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Climate Risk and Financial Instability in Asia-Pacific

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In this study, we estimate the effect of climate risk on financial instability in a panel of four developed Asia-Pacific countries from 2001Q1 to 2020Q4. The empirical results show that climate risk leads to a reduction in financial instability, but not significantly. This effect becomes more significant when mean deviation is used as a measure of financial instability.

I. Introduction

The focus of previous research has extensively been on the impact of climate-related risks on different aspects of the economy, such as agriculture (Luck et al., 2011), productivity (Belsie, 2015), labour productivity, supply (Dasgupta et al., 2021), and its relationship with the financial sector; see Dafermos et al. (2018), Lamperti et al. (2021), Semieniuk et al. (2021), Battiston et al. (2021), Chenet (2021), and Gregory (2021). Given that the effect of climate risk on financial instability can stem from the volatilities and bankruptcies arising from climate shocks that borrowing firms suffer (Lamperti et al., 2021), thus consequently affecting the lending financial institutions, the Asia-Pacific region has adopted several measures to mitigate the possible negative effects of climate-related risks. These measures include insurance models targeted at specific sectors, and advanced early warning systems for events such as floods. It is within this context that we test the hypothesis that climate risk reduces financial instability in Asia-Pacific. We explore this link between climate risk and financial instability by adopting the recent dataset on climate policy uncertainty by Gavriilidis (2021) and Caldara et al. (2021).

Our hypothesis becomes relevant as policymakers grapple with the potential consequences of climate-related risks and seek to understand the extent to which the Asia-Pacific region can withstand such risks. We do show that the region can withstand climate-related risks. This is also explained by the financial instability hypothesis of Minsky (1992), which argues that periods of economic boom, and the optimism that comes with them induce recklessness in borrowers and lenders (without proper regulations), thus creating financial bubbles that eventually burst, leading to market failures. Some of these financial investments are of-

ten made on projects that have implications for the climate and possess the potential for financial instability.

Distinct from previous studies, our paper lays specific emphasis on the effects of climate risk on financial instability in Asia-Pacific. The emphasis on Asia-Pacific stems from the fact that the region is the most vulnerable to climate risk in the world (Venkatachalam et al., 2012) and is host to six of the world's 10 most climate risk-prone countries (Hashim & Hashim, 2016). We approach this issue by adopting a random effects model based on the Hausman test result. Our results show that climate risk reduces financial instability in the Asia-Pacific region.

Following the introduction, the data and methodology for the study are presented in Section II. Section III discusses main findings while Section IV concludes the paper.

II. Data and Methodology

A. Data

We use unbalanced panel data of four developed countries in the Asia-Pacific region, namely Australia, Japan, New Zealand, and Singapore. We use quarterly data from 2001Q1 to 2020Q4. Data on exchange rates and inflation are obtained from International Financial Statistics (IFS). Data on climate risk is proxied using climate policy uncertainty obtained from https://www.policyuncertainty.com/climate_uncertainty.html, and geopolitical risk data is obtained from <https://www.policyuncertainty.com/gpr.html> based on the respective works of Gavriilidis (2021) and Caldara et al. (2021). Data on real gross domestic product (real GDP) and interest rate are accessed from the OECD database via <https://data.oecd.org/gdp/quarterly-gdp.htm> and International Financial Statistics (IFS), while data on stock prices are accessed from <https://www.investing.com/>. The

stock indices used for the study are S&P ASX 200, Nikkei 225, NZX 50, and FTSE Singapore for Australia, Japan, New Zealand, and Singapore, respectively.

According to the World Bank (2016),¹ financial instability can be proxied using market volatility. Thus, in this study, volatility in stock returns,² generated using the GARCH (1,1) process, is used as the proxy for financial instability. For robustness check, we explore the method of generating financial stability by Cihák & Hesse (2007), whereby it is measured as mean deviation of the return series of stock prices.

B. Methodology

According to Schinasi (2007), financial stability (or instability) is affected by several factors such as institutional-based factors (for example, interest rate), events (for example, geopolitical risks), and macroeconomic disturbances (for example, inflation). We control for these variables as we seek to establish the effect of climate risk on financial instability. Thus, in this study, the effect of climate risk on financial instability, controlling for other factors, is presented as follows:

$$\begin{aligned} fins_{i,t} = & \alpha_0 + \alpha_1 cr_{i,t} + \alpha_2 gpr_{i,t} + \alpha_3 inf_{i,t} \\ & + \alpha_4 exch_{i,t} + \alpha_5 rgdp_{i,t} + \alpha_6 intr_{i,t} \\ & + \mu_t + v_i + \varepsilon_{i,t} \end{aligned} \quad (1)$$

$$i = 1, 2, \dots, N; t = 1, 2, \dots, T$$

Where μ_t is the time fixed effects, v_i is the country/region fixed effects, i is the number of groups, t is the number of periods, $fins$ is financial stability (proxied as volatility in stock returns), cr is logarithm of climate risk (proxied as climate policy uncertainty), gpr is logarithm of geopolitical risk, inf is inflation (proxied as logarithm of consumer price index), $exch$ is exchange rate returns (domestic currency to the US dollar), $rgdp$ is growth in real gross domestic product, $intr$ is long term interest rate in percentage, and $\varepsilon_{i,t}$ is the error term.

