Cover Letter

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Date: 08/6/2025

The Organizers

NBER Dissertation Workshop on Climate Finance
National Bureau of Economic Research
Cambridge, MA

Dear Professors Flammer and Giglio,

I am writing to express my interest in participating in the 2025 NBER Dissertation Workshop on Climate Finance. Currently, I am a Ph.D. candidate in Finance at the A.R. Sanchez, Jr. School of Business at Texas A&M International University (expected graduation in May 2026). I believe this workshop represents an opportunity to advance my research, engage with leading scholars, and further develop my contributions to the field of climate finance.

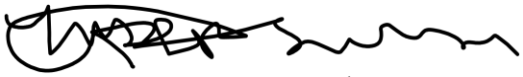
My dissertation, titled **"Greening the Balance Sheet: Climate Change Policy and the Strategic Management of Working Capital,"** examines how stringent climate change policies influence firms' working capital management decisions globally. Utilizing a unique global dataset covering fifty-four countries from 2008–2021, my research highlights that stringent climate change regulations significantly lengthen firms' cash conversion cycles. This relationship arises from regulatory compliance pressures and managerial decisions to delay investment amid policy uncertainty. Moreover, I uncover nuanced effects showing that financially unconstrained firms strategically lengthen their cash conversion cycles more significantly than constrained firms, suggesting a critical interplay between regulatory pressures, operational liquidity management, and financial flexibility.

This research contributes directly to the goals of climate finance scholarship by shedding light on how climate change policy actions reshape corporate financial behavior, influence capital allocation, and potentially affect broader financial market stability. In the long term, my research agenda will explore further intersections of climate policies and financial markets. Specifically, I aim to investigate how climate stringency affects banks' funding costs, the role of financial innovation (fintech) in mitigating macro-level climate risks, central bank independence, and how firms' innovation strategies adapt under varying climate policy scenarios.

My co-adviser, Dr. Nathaniel Graham (Assistant Professor of Finance, A.R. Sanchez, Jr. School of Business, Texas A&M International University; email: nathaniel.graham@tamiu.edu), is familiar with my research and can speak directly to its relevance and rigor.

I am excited about the possibility of discussing my research with peers and esteemed experts during the workshop, and I am eager to contribute actively to the vibrant discourse at NBER. Thank you very much for your consideration, and I look forward to your positive response.

Warm regards,



Nana Twum Owusu-Peprah
Ph.D. Candidate in Finance
Texas A&M International University

Curriculum Vitae

EDUCATION

Ph.D., Finance, Texas A&M International University, USA.	2026(Expected)
M.S. Financial Economics, Ohio University, USA.	2019
M.B.A. Finance, Ghana Institute of Management and Public Adm., Ghana	2013
Bsc. Natural Resource Mgt, Kwame Nkrumah of Science &Tech., Ghana.	2004

COURSES TAUGHT

Instructor - FIN 3310 Introduction to Finance (TAMIU)
Instructor – FIN 4380 International Finance (current)
Clinical Instructional Speaker - FIN 4335 Portfolio Management and Managerial Finance (TAMIU)

RESEARCH ACTIVITY

Selected Peer-Reviewed Journal Articles:

Owusu-Peprah, N. T. "The influence of country-level social capital on a firms' cash conversion cycle." ***Review of Corporate Finance,*** (2025) 1-2.

Owusu-Peprah, N. T. "World development report 2022: finance for an equitable recovery."***The International Trade Journal***, (2022), 129 -132.

Owusu-Peprah, N.T., Tarkom, A., Glavee, P. & Kock, N. "Within-country diversity and economic output: The role of financial development." ***Structural Change and Economic Dynamics***, (2024), 157-175.

Owusu-Peprah, N.T., Enab K., Alokla K., Elizondo T.,& Samak A. "Techno-economic analysis of CO_2 storage in depleted oil and gas reservoirs, saline aquifers, and EOR". (Society of Petroleum Engineers site)

Working Papers:

Evolving Structures and Emerging Risks: A Temporal Graph Network Analysis of the US Mid-Size and Large Interbank Market under Regulatory Shifts. (**To be submitted to Journal of Financial Stability**)

Owusu-Peprah, N.T. *Do macro-level non-performing loans matter? Using fintech to mitigate in sub-Saharan Africa.* **(working paper)**

Owusu-Peprah, N.T. *Does country-level climate change performance matter to corporate innovations?* (**Revise and Resubmit: International Journal of Managerial Finance, ABDC list, ranked A**)

Owusu-Peprah, N.T. & Graham, N. *Climate change stringency policy and working capital management: global evidence***. (To be submitted to the Journal of Behavioral and Experimental Finance)**

Owusu-Peprah, N.T. & Agyeman-Duah, M. *Do managers and their firms get disciplined by competition? The role of innovation, firm efficiency, and market concentration.* **(Under review: International Trade Journal, ABDC ranked B)**

Owusu-Peprah, N.T**.**, Tarkom A. & Glavee P. *The Benevolence of Regional Social Capital and Effective Cash Conversion Cycle Management*. **(On SSRN, Ready to be submitted)**

Work in Progress:

"Debt diversification and venture capital"

"Corporate opportunity waiver and interbank activities"

"How climate stringency affects banks' funding cost."

"How climate Change affects central bank independence"

"How the corporate opportunity waiver affects banking loans"

Conference Presentations:

Owusu-Peprah, N.T. & Graham, N. *Climate change stringency policy and working capital management: global evidence,* Annual Western Hemispheric Trade Conference (WHTC), April 2024.

Owusu-Peprah, N.T. & Agyeman-Duah, M. *Do managers and their firms get disciplined by competition? The role of innovation, firm efficiency, and market concentration, Southwestern Finance Association (SWFA) Annual Conference, February 2024*

Owusu-Peprah, N. T. "The influence of country-level social capital on a firms' cash conversion cycle, Annual Western Hemispheric Trade Conference (WHTC), April 2023

Owusu-Peprah, N.T. *Do macro-level non-performing loans matter? Using fintech to mitigate in sub-Saharan Africa*, Annual Western Hemispheric Trade Conference (WHTC), April 2022. Won a $400 award

Owusu-Peprah, N.T. Market Competition as a Disciplinary Mechanism: Does It Curb Managerial Myopia in Innovation Investments? Annual Western Hemispheric Trade Conference (WHTC), April 2025.Won a $100 award.

RESEARCH AWARD

WHTC - Best student paper award (2022) &Honorable mention award (2025)

PROFESSIONAL EXPERIENCE

Graduate Teaching Assistant, Texas A&M International University, USA.	2024-Present
Research Assistant, Texas A&M International University, USA.	2021-2024
Research Assistant, Texas Tech University, USA.	2020-2021
Teaching Assistant, Ohio University, USA.	2018-2019
Credit/Relationship Manager, Ecobank Plc, Ghana.	2008-2017

PROFESSIONAL SERVICE:
Advising (25 students) at TAMIU

Discussant at the *Financial Management Association Conference*, 2024 – The Working Capital Channel of Investment Under Uncertainty.

PROFESSIONAL MEMBERSHIP

American Finance Association (AFA). (2021 - 2024)
Financial Management Association International (FMA). (2021 - 2025)

GRANT AND HONORS:

Lamar Bruni Vergara Graduate Assistantship, Texas A&M International University
IT Scholarships for Ph.D.. Texas A&M International University
Graduate Assistantship, Ohio University

TECHNICAL SKILLS:

Proficiency: Learning Management System (Blackboard), Bloomberg Terminal, Zoom, STATA, R, MS Office suite

REFERENCES

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Dissertation

Greening the Balance Sheet: Climate Change Policy and the Strategic Management of Working Capital

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Abstract

We document that climate change stringency policy positively correlates with the cash conversion cycle (CCC). Utilizing compliance cost and real options theories, we argue that the lengthening of the CCC arises from firms' regulatory compliance efforts driven by stakeholder pressure, combined with managers' strategic delay in operational investments related to inventory, receivables, and payables amid policy uncertainty.

Using a comprehensive global panel dataset covering fifty-four countries from 2008 to 2021, we demonstrate that stricter climate change policies reduce firms' profit margins, cash flow, and cash holdings. Moreover, financially unconstrained firms lengthen their CCC more significantly compared to constrained firms.

Our findings remain robust across multiple tests, including analyses using CCC components and sub-indices of climate change stringency policy, exclusion of the global financial crisis and COVID-19 periods, alternative dependent variables, and addressing potential endogeneity via instrumental variable and difference-in-differences strategies. These results underscore that firms strategically adjust their working capital management in response to regulatory pressures, with implications for policymakers and corporate finance managers navigating stringent climate regulations.

"Alongside major technological, demographic, and political shifts, our very world is changing. Shifts in our climate bring potentially profound implications for insurers, financial stability, and the economy. Climate change is the Tragedy on the Horizon.

We don't need an army of actuaries to tell us that the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix".

