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| **Group Project 2: Estimate the effect of a banking regulation** |
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# Executive Summary

This paper seeks to evaluate the effectiveness of the Volcker rule announcement in reducing the trading ratio of banks in US. The results suggest that the purpose of Volcker rule is partially achieved, as the treated banks reduced the trading ratio more than the controlled banks after Dodd Frank Act was passed. Our model results are verified by robustness. However, not all banks comply with the rule. Therefore, we discussed the implications of the results to banks and regulators, the evaluation of the rule, and possible amendments to effectively regular the risk taking level of the overall banking industry.

# Introduction and Background

The occurrence of 2008 financial crisis had made many observers realize that the American financial industry lacked of effective supervision on risk taking. Consequently, the Volcker Rule was proposed as an important part of a series of regulations after the crisis. This rule forbidden banks from engaging in certain non-banking activities such as proprietary trading and hedge fund and private equity investing with some exemptions. The Volcker Rule was signed into law on July 21, 2010 as a core component of the Dodd-Frank Act, a larger financial reform legislation in the US.

As the Volcker Rule is not completely implemented yet, we focus on estimating the announcement effect of the rule on US banks. Specifically, we investigate whether the banks decreased their trading assets after the announcement of the rule. We build a full sample model and perform robustness tests to check the validity of our model results. Also, we find out the banks that are most responding and least responding to the rule by analyzing the financial characteristics of the individual. Last but not least, we explain the above results and comment on how the banks and regulators should utilize the results of our analyses.

# Modelling: Full Sample Model

First of all, we use the whole dataset to build a full sample model to analyze the general announcement effect of the Volcker Rule. In order to see the changes and differences of trading assets of the banks before and after the announcement of the Volcker Rule, we use the DiD technique to build our model.

As our focus of the effect is mainly on the changes of banks’ trading assets, ‘bhc\_avgtradingratio’ is chosen as our dependent variable to observe if banks lowered trading ratio in response to the Volcker Rule. The ‘treat\_3\_ b\_avg’ is defined as the dummy variable that represents the Affected BHC (the affected bank holding company). It takes value of 1 if the average trading asset ratio was equal or above 3% during the pre-DFA period (Q3 2004-Q2 2009), and 0 otherwise. As for the time factor, we set ‘after\_DFA\_1’ as 1 after passing the Volcker Rule, including quarters between the third quarter of 2010 and the second quarter of 2015; ‘after\_DFA\_1’ is set as 0 before the rule was passed, which is from the third quarter of 2004 to the second quarter of 2009. Besides, our model contains 2 fixed effects of BHC(γi) and time(δt) respectively to control for influences constant either over time or across BHCs. Thus the fixed effects are related to the variables ‘after\_DFA\_1’and ‘treat\_3\_b\_avg’and presented in our models through the code argument ‘effect = twoways’. Control variables are also included in our model to ensure the effect is only through the announcement of the rule; otherwise those additional covariates might vary over both time and bank and influence the outcomes. We denote these control variables with Xi,t which composed of ‘dep\_roa1’, ‘dep\_leverage’, ‘dep\_lnassets’, ‘dep\_creditrisk\_total3’, ‘dep\_cir’, ‘dep\_depositratio’, ‘dep\_loans\_REratio’, ‘dep\_liquidity’ and ‘dep\_cpp\_bankquarter’.

Therefore, our full sample model is constructed:

Yi,t = α+β\*(after DFAt\*Affected BHCi)+γi +δt + Xi,t+εi,t

And β is exactly what we focus on, standing for the coefficient of interest measuring the announcement effect of the Volcker Rule for the affected BHC.

We run this model in R and obtain the coefficient results as below.

|  |  |  |  |
| --- | --- | --- | --- |
| after\_DFA\_1 | dep\_roa1 | dep\_leverage | dep\_lnassets |
| -1.020172e+09 | 6.199419e-03 | 2.166111e-03 | -1.134556e-04 |
| dep\_creditrisk\_total3 | dep\_cir | dep\_depositratio | dep\_loans\_REratio |
| -1.814128e-05 | 3.379061e-04 | 7.620360e-04 | -9.577423e-03 |
| dep\_liquidity | dep\_cpp\_bankquarter | treat\_3\_b\_avg:after\_DFA\_1 |
| -4.123933e-04 | -2.003504e-04 | -2.337578e-02 |

The interaction coefficient β -0.02338 indicates that the affected banks reduced their trading assets relative to total assets 2.338% more than the not-affected banks, controlling other potential factors and fixed effects.