The study uses the Im, Pesaran, and Shin (IPS) (Im et al., 2003) test to check for the stationarity of the series, given that it is properly-suited for unbalanced data. The result of the IPS panel unit root test in Table 1 shows that the series do not have unit roots. Based on this, the pooled ordinary least squares (OLS) would have been sufficient for estimating the relationship between climate risk and financial stability. However, it will yield inconsistent coefficient estimates as the panel structure of the model is ignored. To address this, we account for the heterogeneous nature of the data with a fixed effects (FE) or random effects (RE) model, depending on the result of a Hausman test to choose between them. The null hypothesis of the Hausman test is that the RE model is the correct estimator.

III. Results

In Table 1, it is observed from the standard deviations of both climate risk and stock returns that there is a large deviation of these series from their respective means. We find that all the variables used in the study exhibit stationarity in the first order (that is, they are $I(0)$).

In Table 2, we present our main empirical results. The results show that climate risk has a decreasing effect on financial instability. That is, climate risk lowers financial instability. Given the susceptibility of the Asia-Pacific region to the negative effects of climate crisis as a result of its dependence on natural resources and the agricultural sector, adaptation measures such as early warning systems and insurance (Venkatachalam et al., 2012) could have possibly contributed to the declining effect of climate risk on financial instability. This confirms the recommendation by Minsky (1992) that active regulatory and interventionist roles are important to avoiding the “Minsky Moment” that results in the financial system becoming unstable. The results show that the financial sector in the Asia-Pacific region can cope with climate risk, given the earlier highlighted active role of governments. This should be a boost to investors and the financial system in the region, knowing that the current state of climate conditions will not be strong enough to cause instability in the financial system.

Table 3 presents the results of the robustness test based on Cihák & Hesse’s (2007) measure of financial instability (i.e., the mean deviation of stock returns). It is observed that the effect of climate risk on financial instability is consistent (and in fact the robustness test results are more statistically significant) with the measure of financial instability based on the volatility in stock returns.

IV. Conclusion

Climate risk has the potential to cause volatilities and bankruptcies in borrowing firms, thus causing financial instability. Using a panel data of four developed Asia-Pacific countries over the period 2001Q1 to 2020Q4, we find that climate risk has a negative (but statistically insignificant) effect on financial instability. In the robustness test, this effect is consistent and statistically significant. Drawing inference from the result, Asia-Pacific countries need to continue the highlighted interventions by the government in such areas as insurance for climate-related damage and the early warning system for floods. These interventions by the governments in the region tend to reduce financial instability in the face of climate-related risk.

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¹ <https://www.worldbank.org/en/publication/gfdr/gfdr-2016/background/financial-stability>

² Stock returns is the log differences of stock prices measured in percentage form.

Table 1. Unit Root Test Results

	Mean	Std. Dev.	IPS
Stock returns	-0.403	23.526	-11.564***
Climate risk	98.645	75.775	-5.251***
Geopolitical risk	110.899	70.643	-7.261***
Inflation	0.423	0.556	-11.090**
Real exchange rate returns	94.544	11.784	-10.817***
Real gdp growth	0.714	4.860	-14.598***
Interest rate growth	3.412	2.080	-10.806***

This table reports Im, Pesaran and Shin (IPS, 2003) unit root test results. The null hypothesis of panel unit root test is that the series contain a unit root.

Table 2. Main Results

Variable	Coefficient
Climate risk	-0.0003 (0.0005)
Geopolitical risk	0.0012*** (0.0004)
Inflation	0.4243*** (0.0534)
Real exchange rate returns	0.0447 (0.0218)
Real GDP growth	0.0104 (0.0083)
Interest rate growth	-0.0647** (0.0301)
Hausman test χ^2_k (Prob)	0.37 (0.9991)
No. of cross-sections	4
No. of periods	80
R^2	0.075
No. of Observations	315

This table contains results obtained from the long, heterogenous panel analysis (namely the PMG estimator). The values reported in parenthesis are standard errors. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3. Robustness Test Results

Variable	Coefficient
Climate risk	-0.0091*** (0.0025)
Geopolitical risk	0.0611** (0.0299)
Inflation	3.7384 (4.2339)
Real exchange rate returns	0.8937 (1.2237)
Real GDP growth	0.6526*** (0.2365)
Interest rate growth	-1.3122** (0.5895)
Hausman test χ^2_k (Prob)	0.88 (0.9899)
No. of cross sections	4
R^2	0.073
No. of Observations	319

Note: This table contains robustness check results where we use mean deviation in stock returns as a proxy for financial instability. The values in parenthesis are standard errors. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.



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