Mark Carney, Former Governor of the Bank of England

Keywords: Climate Change Stringency Policy (CCPI), Cash Conversion Cycle (CCC), Regulatory Compliance, Legitimacy

JEL Classification: G15, G32, G38, Q54

1.0 Introduction

Policies regarding climate change impose challenges and at the same time opportunities on firms' financial decision-making, yet whether such policies influence the day-to-day operational dimension of the firms' working capital management remains underexplored. This study fills this gap in the literature by examining the relationship between the climate change performance index (hereafter CCPI) proxy by climate change stringency policy and working capital mismanagement, particularly, the extension of cash conversion cycle days. We are motivated by the financial liquidity issues that might arise because of the mismanagement of working capital and the concerns of society about the associated risks of the ever-changing climate. Thus, understanding this relationship is essential for policymakers and corporate managers navigating increasingly strict climate regulations. To understand the effect of stringent climate change policy on firms' cash conversion cycle, we leverage two competing theories, namely the compliance cost perspective and the real option.

First, the compliance cost theory postulates that stringent climate regulations increase operational and financial burdens on firms by lengthening the inventory period to preserve liquidity (Krueger et al., 2020; Ilhan et al., 2021). This leads to the extension of the cash conversion cycle (hereafter, CCC) days. Second, unlike the former, real option theory suggests that firms treat regulatory uncertainty (climate change stringency policy) as an opportunity to deter irreversible commitments (Dixit & Pindyck, 1994). This theory emphasizes the views of the manager as options, such that firms exposed to uncertainty and evolving regulatory environments, climate change stringency, benefit from delaying or adjusting operational decisions, such as working capital, to remain adaptable. Given this background, extension of the CCC represents a real option as it aids in the preservation of liquidity and deferment of full compliance expenditures until clearer signs of the regulatory environment emerge. Temporal financial slack emerges by lengthening the CCC, but it affords the firms time to effectively evaluate the potential outcome of the climate change policy and adjust their operational models. We integrate real options theory with the compliance cost perspective to argue that firms extend CCC in response to financial strain and strategically hedge against regulatory uncertainty.

From the lens of the Chief Financial Officer (CFO), this strategy is salient as the real option theory informs CFOs that flexibility in capital allocation, particularly under high uncertainty, holds intrinsic value. Faced with stringent climate change policy, CFOs view the levers of the cash conversion cycle, such as inventory holding period, receivables collection, and payables timing, not just as operational decisions but as contingent choices with embedded option value. Moreover, CFOs do not immediately engage in costly structural adaptation or compliance spending; rather, CFOs prioritize liquidity preservation and delay irreversible financial decisions till such a time that clearer policy trajectories are evident. Taken together, this strategy minimizes

downside risk and allows firms to take advantage of the upside opportunities, such as subsidies, reputational gains, or relaxed regulation in the future.

Using an unbalanced panel dataset covering 54 countries over 13 years (2008–2021), comprising 154,202 firm-year observations, we find that a one standard deviation increase in CCPI corresponds to a nine-day[1] increase in CCC. We identify the cost of capital as the primary mechanism for this relationship, consistent with Chava (2014). However, our study differs by treating the cost of capital as a mediator within a cross-country context. Furthermore, stricter climate policies reduce profit margins, cash flow, and cash holdings. Notably, unconstrained firms disproportionately extend CCC compared to constrained firms, who marginally reduce CCC in response to policy pressure, albeit insignificantly.

Our findings remain robust across alternative specifications, including using CCC components, CCPI sub-indices, exclusion of financial shocks (e.g., GFC and COVID-19), and various identification strategies, such as instrumental variables and difference-in-difference methods.

This research contributes to two main strands of literature. First, it expands the growing climate finance literature by linking climate change policy with firm-level operational decisions. Second, it adds to the body of knowledge in the broad corporate finance literature by illustrating how regulatory compliance on financial constraints and unconstrained firms (Whited & Wu, 2006). Our evidence suggests that in the face of regulatory risks such as stringent climate change policies, firms strategically manage CCC to offset compliance costs and preserve flexibility in line with their real option value, thereby securing future financial adaptability.

Additionally, our study also complements climate change and cash holdings studies, such as Gounopoulos & Zhang (2018), Heo (2021) and Javadi et al., (2023), which generally finds that climate risk increases corporate cash reserves. However, these studies primarily focus on cash holdings as their outcome, using variables such as drought trends or textual analyses of firm-level disclosures. In contrast, we focus on CCC and employ CCPI as a comprehensive policy-based measure of climate risk. Moreover, while two prior studies are U.S.-centric, our cross-country approach enhances generalizability.

The rest of the paper is organized as follows: Section 2 reviews related literature and develops hypotheses; Section 3 details data, variable construction, and methodology; Section 4 presents results and mechanisms; Section 5 addresses robustness and endogeneity; Section 6 concludes

2.0 Literature Review and Hypothesis Development

[1] 0.795 (coefficient in Table 2 Column 4) x 12.054 (Standard deviation of CCPI in Table 1) / (111.813 of CCC in Table 1) = 8.57%.

According to Krueger et al. (2020) Climate risks are mainly physical, regulatory, and transition risks. Physical risk is associated with asset cost and damage because of extreme weather patterns and natural disasters. Regulatory risk refers to governments' and international/ national policies and regulations that reduce carbon emissions to tackle global warming. Transition risk is the risk related to the advent of green innovations, which causes obsolescence and disruption in certain sectors of the economy. Using survey data, they find institutional investors are most concerned about regulatory risk in their portfolio, and the perception is that regulatory risk has already materialized. In another study, Stroebel & Wurgler (2021) argue that the topmost climate risk for investors and businesses is regulatory risk for the next five years and physical risk for the next thirty years. The transition to a low-carbon emissions economy, because of stringent policies, has engaged the general public's attention, as its ripple effect in certain industries has been costly.

In a study carried out in China, Huang et al. (2021) using environmental dynamic stochastic generalized equilibrium (e-DSGE) finds that severe environmental regulations to transition to low-emissions impair firms' balance sheet in the short term by forcing the firms to internalize pollution costs, which exacerbates the risk facing financial systems. Pástor et al. (2022) find that returns on green bonds are high due to strong environmental concerns. Painter (2020) finds that counties likely to be affected by climate change pay high underwriting fees and initial yields to issue municipal bonds.

Using in-sample and out-of-sample, Engle et al. (2020) found that a balanced portfolio performed well in hedging the innovation in climate news. In a cross-sectional study, high carbon emission stocks earn higher returns(Bolton & Kacperczyk, 2021). In accounting for the cost of CO2 (carbon dioxide) abatement, Gordon (2023) posits that the quantity of CO2 level abatement is more flexible to incorporate into countries' policies than the carbon tax.

Ilhan et al. (2021) examine whether uncertainties in climate policy are priced into the derivative markets, which are preferred options market products. They find that the cost of option protection against downside tail risk is high for firms with carbon-intensive business models. Fischer & Springborn (2011) theorized that a shock to the production system through tightening climate regulation reduces output and return on capital. Using the Palmer Drought Severity Index (PDSI), Hong et al. (2019) find that strict environmental regulation reduces firms' profitability ratios.

Against the background of resource allocation, Bartram et al.(2022) find that financially constrained firms, relative to unconstrained firms, reduce GHG (greenhouse gas) emissions in California but increase the emissions in other states. In examining whether climate risk impacts investors' investment decisions, Seltzer et al.(2022) find that institutional investors believe the regulatory risk already impacts their portfolio, and that mitigation approaches are risk management and engagement rather than divestment. They also find that climate risk is not priced into equity valuations, but their overvaluation is small. In a global study, Javadi et al.(2023) examined whether climate change has an impact on corporate cash holding. They find that firm

corporate cash holding is positively associated with climate change pressures. This is consistent with the findings of (Gounopoulos & Zhang, 2018; Heo, 2021).

Reconciling these strands of literature and theories enables us to formulate our hypothesis:

H1: Climate Change stringency policy relates positively to the cash conversion cycle.

3.0 Data and Methodology:

We use several data sources to investigate climate change stringency policy effects on the cash conversion cycle (CCC). These include income statements and balance sheet data from publicly listed firms on COMPUSTAT North America and Global annual files. Following the existing finance literature, we excluded all financial firms (SIC 6000-6999) and utilities (SIC 4900 - 4999) because they are heavily regulated and have different account measurements. The Climate Change Performance Index (CCPI), a measure of the Climate change stringency policy, was obtained from an independent organization called Germanwatch through solicitation. We included world development indicators such as GDP adjusted for PPP, Consumer Price Index, Real Interest Rate, and world governance indicators (Voice and Accountability, Political stability and Absence of Violence, Governance Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption), which were compressed into a single index through principal component analysis. This is because of the linear correlation among the world governance indicators.

After cleaning and merging the various datasets, we obtained firm-year observations of 154,202 and unique firms comprising 32,005 from 2008 to 2021 in 54 countries, including the United States. We converted the market capitalization of the global firms to United States dollars using exchange rates at the prevailing market rate.

We describe and construct the main variables of interest: climate change stringency policy, the cash conversion cycle (along with its components), and the controls below.

3.1 *Independent variable:*

The climate change stringency policy, proxy by Climate Change Performance Index (CCPI), is the main independent variable. Among the many objectives of the policy is to track the progress of countries in protecting and achieving the goals of the Paris Agreement of reducing global warming below the levels of 2 degrees Celsius. (Burck et al., 2019)

The annual index is developed and published by Germanwatch in collaboration with the New Climate Institute and Climate Action Network. It is an independent monitoring tool aimed at increasing transparency in international climate politics and facilitating comparisons of the progress and efforts being made by countries to combat climate change (Burck et al., 2019).