# Modelling: Robustness Tests

To verify our outcomes are robust and reasonable, we consider fixed effects in our models and verify in various approaches. The final results are displayed in the following tables.

# Propensity Score Matching (2004, 2007, 2009)

We use Propensity Score Matching to enable unbiased estimation of the treatment effect. First we use treatment dummy specification with propensity score matching for the treatment group and the control group. Then we find the coefficient of interaction term.

The first step is to select treatment group and reorganize the specific dataset including treatment and control groups from a single period. We chose 3 time periods to verify the robustness of the results. The 3 chosen distinct periods are first quarter preceding DFA announcement (Q3 2004), global financial crisis in 2008 (Q2 2007) and last quarter preceding DFA announcement (Q2 2009).

Secondly, we compute a score for the propensity of a BHC to be in the treatment group by using logistic regression for each bank forecast: dependent variable is Affected BHC, independent variables are the control variables. For each treated bank, we select 3 control banks with closest propensity score.

Finally, we run our model on the matched dataset where these banks are very similar in their propensity to be affected, with 25% of them are in the affected group.

Table: Propensity Score Matching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Full Sample | Matched  (Q3 2004) | Matched  (Q2 2007) | Matched  (Q2 2009) |
| \* | -0.02338\*\*\* | -0.02858\*\*\* | -0.0244\*\*\* | -0.0214\*\*\* |
| Constant | YES | YES | YES | YES |
| Controls | YES | YES | YES | YES |
| Fixed Effects | YES | YES | YES | YES |
| Observations | 40026 | 1668 | 2031 | 2176 |
| R-squared | 0.053 | 0.186 | 0.096 | 0.10747 |

We verify the results are robust as the coefficient of the interaction terms are all negative and the values are about the same. This suggested the treated bank after DFA has a lowered trading ratio. Also, we recommend to use the result of Matched Q2 2009, since it is closest to the date when the DFA was passed. There is a stronger validation on the control and treatment groups. Also, the closure of some banks and data issue for treated banks making matched result of 2004 and 2007 less evident and less reliable.

# Top 10 BHCs

We use the top 10 BHCs with the highest average trading asset ratio between Q32004 and Q42006, and banks with average trading asset ratio greater than 3% during the same period as our treatment group.

We found the Top 10 BHCs respond with 4% decline in trading ratio compared with non-top 10 BHCs.

# Excluding Non-trading BHCs

We excluded all observations with average trading ratio as zero and with empty value as these observation cannot be in our treated or control groups. We use all the observations and the same model as in the full sampling part to regress the coefficient of the interaction term. The value of β as -0.022 is very close to the coefficient in the previous samples. Therefore our results in the first part are robust.

Table: Robust test (Top 10 and excluding non-trading)

|  |  |  |
| --- | --- | --- |
|  | Top 10 | Excluding non-trading BHCs |
| \* | -0.0402\*\*\* | -0.022\*\*\* |
| Constant | YES | YES |
| Controls | YES | YES |
| Fixed Effects | YES | YSE |
| Observations | 1684 | 5210 |
| R-squared | 0.808 | 0.9693 |

# Modelling: Responsiveness of Individual Banks

We analyze some of the treated banks with a specific time period to verify if all banks comply with the Volcker rule. We use propensity score matching method to match dataset. Similar to rationale in part 3.1 for recommendation of model result, we choose Q2 2009 data for the matching for a more reliable outcome.

We compute the value of beta and obtain the maximized and minimized value which represent the extent of responsiveness to the Volcker rule. The bank with BHC code 2162966 responds most to the regulation, with reduction of 12.49% of the average asset ratio compared to the controlled banks. The bank with BHC code 3587146 responds least, as there is an increment of 4.11% of the average asset ratio after the DFA was passed compared to the controlled banks.

