**Motivation**
- Climate-related risks are becoming more and more relevant
  - Transition risks: regulatory reform intended to combat global warming
  - Physical risks: emerge from extreme (weather) events
- Adequate disclosure aids efficient pricing of risks
- Securities and Exchange Commission (SEC) requires firms to report self-identified (climate) risks in their annual 10-K filings (e.g. item 1.A Risk factors)
- We use BERT, a state-of-the-art NLP technique, to develop firm-specific measures of economic risks based on (qualitative) regulatory disclosure
- Analyse effect on term structure of credit default swap (CDS) spreads (including climate-related risks)
- Transition change affects firms at different horizons
- Various CDS maturities
- CDS market unlikely to be driven by preferences, focus on risk (hedging)

**The effect of (climate) risk disclosure on credit spreads: theory**

**Risk-perception effect**
- Risk disclosure may increase perception of corporate risk (Kothari et al., 2009)
- Transition risk
  - Argument based on the classical Merton (1974) model
  - Smooth transition to new regulatory regime will reduce firm’s asset value
- Physical risk
  - Increase in the severity and frequency of (extreme) climate events
  - Adding jumps to model (Zhou, 2001)

**Information uncertainty effect**
- Risk disclosure may reduce information asymmetry between firms and investors
- Transition risk
  - Disclosure reduces uncertainty on firm’s asset value (Duffie & Lando, 2001)
- Physical risk
  - Argument follows from implications of imprecise knowledge about rare events under ambiguity aversion (Liu et al., 2005)

**Methodology – BERT**
- Developed at Google (Devlin et al., 2019)
- Contextual neural language model
- Used on Item 1.A in 10-K reports
  - Look for presence of climate-relevant topics (CN task)
  - Assessment transition or physical risk (TP task)
  - Sentence level (CN) score
  - Aggregated on document level (~ firm-year level)
- Transition and Physical score

**Methodology – Regression setup**
- Baseline model – Panel first-difference model
  \[
  \Delta S^m_{i,t} = \beta_1 \Delta Transition_{i,t} + \beta_2 \Delta Physical_{i,t} + \Phi \Delta X_{i,t} + \Theta \Delta Y_{i,t} + \epsilon_{i,t+1},
  \]
  - with \( S^m_{i,t} \) next month’s (average) \( m \)-year spread
- Paris agreement. December 2015
  - Accelerated the global push for climate regulation
  - Especially relevant for transition risk disclosure
  - Effect: Transition should be even stronger after the Paris agreement
  - Introduce post-Paris dummy and interact with Transition and Physical

**Main results**
- General climate material sample

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- A one-standard-deviation increase in Transition leads to an increase of 6.99bps (4.4%) in the average five-year CDS spread for the post-Paris period.

- Focus on physical risk material industries

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- A one-standard-deviation increase in Physical results in a decrease in the average five-year CDS spread of 7.37bps (4.1%).

**Robustness check – Substantial advantage new BERT measure?**
- Carbon emissions data as proxy for transition risk
- Comparing with keyword-based NLP algorithms
  - CookESG research/CERES climate risk measure based on 10-K reports (Berkman et al., 2019)
  - Industry level climate risk materiality (Matsumura et al., 2018)
  - Disclosure reduces information uncertainty on firm’s asset value (Duffie & Lando, 2001)
- Physical risks: emerge from extreme (weather) events

**References**