. First, Deaths, i.e., deaths caused by natural disasters, such as wildfires, volcanic activity, storms, floods, droughts, extreme temperatures, and earthquakes (Fatouros and Sun, 2020), and second, the global Palmer Drought Severity Index (PDSI) data which build the climate risk exposure index (Hong et al., 2019); Javadi et al., 2023). The PDSI value ranges from −10 to +10, with negative values indicating drought conditions, and positive values indicating moisture conditions. A higher value of the index indicates higher long-term climate risks exposure. The new results are reported in Table 2, where column (1) uses the Deaths variable and column (2) the Drought variable as the two proxies of physical risks. The new findings document the robustness negative effect of the TRI on corporate risky asset holdings, as well as the negative effect of both physical risk definitions on such decisions.

Table 2. Both climate transition and physical risks on corporate risky asset decisions

Variable	(1)	(2)
TRI	-0.385***	-0.379***
	[0.00]	[0.00]
Deaths	-0.418***	
	[0.00]	
Drought_trend		-0.477***
		[0.00]
Diagnostics		
Adjusted R^2	0.87	0.86
AR(1)	[0.00]	[0.00]
AR(2)	[0.40]	[0.43]
Hansen test	[0.47]	[0.46]
Difference Hansen test	[0.50]	[0.49]
Instruments	27	27
Controls	YES	YES
Firm fixed effects	YES	YES
Year fixed effects	YES	YES
No. of obs. Firms' data	22,440	22,440

Notes: Figures in brackets denote p-values. ***: p≤0.01.

Based on a referee's recommendation, we check out the robustness of the results reported in Table 1 through the Difference-in-Difference (DiD) regression methodology. Based on a combination of before-after and treatment-control group comparisons, this methodology has been widely used in many fields. In our case, we use carbon emission intensities computed as emissions scaled by revenues, which removes the bias coming from large firms that have higher emissions due to the scale of their operations. This variable is prudent for carbon disclosing firms that consistently disclose emissions in consecutive years (Busch et al., 2020). In that sense, since past emissions may be either disclosed or inferred by third-party data providers, we can have these two groups for comparisons provided by our data sample. To formalize, the basic DiD version has data from two groups. Wooldridge (2012) uses in his examples the two types of data structure and discusses the potential advantages of having a panel. We construct a dummy variable, DISCL, which takes one for those firms that self-disclose their emissions and zero for inferred emissions. The new results are reported in Table 2a. Empasis is given on the variable of interest. It is evident that the new findings provide supportive evidence to those reported in Table 1; they also illustrate the support of the relevance of the act of self-disclosing emissions. Firms which disclose such information do report less risky asset holdings than their non-disclosing peers as reflected in the coefficients on the dummy variable.

Table 2a. DiD results: Dependent variable = corporate risky assets over physical capital

Variable	(1)	(2)	(3)
TRI	-0.391***	-0.376***	-0.369***
	[0.00]	[0.00]	[0.00]
DISCL	-0.237***	-0.216**	-0.198**
	[0.01]	[0.02]	[0.03]
Diagnostics			
Adjusted R^2	0.42	0.89	0.93
Controls	YES	YES	YES
Firm fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
No. of obs. Firms' data	22,440	22,440	22,440

Notes: Figures in brackets denote p-values. ***: p≤0.01; **: p≤0.05.

Finally, this part of the analysis considers the separation between financial constrained and unconstrained firms using the KZ Index (Kaplan and Zingales, 1997). Increased awareness about climate risks' adverse impact on the cost of external financing compels the financially constrained firms to decrease their risky asset holdings more than their unconstrained counterpart (Acharya et al., 2012). The results are shown in Table 3. They clearly illustrate that transition climate risks reduce risky asset holdings by firms almost five times more for the constrained group. The Chow test of coefficient equality strongly rejects the null that the transition risks coefficients in the two groups are equal.

Table 3. Financially constrained vs unconstrained firms

Variable	Financially constrained	Financially unconstrained
TRI	-0.536***	-0.129*
	[0.00]	[0.08]
Diagnostics		
Adjusted R^2	0.85	0.83
AR(1)	[0.00]	[0.00]
AR(2)	[0.44]	[0.37]
Hansen test	[0.49]	[0.40]
Difference Hansen test	[0.54]	[0.42]
Instruments	23	23
Controls	YES	YES
Firm fixed effects	YES	YES
Year fixed effects	YES	YES
No. of obs. Firms' data	14,980	7,460
Chow test	[0.00]	

Notes: Figures in brackets denote p-values. ***: p≤0.01; *: p≤0.10.

5. Conclusion

This study filled a gap in the literature concerning how transition climate risks impacted US firms' risky asset holdings decisions. The analysis documented that these firms held less risky assets to mitigate the risks associated with their exposure to transition climate risks for precautionary savings. The findings recommend that firms do view transition climate risks as a risk factor and as a result motivate firms to reduce their risky asset holdings as a precaution.

Our findings also carry important implications for certain stakeholders. The identification of transition risks highlights the need for firms for integrating climate risks into the core of their financial decisions and risk management. Moreover, regulatory bodies should do the same in their regulatory supervision activities, suggesting the value in advocating enhanced transparency and consistency in firms' disclosure of environmental metrics, such as ESG performance. This, in turn, will enable investors to make more informed decisions, leading to a more efficient allocation of capital across all markets and, thus, mitigating the risks associated with climate shocks and risks.

Potential extensions could include alternative definitions of the transition risks, alternative methods of estimates, the difference of firms as strong or weak carbon emitters, and the study of other countries.

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