The CCPI is made up of four mutually inclusive components with their percentages to the overall index: Green House Gas (GHG) Emissions Improvements (40%), Renewable Energy (20%), Energy Efficiency (20%), and Climate policy (20%). It ranges from 0 to 100, and a higher score

on the index indicates better performance toward achieving the climate goals. The CCPI is available for 59 countries and is expensive, covering approximately 90 percent of global GHG emissions, making it one of the comprehensive indices for climate policy. See the Germanwatch website for changes to methodological calculations to the index[2].

The CCPI index measures climate change stringency policy because of its advantages of facilitating cross-country comparison using a single variable, which has been a challenge until now. It also mitigates the challenges where different national and international climate policies are being implemented unequally in intensity. The evaluation of the various countries' policies is conducted by 450 independent climate experts on an annual basis. CCPI factors in the policies and their respective outcomes by assigning weights to the outcomes, such as GHG emissions. Also, CCPI considers emissions generated from production, not consumption, making it a better fit to investigate how firms manage their working capital in the face of climate change policies. Moreover, the index is transparent and gives no room for researchers' discretion and selection biases. Finally, this index has been widely used by financial industry practitioners (e.g., Blackrock, and researchers, for example, Bolton & Kacperczyk (2023), Atanasova & Schwartz (2019), etc.

3.2 *Dependent variable:*

Working capital management of a firm, hereafter referred to as cash conversion cycle (CCC), is our main dependent variable. The CCC is defined as the period between the initial outlay of cash for purchases to receipt of money from sales (Wang, 2019). The CCC is constructed from days of sales outstanding (DSO), days of inventory on hand (DOH), and days payable outstanding (PDP). I followed previous literature by Zeidan & Shapir (2017) to construct the cash conversion cycle:

CCC= 365 * (Average Inventory/cost of goods sold + Average Receivables/sales – Average Payables/cost of goods sold).

3.3 *Controls variables:*

The control variables are mainly firm and country levels. We follow the extant literature and include return on assets (ROA), defined as income before extraordinary items divided by total assets. Size is the logarithm of total assets. Book-to-market (BM) is the book value ratio divided by the market value. Leverage (LEV) is the firm's total liabilities divided by its total assets. Sales are the firm's total revenue.

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[2] Germanwatch made some changes in the methodology calculations of the index. See the website; https://ccpi.org/methodology/

The country-level variables are the logarithm of GDP per capita (LGDP), defined as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products divided by the national population and adjusted PPP. We included the log of the Consumer Price Index (log CPI), which reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals. The real interest rate (RIR) is the lending interest rate adjusted for the effects of inflation. More precisely, it reflects the purchasing power value of the interest paid on an investment or loan. We also include world governance indicators (WgI Proxy) and use principal component analysis to aggregate the six components (Voice and Accountability, Political stability and Absence of Violence, Governance Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption) into a composite index because of the extent of correlation among these governance indicators. WgI proxy is a linear combination of these indicators with value placed on the indicators that reflect the true level of the country's governance. Detailed definitions and sources of the variables are presented in **Appendix 1**.

Table 1A

Summary statistics

Variables	**N**	**Mean**	**SD**	**p25**	**Median**	**p75**	**p95**
CCC	154202	111.813	399.960	23.12	73.032	147.06	461.415
Climate Change Stringency (CCPI)	154202	45.508	12.054	38.626	46.168	53.052	66.022
Climate Policy	154202	9.079	5.197	4.876	8.443	13.963	16.78
Renewables	154202	3.979	2.740	1.867	3.448	5.636	8.683
Energy Efficiency	154202	6.562	3.291	4.085	5.251	8.279	13.977
Emissions	154202	25.886	9.180	18.59	28.746	33.209	38.605
ROA	154169	-.068	0.353	-.003	0	.017	.111
Size	154169	2.763	2.973	.092	1.305	5.102	8.539
Book-to-Market (BM)	154202	0.167	0.459	7.47e-09	9.74e-08	0.161	1.036
Leverage	154169	.308	0.492	.006	.096	.483	.966
Sales	154123	2.503	3.023	.08	1.102	4.767	8.34
DSO	154202	127.196	281.441	40.662	66.297	107.813	342.576
DOH	154202	103.408	172.771	11.263	57.724	120.482	347.866
PDP	154202	136.524	367.857	30.551	55.152	101.287	388.345
WgI Proxy	154202	2.019	1.806	-.206	3.079	3.345	4.101
GDP (log)	154202	10.366	0.710	9.877	10.646	10.847	11.084
Real interest rate (%) (RIR)	123294	2.537	2.331	1.148	2.237	3.839	6.695
CPI (log)	135957	.59	0.886	.232	.667	1.119	1.891
Cash holding	150145	.339	0.352	0.085	0.227	0.471	1.082
Cash Flow	50826	-1.139	1.194	-0.086	0.055	0.109	0.212
Payout	48147	0.032	0.062	0	0.004	0.035	0.15
Profit Margin	154202	0.032	2.191	.179	.311	.49	.792
Environmental Concerns (Env Con)	25277	6.373	1.359	5.5	6.5	7	9

Note: This table reports the summary statistics of all the variables used. Our dependent variable of interest is the cash conversion cycle (CCC), and our independent variable is the climate change stringency policy (CCPI). We also report additional variables that we use in other heterogeneity analyses. The sample period is from 2008 to 2021 for publicly listed firms in fifty-four countries. The variables are winsorized at the top and bottom 1% level. Refer to Appendix 1 for all variable definitions.

In Table 1A, the average CCC days is approximately 112, and further investigation reveals the average days of sales on credit (DSO) is approximately 127, the average days of inventory on hand (DOH) is approximately 103, and the average days of payables outstanding (PDP) is approximately 137. The DSO and DOH days indicate how cash is tied up in the firm's operations. This revelation points to the importance of managing working capital efficiently.

The main independent variable is the climate change performance index (CCPI), which measures climate change stringency policy. This index compares countries' progress and efforts toward reducing global warming to levels below 2 degrees Celsius. The higher the value recorded by a country on the CCPI, the greater the stringency of climate change policy in that country. Also, from Table 1A, the average CCPI is 45.508. A further examination of the components of the CCPI indicates that Climate Policy has an average of 9.08, Renewables have an average of approximately 4, Energy Efficiency has an average of approximately 7, and Emissions have approximately 26. Emissions are the highest contributor to the climate change stringency policy. The country with the lowest climate stringency is the Kingdom of Saudi Arabia (20), and the country with the highest is Sweden (72). Interestingly, the stringency recorded by Sweden correlates with high CCC days of approximately 139 days, about 27 percentage points above the mean. This is consistent with our main hypothesis that climate change stringency policy influences the management of working capital, proxied by cash conversion cycle days. **See Appendix 2** for the countries and their frequency.

3.4 *Empirical Strategy*:

The focal point of our research is to establish the relationship between climate change stringency policy and cash conversion cycles (CCC) days of firms domiciled in the countries covered in our sample. To achieve this objective, we need to address two identification challenges: (1) working capital management of firms. That is, a country's climate change stringency policy can alter firms' efficient working capital management in the country. This is based on the idea that the affected firms recognize country-level CCPI as an indicator of working capital in the country. (2) Omitted variables can affect both the CCC and CCPI. For instance, the country's macroeconomic conditions may affect the cash conversion cycle management and adaptation of climate change stringency policy. These two identification challenges call for proper firm and country-level controls exogenous to the climate change stringency policy (CCPI). We address these challenges by exploiting the granularity of our dataset to include firm and year-fixed effects and clustering the standard errors at the firm level.

We then estimate the following linear model:

$$CCC_{c,i,t} = \alpha_0 + \beta CCPI_{c,t} + \gamma Firm\ Controls_{i,t} + \vartheta CountryControls_{c,t} + Firm\ FE_i$$

$$+ \text{Year } FE_t + \varepsilon_{c,i,t} \qquad \text{Eq (1)}$$

Where $CCC_{c,i,t}$ is the dependent variable defined as days of sales outstanding plus days of inventory on hand minus payable days outstanding of firm i located in a country c in a year t. $CCPI_{c,t}$ is a measure of climate change stringency faced by firms in a country c during the year t. α is the intercept term. γ is the coefficient for vector firm-level controls. We followed (Bates et al., 2009) to include firm-level controls: return on assets, firm size, book-to-market, leverage, and sales to control for firm-level heterogeneities. ϑ is the coefficient for the vector of country-level controls. Given the global nature of the study and following (Kalcheva & Lins, 2007), we include the following country-level controls: the log of GDP adjusted by PPP, Consumer Price Index, and real interest rate. To control for firm and country-level variations that are constant over time, we add firm FE and Year FE, which are firm and year-fixed effects in our model. The addition of fixed effects ensures that estimated coefficients reflect the within-country changes in CCPI and reduce time-invariant omitted variable biases in the model. The standard errors are clustered at the firm level (see Petersen, 2008, for clustering panel data). $\varepsilon_{c,i,t}$ is the error term. Our conceptual model predicts a significant positive relationship between CCC and CCPI, consistent with our hypothesis.