# Results

# Do the overall banking industry reduce the trading ratio?

One of the aims of introducing the Volcker Rule was to restrict banks from taking excessive risks to stabilize the financial markets, with a focus on limiting certain trading activities. To access if the banks decreased their trading assets after Volcker Rule announcement, we look at the coefficient of the interaction term (After DFA and treatment group) for the full sample model. The coefficient of -2.338% from the treatment group in the model suggests that the overall banking industry decreased their trading ratio after the announcement. This result is robust to variation in timing, a propensity score matching approach and putting Top 10 banks in terms of trading ratio as treatment. All of the above approaches result in negative coefficient for the interaction term. Therefore the banks in general reduced the trading ratio.

# Does every single bank comply with the Volcker Rule? If not, why and what is the implications?

Collectively the banking industry reduced the trading ratio in response to the Volker Rule announcement, but the reactions of each bank varies. We investigated each of the control variables for the explanations.

In fact, the bank that responded most to the policy increased their dep\_loans\_REratio (ratio of loans secured by real estate divided by total loans) at 300% from 2009 to 2015, and the coefficient of this variable is negative with its value being relatively larger than the others. This suggests the dep\_loans\_REratio plays a key role in the bank’s trading ratio. One possible reason for this is the bank viewed such loan as a relatively high risk taking business. Therefore, the bank relatively places less money on trading activities to balance the overall risk portfolio. This could be due to the fact that a major cause of the financial crisis in US was the housing bubble. Since then, the bank was more conservative in granting such loan to minimize the default risk from borrowers, and possibly the bank was pessimistic to the US property market.

In contrast, the bank responded least to the rule has its dep\_liquidity (liquidity ratio) doubled over the years. The corresponding coefficient has a larger value compared to the other control variables, and it is a positive coefficient. One explanation could be the bank’s liquidity ratio was improved so they could relatively pursue riskier trading business with the backing of stronger liquidity. Another possibility is that as more of their assets were put into other depository institutions which were believed to have low yields, the bank needed to pursue riskier business to achieve their profit target. Interestingly, this bank’s deposit ratio increased 40% over the years which may suggests that the bank needed to look for profitable business to create revenue from this additional source of cash flow.

Even so, one cannot conclude that banks respond most or least means they are most obliged or least obliged to the Volcker Rule. There could be other coincidence events and factors that are not included in our model. Firstly, banks may fundamentally transform how they do business, either from investment driven to commercial/retail driven or the other way round. Secondly, there may be a weak link between change in trading ratio and the riskiness of business taking. There are trading activities exempted by the Volcker Rule that could be more attractive to some banks, and banks may attempt to achieve same profitability level by doing riskier business with higher profit volatility in response to a drop in trading ratio. Thirdly, banks may rebalance their risk portfolio over the years to maximize their profits. Key indicators not included in our control variables can be influential in banks’ decision making on risk-taking strategy. Banks and regulators should examine the impact of Volcker Rule with caution to decide the next steps.

# How should the regulators and banks use the results?

The announcement of Volcker Rule lowered average trading ratio of banks that are affected by the Volcker Rule. This should be an expected result for the regulators as the purpose of the Volcker Rule is to reduce banks’ trading ratio. The government believed banks performed excessive trade activities with high risk that posed threat to stability of the financial industry, and led to the outbreak of financial crisis.

However, the Volcker Rule is believed to lower the profitability of a bank, since banks are restricted to certain trade activities. To compensate the loss of profit, banks could perform permitted trade business, rebalance their risk portfolio or even do non-trading business with higher risk. All these would possibly lead to higher volatility of bank profit, and does not necessary lower the overall risk portfolio, thus making Volcker Rule less effective.

Since the lowered trading ratio may not serve the purpose of decreasing the unsystematic risk of the financial market, and average trading ratio is only a part of the overall risk portfolio of a bank, we suggested using Z-score to assess individual bank’s risk level, which z=(ROA+CAR)/ ROA, where *ROA* is the return on assets, *CAR* is the capital asset ratio, and *σRoA* is the estimated standard deviation of the return on assets. We believed ROA was influential in the formula since the proprietary trading and fund investing were the major source of banks’ income, but how CAR and ROA changed after the announcement of Volcker Rule were uncertain. If CAR is decreasing and ROA is increasing, z-score will decrease which means banks have higher risk of default. Besides Z-score, the regulators should have a basket of indicators to objectively assess the holistic risk of banking industry to ensure the regulations on banks are effective.

