Hypothesis:

- From Paper #2: Negative interest rate policy is contractionary to bank lending due to limited pass-through to deposits
- This extended paper has three aims:
  - Is the finding from paper #2 rigorous to the following robustness checks?
    - There is empirical evidence that quantitative easing may reverse the efficacy of negative interest rate policy. Therefore, our results may be biased by the interaction between QE and NIRP. Perform a DDD on countries who employed QE based on size of central bank balance sheet versus those countries that did not (relative small change in central bank balance sheet).
    - NIRP may be more appropriately evaluated by the banks that are most exposed to the policy. Banks that are particularly reliant on retail deposits for their fundings should be more impacted by NIRP. I will use data from Luxembourg (one country), which has the most complete data, and perform a DDD on retail deposit reliant banks and non-retail deposit reliant banks. Refining this analysis to one country should help further ensure that any adverse effects that impact the country (aside from NIRP) is controlled for. The country for this selection may still change, depending on analysis.
    - The majority of the NIRP-adopting countries are European. Add a dummy variable for Europe. Perform a DDD on European versus non-European banks that adopted NIRP.
  - Additional LHS and RHS variables
    - LHS:
      - Profitability of banks
      - Inflation
      - Reserve ratio
      - Savings and deposits
    - RHS:
      - Growth of Central Bank Balance Sheet Size
      - Growth of Money Supply
  - Expanding the parallel trend assumption
    - Increasing the duration to include 2008-2012
- Extra ideas:
  - Evaluating what the impact of NIRP would have been on U.S. recovery (see Literature Review)
    - Concern: no model was given in the paper, so I am not certain about how to go about creating this model.

Importance of Paper
This paper will examine the efficacy of NIRP in a number of different settings and on a number of different LHS variables, in order to isolate the effects of NIRP from other factors. This will have policy implications not only about NIRP, but in what settings, NIRP may be effective (i.e. retail deposit funded banks, European banks, etc.).

Background Information and Motivations:
- Between 2014 and 2016, a number of ECB countries adopted negative interest rate policies, meaning they would pay negative interest rates on reserves held at the bank.
- In theory, this would incentivize banks to lend money rather than lose money while holding reserves which were charged negative interest rates.
- On the other hand, since there is limited pass-through to deposit rates, NIRP can hurt bank profitability and lead banks to increase lending rates to make up for deposit funding losses.
- This paper attempts to ascertain which hypothesis is at play.

Literature Review:
- Wallace (1981) and Eggertsson and Woodford (2003): established the traditional view of monetary policy that nominal rates could never go negative. Beyond the zero lower bound, they argued further liquidity provided no additional stimulus to the economy.
  - The global financial crisis of 2008 refuted this claim as central banks around the world effectively applied unconventional monetary policies, including large asset repurchase program (LARP), forward guidance, and NIRP that rejuvenated productivity and real spending. A large body of literature has been published to convincingly establish the benefit of LARP and forward guidance. However, academics are dispersed on the issue of NIRP.
- Spiegel, Lopez and Rose (2018) find that losses in interest income as a result of NIRP are perfectly offset by savings in deposit expenses (i.e. due to lower deposit rates) and gains in fee-based income (i.e. as banks pivot their business model in favor non-interest income). These results were robust to high deposit-ratio banks, which did not seem to be “disproportionately vulnerable to negative rates” despite what the theory suggests (Spiegel, Lopez and Rose, 2018).
- On the other end of the spectrum, Eggertsson, Juelsrud and Wold argue that when interest rates turn negative, the traditional transmission mechanism of monetary policy collapses. Limited pass-through of negative policy rates to deposit and lending rates reduces bank profits and results in contractionary total effect on the economy. (It should be noted that Eggertsson was one of the early advocates of the zero lower bound.)
- Molyneux et al. find similarly that bank lending is weaker in NIRP-adopter countries and may also cancel out positive stimulus from other monetary policies. Still others have proposed more intermediate and more nuanced stances on the issue of NIRP.
- Brunnermeier and Koby (2018) propose a particularly interesting hypothesis, which they term the “reversal interest rate.” This reversal interest rate is defined as “the rate at which accommodative monetary policy reverses its intended effect and becomes contractionary for lending. Using a New Keynesian model, they find that this exact point “occurs when banks' asset revaluation from duration mismatch is more than offset by decreases in net interest income on new business, lowering banks' net worth and tightening their capital constraints” (Brunnermeier and Koby, 2018). The reversal interest rate is variable and depends on bank-specific characteristics such as...
capitalization, degree of pass-through, capital constraints and quantitative easing measures. Crucially, this rate is not well-defined and may be negative, zero or positive, or all of the above at different points in time.

  - Methodology: DSGE
  - Studies the principal tools of unconventional monetary policy and the interactions between them
  - A large balance sheet (QE) retracts from the effectiveness of NIRP

- Vasco Cúrdia: How Much Could Negative Rates Have Helped the Recovery?
  - Methodology: unclear
  - Conclusions: allowing the Federal funds rate to fall below zero may have reduced the depth of the 2008 financial recession and helped return the economy more quickly to its long-term potential. In particular, would have allowed inflation to rise faster 2% target.

- ECB: Negative interest rates, excess liquidity and retail deposits: banks’ reaction to unconventional monetary policy in the euro area
  - Key results: NIRP increases the supply of loans (particularly for retail-deposit reliant banks which are most affected by NIRP)

  - Key results: NIRP reduces bank lending.

Data:
- I’ve constructed a dataset of aggregate macroeconomic data and high frequency bank level data from 25,234 banks in the 36 OECD countries over the sample period 2008-2018.
- Sources: Global Financial Data and the World Bank

Empirical Strategy:
- Methodology: Difference-in-difference (DiD), Difference-in-difference-in-difference (DDD)
- Model specification:
  - DiD: $\Delta L_{ijt} = \alpha + \beta_1 Treated_{ij} + \beta_2 Post_{jt} + \beta_3 (Treated_{ij} \times Post_{jt}) + \beta_4 X_i + \varphi t + \epsilon_{ij}$
    - $\beta_3$ measures the NIRP effect
  - DDD: $\Delta L_{ijt} = \alpha + \beta_1 Treated_{ij} + \beta_2 Post_{jt} + \beta_3 (Var) + \beta_4 (Treated_{ij} \times Post_{jt}) + \beta_5 (Treated_{ij} \times Var) + \beta_6 (Var \times Post_{jt}) + \beta_7 (Treated_{ij} \times Post_{jt} \times Var) + \beta_8 X_i + \varphi t + \epsilon_{ij}$
    - $\beta_7$ measures the NIRP effect
- Identifying assumptions: parallel trend assumption
Potential Limitations:

- Professor Fair: “Say that in 2014 some bad thing happened to countries (not observed in X) that led them to adopt NIRP. And say that this bad thing persisted beyond 2014 (but did not exist before). Maybe this bad thing also led after 2014 to lower loan growth. And say the bad thing did not occur in the other countries. Would this bias your results?”
  - This is a potential drawback of DiD models, but the series of DDD models I have proposed will be able to check for such biases.