4.0 Results

4.1 *Univariate Analysis*

Appendix 3 presents the correlation matrix, which shows a positive and statistically significant relationship between the cash conversion cycle (CCC) and climate change stringency policy (CCPI), and the relationship is significant at a 1% significance level. The magnitude of the correlation is 0.0594. The CCPI sub-components, climate policy, renewables, and energy efficiency, also exhibit a positive relationship with the cash conversion cycle at a 1% significance level, except for emissions, which recorded a negative and insignificant relationship. The magnitude of the components of the CCPI is 0.0594, 0.0790, 0.0604, 0.0540, and 0.0038 for climate policy, renewables, energy efficiency, and emissions, respectively.

Further, the components of the CCC, days sales outstanding (DSO), days inventory on hand (DOH), and days payables (DPO), have a positive relationship with CCPI, and this relationship is significant at 1%. The magnitudes are 0.0833, 0.0771, and 0.0448 for DSO, DOH, and PDP, respectively.

4.2 *Multivariate Analysis*

Table 2 (panel A) presents the result of a linear model in equation (1). Across models, the CCPI coefficient is positive and statistically significant, confirming our hypothesis that stringent climate policies lengthen CCC. Specifically, in model 4, a one-standard-deviation increase in CCPI increases CCC by approximately nine days and is significant at the 1% level. This result underscores that stringent climate regulations impact firms' operational liquidity by delaying cash receipts post-sales transactions.

Panel B of Table 2 further decomposes CCC into its components, revealing significant positive effects of CCPI on each, and this is also consistent with our hypothesis. This is nontrivial and has economic significance. Thus, a standard deviation increase in CCPI leads to increases in DSO, DOH, and PDP by 15.64%, 5.23%, and 15.32%, respectively, and all significant at 1%. These findings indicate operational inefficiencies under stringent climate policies, notably in receivables management and inventory handling.

Table 2: Main Results.

We present our main results and other heterogeneous results in this section and beyond.

Panel A: The **Baseline Results**

VARIABLES	(1) CCC No Controls	(2) CCC Firm Controls	(3) CCC Country Controls	(4) CCC Full Sample
Climate Stringency (CCPI)	0.368*	0.378**	0.801***	0.795***
	(1.719)	(2.258)	(3.268)	(3.298)
ROA		-60.60***		-46.88***
		(-5.673)		(-3.990)
Size		102.0***		86.80***
		(14.24)		(10.19)
BM (Book-to-Market)		0.00245		0.00274
		(0.539)		(0.568)
Leverage		-84.72***		-75.12***
		(-7.775)		(-6.216)
Sale		-115.9***		-90.53***
		(-15.06)		(-9.878)
WgI proxy			-0.483	5.978
			(-0.0690)	(0.844)
GDP log			-57.12	-65.78
			(-1.320)	(-1.539)
Real Interest Rate (%) (RIR)			1.682	1.480
			(1.506)	(1.382)
CPI log			1.900	2.687
			(1.136)	(1.639)
Constant	94.91***	125.9***	659.8	744.8*
	(9.757)	(7.406)	(1.501)	(1.722)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm
Observations	150,566	150,445	110,210	110,113
R-squared	0.620	0.638	0.635	0.649

Note: This table presents the baseline regression results. CCC is the dependent variable, and CCPI is the main independent variable. It includes year and firm fixed effects. We clustered the standard errors at the firm level. In parentheses, there are robust t-statistics. ***, **, * are the significant levels at 1%, 5% and 10% respectively. All variables are described in Appendix 1.

Panel B: Regressions of the Components of CCC

VARIABLES	(1) D.V: DSO	(2) D.V: DOH	(3) D.V: PDP
Climate Stringent (CCPI)	1.650***	0.449***	1.735***
	(9.025)	(4.518)	(7.686)
Controls	Yes	Yes	Yes
Constant	-919.1***	1,564***	317.3
	(-2.879)	(7.738)	(0.904)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Cluster	Firm	Firm	Firm
Observations	110,113	110,113	110,113
R-squared	0.688	0.729	0.636

Note: This table reports the regressions of the components of CCC on CCPI. The dependent variables are DSO, DOH, and PDP, and the independent variable is CCPI. It includes year and firm fixed effects. We clustered the standard errors at the firm level. Robust t-statistics are in parentheses. ***, ** , * are the significant levels at 1%, 5% and 10% respectively. All variables are described in Appendix 1.

4.3 Mechanism Regressions

Our results thus far indicate that the Climate Change Performance Index (CCPI), a measure of climate change stringency policy, has a positive relationship with CCC. The rationale for identifying the mechanism is that the established relationship could be endogenously driven. Table 3 identifies cost of capital (COC) as a key mechanism. CCPI negatively correlates with COC, and this is significant at a 1% significance level; both CCPI and COC positively relate to CCC at a 1% significance level. This supports our theoretical argument that firms extend CCC strategically to maintain flexibility by exercising their real option under regulatory pressures by managing their capital costs.

The argument is that if CCPI reduces the cost of capital, firms will have a good reason to halt operational efficiency, which impacts DSO, DOH, and PDP, leading to increases in the cash conversion cycle. On the first stage, we regress the CCPI on the cost of capital (COC), including the battery of controls. Second, we regress CCC on CCPI and COC, including the battery of controls. The results are presented in Table 3:

Table 3: The regression Mechanism

	(1)	(2)
VARIABLES	D.V. Cost of Capital (COC)	D.V: CCC
COC		105.0***
		(5.568)
Climate Stringency (CCPI)	-0.000728***	0.857***
	(-5.859)	(3.573)
	(-0.796)	(1.658)
Controls	Yes	Yes
Constant	0.772***	651.4
	(3.599)	(1.502)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Cluster	Firm	Firm
Observations	109,975	109,975
R-squared	0.873	0.650

Note: This table reports the regressions of the mechanism using Cost of Capital as the dependent variable in column (1) and CCC in column (2), including the battery of controls. It includes year and firm fixed effects. The standard errors are clustered at the firm level. In parentheses, there are robust t-statistics. ***, **, and * represent 1%, 5% and 10% significance. All variables are described in Appendix 1.

4.4 Additional Firm-Level Effects

Table 4 highlights that stringent climate change policies negatively affect firm profitability, cash holdings, and cash flow. This is important to highlight because the metric for corporate performance is understood along the lines of profitability and cash generation.

According to the models, specifically, a one standard deviation increase in CCPI reduces profit margins, cash holdings, and cash flow by approximately 26%, 5%, and 13%, respectively and statistically significant at 1% and 10%). These findings underscore potential negative financial health implications for firms in stringent regulatory environments.

Table 4.0 Regression Results of Profit margin, Cash holding, and Cash Flow

	(1)	(2)	(3)
VARIABLES	Profit Margin	Cash holding	Cash flow
Climate Stringent (CCPI)	-0.0739*	-0.00131***	-0.0119*
	(-1.757)	(-2.992)	(-1.906)
Controls	Yes	Yes	Yes
Constant	-72.76	2.536***	226.9***
	(-1.162)	(4.136)	(4.794)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Cluster	Country	Country	Country
Observations	110,113	106,819	44,434
R-squared	0.340	0.793	0.448

Note: This table reports the results of the additional findings relating to profitability, cash holding, and cash flow. Dependent variables are Profit Margin, Cash Holding, and Cash Flow. The independent variable is CCPI. The regressions include year and firm fixed effects and clustering standard errors at the country. In the parentheses are Robust t-statistics. ***, **, and * is 1%, 5% and 10% significance level. All variables are described in Appendix 1.

In sum, the insights from the results demonstrate the negative impact of CCPI on profitability, cash holding, and cash flow, which are important factors in determining financial health, such as interest coverage and diversification in investments (Duchin, 2010) and the fortunes of firms. According to Keynes (1937) one of the merits of a liquid balance sheet is that it allows firms to undertake valuable projects when needed. However, the results presented rather stifle firms from undertaking such projects. We infer that these findings, the reduction in the firms' profitability and liquidity as a result of stringent regulation, may be the reason why major US Money Managers are boycotting Climate Action 100^{+} (Masters & Temple-West, 2024). Climate Action 100 is an investor-led action to ensure that the world's corporate greenhouse gas emitters take the necessary actions towards climate change. We also present the margin plots of the interaction between CCC*CCPI on profit margin, cash holding, and cash flow (see figures 1, 2, and 3)

4.5: Firm Behaviors - Financially constrained and unconstrained firms

Table 5 differentiates responses between financially constrained and unconstrained firms. It is important to carry out this distinction as firm responses in the face of stringent policies are heterogeneous. According to a study by Tirole, (2010), financial constraint is due to friction in the supply of capital, mainly due to asymmetric information between investors and firms. This definition is based on the curvature of the supply of capital curve and has been argued for by other researchers (Almeida & Campello, 2001; Whited & Wu, 2006). Another broader definition of financial constraint centers on the wedge between the supply of capital curve level and the firm's opportunity cost of internal capital. The proponents are mainly Fazzari et al. (1988). Following the extant literature, we use observable firm characteristics, such as dividend payout and the degree of debt, as measures of financial constraint and unconstraint.

Table 5 Financially constrained and unconstrained firms.

Responses of Financial Constraint and Unconstrained Firms

D.V: CCC	(1)	(2)	(3)	(4)
	Leverage		Payout	
VARIABLES	Constraint	Unconstraint	Constraint	Unconstraint
Climate Stringency (CCPI)	-0.105	0.839***	-1.711	1.040***
	(-0.0815)	(3.145)	(-0.764)	(4.208)
Controls	Yes	Yes	Yes	Yes
	(-1.038)	(2.069)	(0.251)	(0.520)
Constant	-13,776***	536.9	-12,733*	747.0*
	(-3.041)	(1.231)	(-1.884)	(1.755)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm
Observations	24,561	84,069	19,911	88,928
R-squared	0.644	0.663	0.620	0.665

Note: The table reports the results of the behavior of financially constrained and unconstrained firms in the face of climate change stringency policy (CCPI). The dependent variable is CCC, and the independent variable is climate change stringent policy (CCPI). The proxy measures of financial constraints and constraints are leverage and dividend Payout. These regressions include firm and year-fixed effects and cluster the standard errors at the firm level. In the parentheses are Robust t-statistics. ***, **, and * is 1%, 5% and 10% significance level. All variables are described in Appendix 1.

From Table 5, it is evident that unconstrained firms increase their cash conversion cycle days in the face of climate change stringency (CCPI). Dasgupta et al. (2019) find that constrained firms cannot build up inventory relative to unconstrained firms in the face of shocks. From column

(2), a unit increase in CCPI increases the number of days unconstrained firms receive cash after the initial outlay by approximately 0.84%, and this is nontrivial as it is statistically significant at 1%. Also, for column (4), a unit increase in CCPI increases CCC by approximately 1.04 % for unconstrained firms, which is statistically significant at 1%. This provides insights into how unconstrained firms continue to exercise their operational options in the face of regulatory risk (Krueger et al., 2020). This is done by extending the number of cash conversion cycles. There is a negative relationship between CCPI and constrained firms regarding columns (1) and (2), though not significant. By way of interpretation, constrained firms are aggressive in collecting cash in the face of climate change stringency (CCPI), underscoring the compliance cost theory.

Table 6: Robustness and Endogeneity

This section validates the baseline results and addresses issues of observable and unobservable omitted variables that have the potential to taint our results thus far.

Panel A: Components of CCPI – Climate Policy, Renewables, Emissions, and Energy Efficiency

VARIABLES	(1) D.V: CCC	(2) D.V: CCC	(3) D.V: CCC	(4) D.V: CCC
Climate Policy	0.269			
	(0.457)			
Renewables		3.681**		
		(2.535)		
Emissions			1.702***	
			(2.988)	
Energy Efficiency				3.509***
				(4.297)
Controls	Yes	Yes	Yes	Yes
Constant	776.4*	964.0**	772.4*	329.7
	(1.776)	(2.139)	(1.780)	(0.781)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm
Observations	110,113	110,113	110,113	110,113
R-squared	0.649	0.649	0.649	0.649

Note: This table reports the breakdown of the Climate Change Performance Index (climate Policy, Renewables, Emissions, and Energy Efficiency). The dependent variable is CCC, and the independent variables are the components of CCPI (climate policy, renewables, emissions, and energy efficiency). It includes fixed effects and clustering of standard errors at the firm level. In the parentheses are robust t-statistics. ***, ** and * represent 1%, 5% and 10% significance level. All variables are described in Appendix 1.

To strengthen our results, we regress CCC on the components of the CCPI and find a positive relationship between the components of CCPI (Climate policy, Renewables, Emissions, and Energy Efficiency) and CCC. In economic terms, a one standard deviation increase in Renewables increases CCC by approximately 22.16% in standard deviation, a one standard deviation increase in Energy Efficiency increases CCC by approximately 12.31% in standard deviation, and a one standard deviation increase in Emissions increases CCC by approximately 70.78% in standard deviation. These are statistically significant at 5%, 1%, and 1%, respectively. The Climate Policy component is not significant. We explain that perhaps the Climate Policy of one country is subject to the whims of the political party in government, which can be changed through elections. For example, the Former President of the USA, Mr. Trump, is a known climate skeptic who pulled the USA from the Paris Agreement on climate change, reversing the agreement signed by his predecessor. The results highlight the importance of Renewables, Emissions, and Energy efficiency as components of CCPI to positively impact the CCC days. These are consistent

with our baseline results, which show a positive and statistically significant relationship between CCC and CCPI.

Panel B: Eliminating the Global Financial Crisis and the Covid-19 Periods

DV: CCC	(1)	(2)
VARIABLES	No GFC CCC	No Covid-19 CCC
Climate Change Stringency (CCPI)	0.901***	0.760***
	(3.706)	(2.729)
Control variables	Yes	Yes
Constant	652.9	873.0*
	(1.513)	(1.914)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Cluster	Firm	Firm
Observations	107,434	99,541
R-squared	0.651	0.652

Note: This table presents eliminations of the periods of the Global Finance Crisis (GFC) and COVID-19 from the sample. The dependent variable is CCC, and the independent variable is CCPI. It includes fixed effects and clustering at the firm level. In the parenthesis are the robust t-statistics. ***, ** and * represent 1%, 5% and 10% significance level. All variables are described in Appendix 1.

Additionally, to strengthen our findings, we eliminate the Global Financial Crisis (GFC) and COVID-19 periods from our sample, as shown in Table 6, panel B. Column (1) shows a positive and significant relationship between CCC and CCPI after eliminating the GFC period from the sample. A unit increase in CCPI increases CCC by approximately 0.90% without the 2008-2009 GFC. This is statistically significant at the 1% significance level. Column (2) shows a positive and statistically significant relationship between CCC and CCPI after eliminating the COVID-19 period. To interpret, a one-unit increase in the CCPI increases CCC by approximately 0.76% and is statistically significant at the 1% significance level. These subsample results are quantitatively similar to our full-sample results, and an indication that these shocks are not the drivers of the results.

Moreover, to dispel any idea that the positive association between CCPI and CCC is spuriously driven, we use different dependent variables such as the year lag of CCC, one year forward of CCC, and the natural log of CCC, following (Heo, 2021). The explanation is that we expect differences in the contemporaneous CCC, yesterday's CCC, tomorrow's CCC, and the logarithm of CCC. Based on the empirical specification in Eq (1), we estimate the relationship between the CCPI and these dependent variables to support our initial findings further:

Panel C: **Alternative Dependent Variable; lag of CCC, lead of CCC, and log of CCC**

	(1)	(2)	(3)
VARIABLES	$_CCC_{t-1}$	CCC_{t+1}	logCCC
Climate Change Stringency (CCPI)	0.548*	0.523**	0.00249***
	(1.793)	(1.961)	(3.952)
Controls	Yes	Yes	Yes
Constant	693.3	713.2	9.788***
	(1.272)	(1.038)	(8.217)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Cluster	Firm	Firm	Firm
Observations	71,961	78,033	92,080
R-squared	0.676	0.677	0.812

Note: This table reports alternative dependent variables: one year lag of CCC, one year forward of CCC, and the natural log of CCC. The regression includes controls as described in **Appendix 1**. We also included year and firm fixed effects, and the standard errors were clustered at the firm level. In the parentheses are robust t-statistics. ***, ** and * represents 1%, 5% and 10% significance level.

To interpret, from Table 6, panel C, column (1), one unit increase in climate change stringency (CCPI) increases last year's CCC by 0.548 %, and this is statistically significant at a 10% significance level. In column (2), a one-unit increase in the CCPI increases future CCC by 0.523%, which is also statistically significant at the 5% significance level. Lastly, in column (3), one unit increase in CCPI increases CCC by 0.249%. We have demonstrated that after using different measures of the main dependent variable, our initial results still hold that there is a positive and significant relationship between CCC and CCPI.

6.1 Instrumental Variable Approach

We believe that our results are not insulated from the negative impact of endogeneity issues due to omitted unobservable and observable variables not specified in the model. To address this concern, we employ an instrumental variable approach (Angrist & Pischke, 2009). We are informed by stakeholder theory and employ the share of seats in parliament by the Green Party (%) as an instrumental variable. This instrument has been used in extant literature(Ongena et al., 2021). This instrument satisfies the relevance condition as it correlates with the supposed

endogenous variable, climate change stringency policy (CCPI), and is uncorrelated with the error term. The exclusivity condition is also satisfied as the instrument does not directly affect the cash conversion cycle (CCC) except through climate change stringency policy (CCPI), and moreover, it is not affected by macroeconomic development factors because it is mainly affected by election cycles.

. We estimate the following models for the first stage (Eq. 2) and second stage (Eq. 3) by following (Angrist et al., 1996; Angrist & Imbens, 1995). We present the first and second stages of instrumental regressions, respectively:

$$CCPI_{i,t} = \beta_0 + \beta_1 IV_{i,t} \sum_{n=1}^{5} \partial_n FirmControl_{i,t} + \sum_{n=1}^{4} \emptyset_n CountryControl_{c,t} + FrimFE_i + YearFE_t + \mu_{i,t} \quad -Eq(2)$$

$$CCC_{i,t} = \delta_0 + \delta_1 \widehat{CCPI} + \sum_{n=1}^{5} \partial_n FirmControl_{i,t} + \sum_{n=1}^{4} \emptyset_n CountryControl_{c,t} + FrimFE_i + YearFE_t + \vartheta_{i,t} \quad -Eq(3)$$

Panel D: **Instrumental Variable through Two-stage least square regressions**

VARIABLES	1st Stage CCPI	2nd Stage CCC
Green Party (%)	0.45***	
	(20.21)	
CCPI(Predicted)		11.214***
		(5.86)
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Cluster	Firm	Firm
Observations	59439	59439
R-squared	0.0068	0.0284

Under identification test
(Anderson canon. corr. LM statistic): 405.812
Chi-sq(1) P-val= 0.000
Weak Identification test
(Cragg-Donald Wald F statistic): 408.526
Stock-Yogo weak ID test critical values:
10% maximal IV size 16.38

Note: This table reports two-stage least square regression with first and second stages. The dependent variable for the first stage is CCPI, and the independent variable is Green Party seats (the instrument). In the second stage, the dependent variable is CCC, and the independent variable is the predicted CCPI. We included firm and year-fixed effects, and the standard errors are clustered at the firm level. In parentheses

there are robust z-statistics. ***, ** and * represent the 1%, 5% and 10% significance levels. All variables are described in Appendix 1

Table 6, Panel D, column (1) shows the first stage, where the relationship between the instrumental variable and the endogenous variable, climate change stringency (CCPI), is positive and statistically significant at a 1% significance level in the model (2). This satisfies the relevance condition of the instrument. From Table 6, panel D, the weak identification test, which is based on Wald F-statistic of Cragg & Donald (1993) and the critical values of (Stock & Yogo, 2005) shows a strong identification strength of the instrumental variable. Also, the under-identification test, which also checks the relevance of the instrumental variable, is significant as the P-value of the Kleibergen-Paap rk LM statistic is less than 0.05, indicating that the instrument is not under-identified. In Panel D of Table 6, column (2), we present the second stage of the instrumental variable regressions and show a positive and significant relationship between the predicted CCPI and cash conversion cycle (CCC). The coefficient is statistically significant at a 1% significance level in the model (3).

6.2 Difference-in-Difference (DID) Approach

We introduce the Paris Agreement as a shock and conduct a quasi-natural experiment around the Paris Agreement by exploiting the exogenous nature of this event to determine a causal effect of climate change stringent policy on firms' cash conversion cycle. The Paris Agreement is a legally binding international treaty on climate change that was adopted by 196 parties at the United Nations (UN) Climate Change Conference and signed on December 12, 2015[3]. The Paris Agreement, also known as COP21, is the first conference to have invited other stakeholders (non-party stakeholders), such as civil society, local governments, and academia, for dialogue on climate change. After the agreement, firms' attention was drawn to climate change as they responded to government rules and regulations, which invariably affected how they managed their operations.

Our motivation for conducting this test is to examine how firms manage their cash conversion cycle around the Paris Agreement. The estimate from this specification relies on no anticipation and parallel trend assumptions (Angrist & Pischke, 2009; Imbens & Wooldridge, 2009). The no anticipation assumption is premised on the idea that firms in our sample did not have any knowledge about the agreement before or on the day it was signed. On the other hand, the parallel trend assumption is based on the notion that the treatment and control groups will move in unison before applying the treatment and differently after the treatment. The DID provides a valuable test to validate our initial findings and alleviate omitted unobservable and

[3] See for more information on Paris Agreement: https://unfccc.int/process-and-meetings/the-paris-agreement?gad_source=1&gclid=Cj0KCQjwwMqvBhCtARIsAIXsZpYsSdgmIF6VO_d7fTld51ZOeU9GkDY2p7NE3kZygNE8WvjiY7Gnsn4aAmETEALw_wcB

observable variables that might bias our results. We accomplish this by estimating the model below:$CCC_{i,t} = \gamma_0 + \gamma_1 TCCPI_i * Post_t + \sum_{n=1}^{5} \gamma_n FirmControls_{i,t} + \sum_{n=1}^{4} \gamma_n CountryControls_{c,t} + FirmFE_i + YearFE_t + \varepsilon_{.i.t}$ --Eq (4)

TCCPI is a dummy variable that takes on a value of 1 if a firm faces a more stringent climate change policy and 0 otherwise. The Paris Agreement was signed in 2015, so the date after 2015 is characterized as the post-treatment period. *Post* is a dummy variable that takes on a value of 1 after 2015 and 0 otherwise. The coefficient (γ_1) of interest is for the interaction between $TCCPI_i * Post_t$ dummies. Based on previous literature by Angrist & Pischke (2009) and Imbens & Wooldridge (2009), when the coefficient of the interaction term is significant, then climate change stringency impacts the CCC of the treated firms following the Paris Agreement event. We added year and firm fixed effects, which capture the individual coefficients of the TCCPI and Post, and the standard errors are clustered at the firm level. In Table 6 Panel E, columns (1) through (4), the treated firms have positive and statistically significant at a 5% significance level effects on all the alternative dependent variables as shown below. This means the agreement caused the treated firms to increase their cash conversion cycle. The rest of the variables and subscripts are as defined previously (section 3.4).

Panel E: **The difference-in-difference regression.**

	(1)	(2)	(3)	(4)
VARIABLES	*CCC*	CCC_{t+1}	CCC_{t-1}	*LogCCC*
High Climate Change Stringency (TCCPI) x Post	10.51**	11.55**	15.84**	0.0265**
	(2.295)	(2.412)	(2.532)	(2.274)
Controls	Yes	Yes	Yes	Yes
Constant	704.6	833.7	792.8	9.537***
	(1.611)	(1.169)	(1.455)	(8.014)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm
Observations	110,113	78,033	71,961	92,080
R-squared	0.649	0.677	0.676	0.812

Note: This table presents a difference-in-difference. The dependent variables are contemporaneous CCC, lead of CCC , lag of CCC and log of CCC. The regression includes controls as described in **Appendix 1**. We also included year and firm fixed effects, and the standard errors were clustered at the firm level. In the parentheses are robust t-statistics. ***, ** and * represents 1%, 5% and 10% significance level.

6.0 Conclusion

We investigate the role of climate change stringency policy on firms' cash conversion cycle across many countries, which remained unexplored in the extant literature until this research. We leverage regulatory compliance cost and real options theories and argue that firms in a stringency climate environment increase the days they receive cash after transactions because of pressure from stakeholders and the irreversibility of investments so managers defer their decisions till clearer signals prevail. Unlike greenwashing, regulatory compliance costs and managers' real options are for best practices in environmental and social responsibility courses, and firms adapt by extending the days to receive cash after transactions with trading partners.

Using a large global panel dataset from 2008-2021, covering fifty countries and firm-year observations of 154,202, we find that climate change stringency policy is positively associated with an increased cash conversion cycle. Thus, the cash conversion cycle increases by approximately nine days for a one standard deviation increase in climate change stringency policy. We show that lengthening the cash conversion cycle hurts the firm's short-term liquidity position and profitability regarding profit margins, cash flow, and cash holdings. We reveal that the cost of capital is the main mechanism mediating the relationship. We document heterogeneous responses among firms, highlighting that the impact of climate stringency policy is more pronounced for financially unconstrained firms compared to financially constrained firms.

This study contributes to the growing literature on climate finance, ESG practices, and general corporate finance by providing empirical evidence linking climate change policy stringency to operational liquidity management. Given increasing investor demand for sustainable investments and stringent regulatory environments, firms strategically manage their working capital to offset compliance costs and preserve flexibility through real options.

Our results remain robust after employing various robustness checks, including analysis of CCC components, climate change policy sub-indices, alternative dependent variables, and controlling for periods of economic shocks such as the global financial crisis and COVID-19 pandemic, and other econometric specifications such as instrumental variables and difference-in-difference to address endogeneity issues.

Therefore, it is crucial to design climate change policies that balance environmental goals with firms' operational and financial sustainability.

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Appendix 1:

Variable Definitions and Sources

Variables	Notations/Sign	Definitions	Sources
Cash Conversion Cycle	CCC (+)	365*(Average Inventory/cost of goods sold + Average Receivables/sales – Average Payables/cost of goods sold).	Compustat
Climate Change Stringency (CCPI)	CCPI (+)	Climate Change Performance Index	GermanWatch
Climate Policy	Climate Policy (+/-)	National and International Policy. This is a component of CCPI.	GermanWatch
Renewables	Renewables (+/-)	Renewable energy 20230 Target compared to a well below 2 degrees Celsius. This is a component of CCPI.	GermanWatch
Energy Efficiency	Energy Efficiency (+)	Total Primary Energy Supply (TPES)/Capita 2030 target compared to a well below 2 degrees Celsius. This is a component of CCPI.	GermanWatch
Emissions	Emissions (+)	Current levels of GHG (greenhouse gas) per capita	GermanWatch
Return on Asset	ROA (+/-)	Income before extraordinary item divided by total assets	Compustat
Firm Size	Size (+/-)	Logarithm of total assets	Compustat
Book-to-market	BM (+/-)	Book value ratio divided by the market value	Compustat
Leverage	LEV (+/-)	The firm's total liabilities divided by its total assets	Compustat
Sales	Sales (+/-)	Total revenue of the firm	Compustat
Days of sales Outstanding	DSO (+/-)	Average Receivables/sales	Compustat

Days of Inventory on Hand	DOH (+/-)	365* Average Inventory/cost of goods sold.	Compustat
Days of Payable Outstanding	PDP (+/-)	Average Payables/cost of goods sold	Compustat
Cash holding	Cash holding (+/-)	Total short-term cash and Investments plus cash divided by total asset	Compustat
Cash Flow	Cash Flow (+/-)	Income before extraordinary items (ib) + depreciation and amortization (dp))/total assets.	Compustat
Dividend Payout	Payout (+/-)	Total dividends (dvt) + purchase of common and preferred stock (prstkc))/ total assets.	Compustat
World Governance Indicators	WgI proxy (+/-)	Aggregate of the World governance indicators using principal component analysis	World Bank
Gross Domestic Product per capita	GDP (log)(+/-)	The sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products divided by the national population.	World Bank
Real interest rate	Real interest rate (%) (RIR)(+/-)	The lending interest rate adjusted for the effects of inflation	World Bank
Consumer Price Index	CPI (log) (+/-)	reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals	World Bank

Green Party seats in Parliament	Green Party (+/-)	The number sits with the Green Party in parliament.	National archives of Election results

Appendix 2: -- Tabulations of the countries in the sample, frequencies and percentages

Tabulation of country

country	Freq.	Percent	Cum.
Argentina	292	0.19	0.19
Australia	4639	3.01	3.20
Austria	188	0.12	3.32
Belgium	340	0.22	3.54
Brazil	1162	0.75	4.29
Bulgaria	295	0.19	4.49
Canada	9118	5.91	10.40
Chile	109	0.07	10.47
China	17680	11.47	21.93
Croatia	392	0.25	22.19
Cyprus	274	0.18	22.37
Czechia	37	0.02	22.39
Denmark	384	0.25	22.64
Egypt, Arab Rep.	808	0.52	23.16
Estonia	86	0.06	23.22
Finland	481	0.31	23.53
France	2218	1.44	24.97
Germany	1985	1.29	26.26
Greece	881	0.57	26.83
Hungary	83	0.05	26.88
Iceland	28	0.02	26.90
India	13719	8.90	35.80
Indonesia	2317	1.50	37.30
Ireland	460	0.30	37.60
Italy	966	0.63	38.22
Japan	17351	11.25	49.48
Kazakhstan	64	0.04	49.52
Korea, Rep.	10209	6.62	56.14
Latvia	118	0.08	56.21
Lithuania	150	0.10	56.31
Luxembourg	209	0.14	56.45
Malaysia	4369	2.83	59.28
Malta	68	0.04	59.32
Mexico	450	0.29	59.62
Morocco	291	0.19	59.81
Netherlands	450	0.29	60.10
New Zealand	519	0.34	60.43

Norway	562	0.36	60.80
Poland	3122	2.02	62.82
Portugal	150	0.10	62.92
Russian Federation	825	0.54	63.46
Saudi Arabia	980	0.64	64.09
Singapore	1650	1.07	65.16
Slovak Republic	30	0.02	65.18
Slovenia	121	0.08	65.26
South Africa	937	0.61	65.87
Spain	399	0.26	66.12
Sweden	2226	1.44	67.57
Switzerland	770	0.50	68.07
Thailand	2172	1.41	69.48
Turkey	1678	1.09	70.56
Ukraine	83	0.05	70.62
United Kingdom	4413	2.86	73.48
United States	40894	26.52	100.00
Total	154202	100.00	

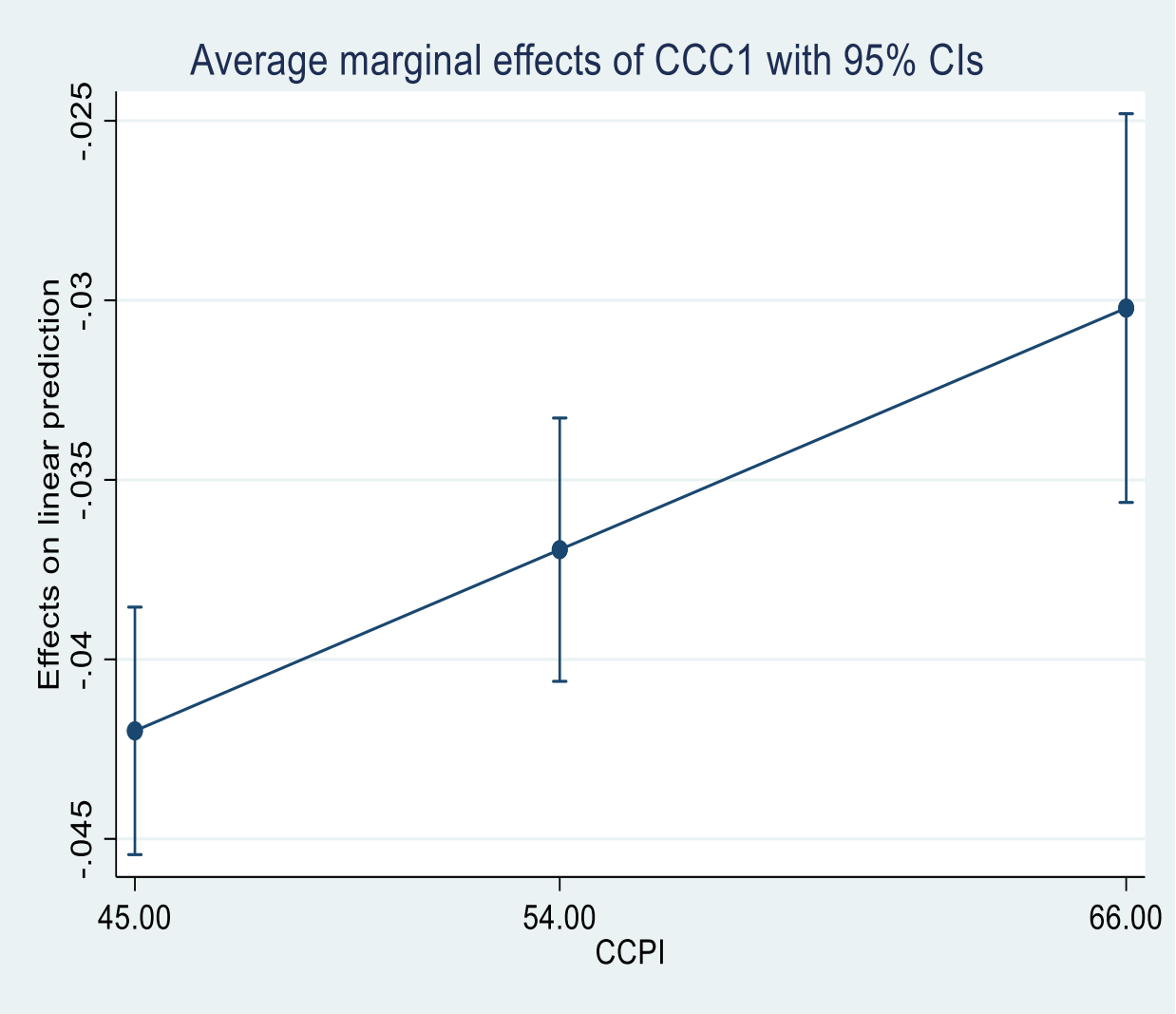
Appendix 3 – Pairwise correlation matrix of the variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) CCC	1.000																	
(2) CCPI	0.059*	1.000																
	(0.000)																	
(3) Climate Policy	0.079*	0.636*	1.000															
	(0.000)	(0.000)																
(4) Renewables	0.060*	0.342*	0.360*	1.000														
	(0.000)	(0.000)	(0.000)															
(5) Energy Efficiency	0.054*	0.366*	0.128*	0.636*	1.000													
	(0.000)	(0.000)	(0.000)	(0.000)														
(6) Emissions	-0.004	0.711*	0.114*	-0.285*	-0.144*	1.000												
	(0.134)	(0.000)	(0.000)	(0.000)	(0.000)													
(7) ROA	0.112*	0.069*	0.086*	0.084*	0.063*	-0.006	1.000											
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.026)												
(8) Size	-0.064*	-0.138*	-0.249*	-0.218*	-0.127*	0.069*	0.114*	1.000										
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)											
(9) BM	0.004	-0.207*	-0.230*	-0.230*	-0.185*	-0.007*	0.133*	0.390*	1.000									
	(0.146)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)										
(10) LEV	-0.190*	-0.079*	-0.174*	-0.154*	-0.084*	0.070*	-0.584*	0.387*	-0.079*	1.000								
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)									
(11) Sale	-0.090*	-0.113*	-0.217*	-0.200*	-0.118*	0.075*	0.208*	0.955*	0.363*	0.341*	1.000							
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
(12) DSO	0.553*	0.083*	0.073*	0.065*	0.071*	0.023*	-0.092*	-0.112*	-0.056*	-0.025*	-0.218*	1.000						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
(13) DOH	0.404*	0.077*	0.116*	0.078*	0.067*	-0.011*	-0.025*	-0.097*	-0.057*	-0.047*	-0.117*	0.194*	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(14) PDP	-0.290*	0.045*	0.030*	0.023*	0.035*	0.022*	-0.260*	-0.084*	-0.093*	0.200*	-0.172*	0.379*	0.306*	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
(15) WgI proxy	-0.123*	-0.215*	-0.426*	-0.224*	-0.172*	0.085*	-0.134*	0.431*	0.257*	0.327*	0.381*	-0.099*	-0.166*	-0.024*	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(16) LGDP	-0.128*	-0.434*	-0.470*	-0.173*	-0.181*	-0.187*	-0.141*	0.517*	0.265*	0.374*	0.462*	-0.133*	-0.155*	-0.047*	0.838*	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
(17) Real interest Rate	0.077*	0.240*	0.291*	0.025*	0.020*	0.119*	0.043*	-0.189*	-0.120*	-0.133*	-0.173*	0.094*	0.086*	0.041*	-0.429*	-0.492*	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		

(18) CPI	0.055*	0.030*	-0.004	-0.083*	0.123*	0.025*	0.051*	-0.188*	-0.035*	-0.153*	-0.165*	0.068*	0.069*	0.035*	-0.403*	-0.445*	0.224*	1.000
	(0.000)	(0.000)	(0.105)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

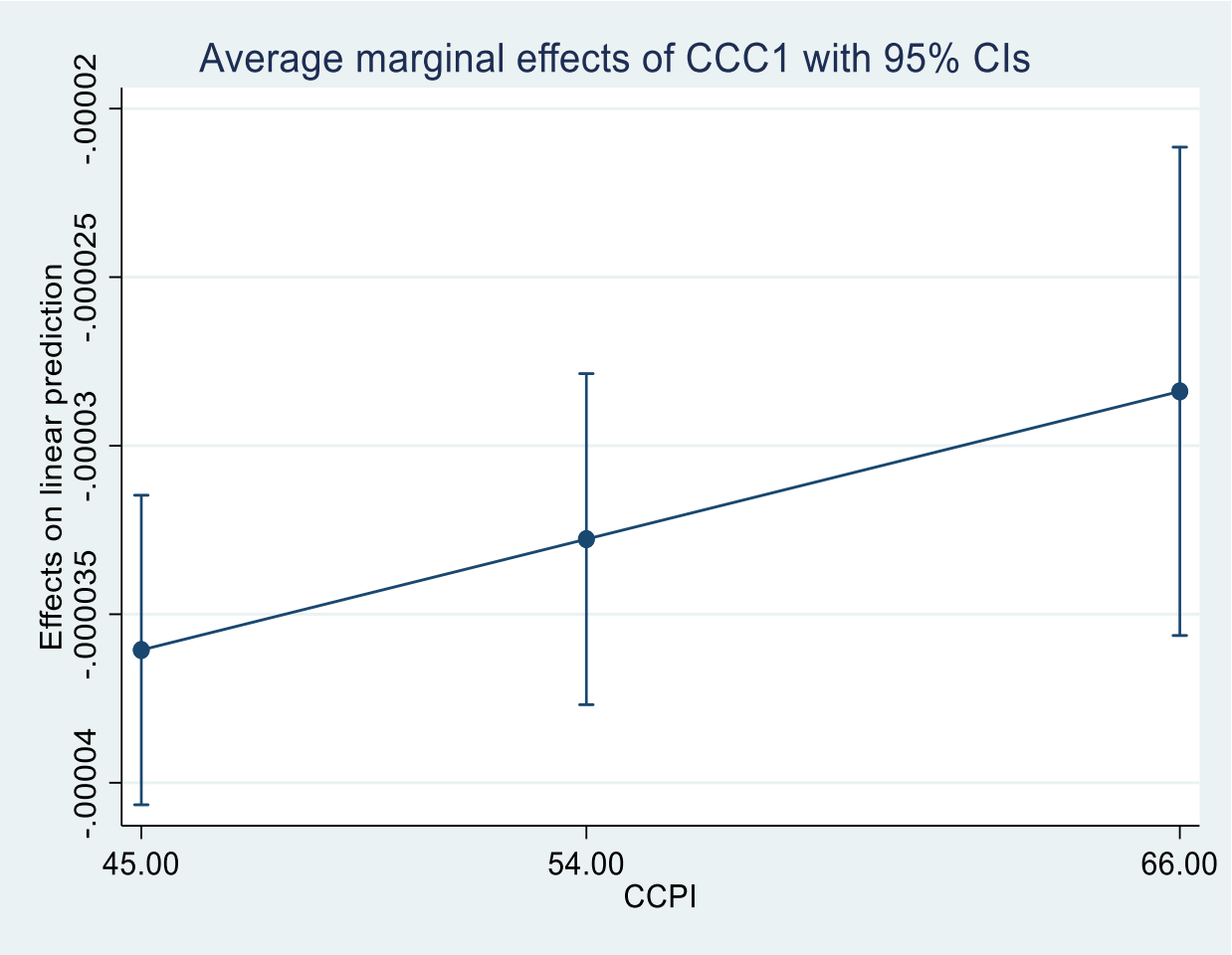
*** represents a 1% significance level.

Figure 1: Margins plot of Profit Margin on the interaction between CCC*CCPI



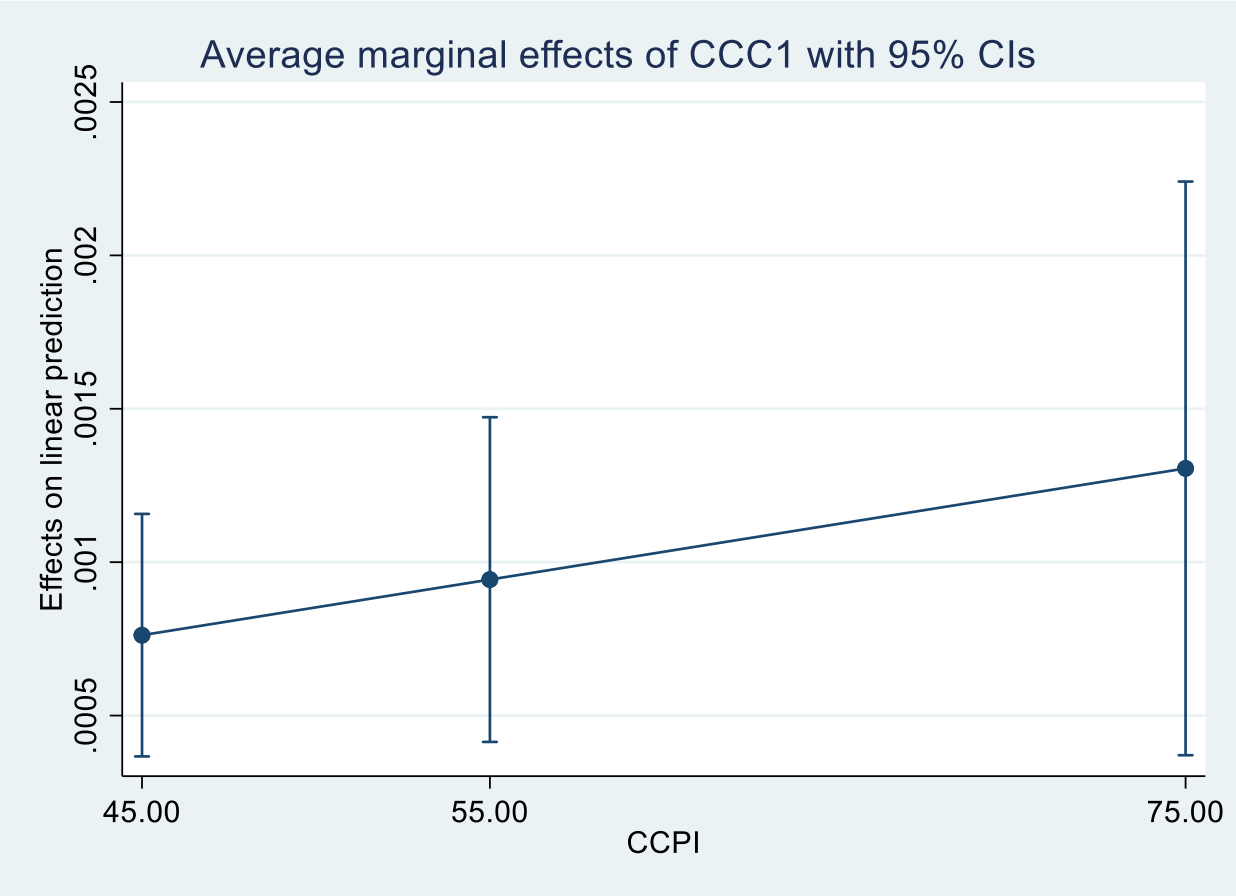
CCPI pegged at the Mean, Median, and P95

Figure 2: Margins Plot of Cash holding on the interaction between CCC*CCPI



CCPI is pegged at the mean, median, and P95

Figure 3: Margins Plot of Cash Flow on the interaction between CCC*CCPI



CCPI is pegged at the mean, median, and P95