In addition, does a drop of 2.3% of trading ratio effective in reducing banks’ trading risk level? What is the optimal trading ratio the regulators targeting? Would the Volcker Rule be lifted one day? How to cope with banks not complying with the Rule? To address this, regulators may consider implementing the Rule on targeted segments, such as on investment banks only (higher trading ratio than commercial banks), on systematically important banks only (higher impact on the banking industry and the society) or on banks with weak financial strength (higher chance to default). The regulators should also evaluate the rule regularly so the competitiveness and profitability of US banks will not be adversely affected.

For banks, if their trading book ratio is decreased, their risk and profit will decrease if other kept constant. Banks will have to look for attractive business other than trading to optimize own risk and profit. Therefore banks are likely to raise the asset return risk or increase the leverage to accomplish their profit target. Another possibility is that since the trading book ratio is decreasing, the bank will accept riskier business for more profit for the permitted trading activities. Banks have to control their overall risk taking level from excessive. Furthermore, the bank may perform their proprietary trading business outside the U.S to get rid of the Volcker Rule. This in turn is another consideration for the regulators on how to implement Volcker Rule effectively to achieve the purpose.

# Conclusions

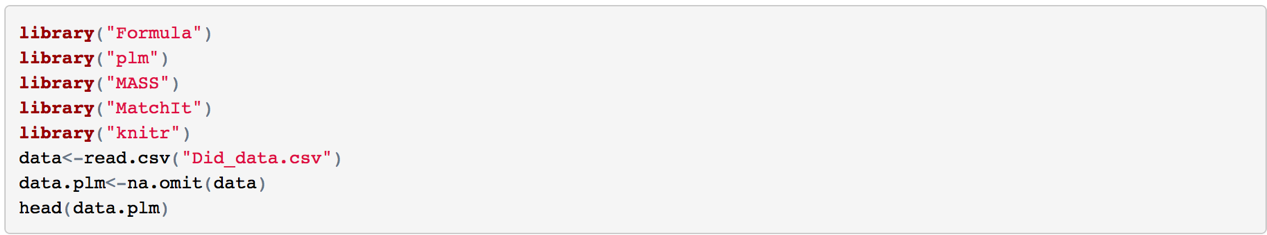
We estimate the announcement effect of the Volcker Rule on US bank holding companies. By doing so, we construct a full sample model to test the general affectedness of BHCs by the rule, and find that the bank holding companies that are affected by the Volcker Rule decreased their trading assets ratio 2.338% more than those not affected. Furthermore, we verify that the model results are robust by testing different time data, propensity score matching data, top 10 banks data and excluding zero trading assets ratio data. In this process, we identify the banks that respond to the regulation most and least. The most responding bank, decreased its trading assets ratio 12% more than banks in controlled group, has a 300% increase on its dep\_loans\_REratio. This implies the bank viewed real estate loan as high risk business thus putting less resource on other risky business such as trading. On the other hand, the bank responded least to the rule with 4% increment of trading has its dep\_liquidity doubled with a positive and relatively large coefficient. This may suggest the bank is turning to riskier trading business to pursue profit because of the improvement of its liquidity ratio and the low yields of its assets.

Summarizing all our model results, we agree that the Volcker Rule has reached part of its expected announcement effects on US banks. However, what we have analyzed about the banks’ trading ratios so far cannot be the ultimate conclusion. A more practical and macro purpose of the Volcker Rule as a part of the Dodd-Frank Act is to reduce the overall bank risk and increase the bank and thereby financial stability. Thus the regulators and government should analyze further on the risk part of the banks by using z-score or other measurements to assess the effect of the rule. This also is a reminder that when the banks adjust their strategies to comply the rule, they should ensure their risk targets are reachable but in a safe range.

# Appendices

R Codes:

1. prepare data

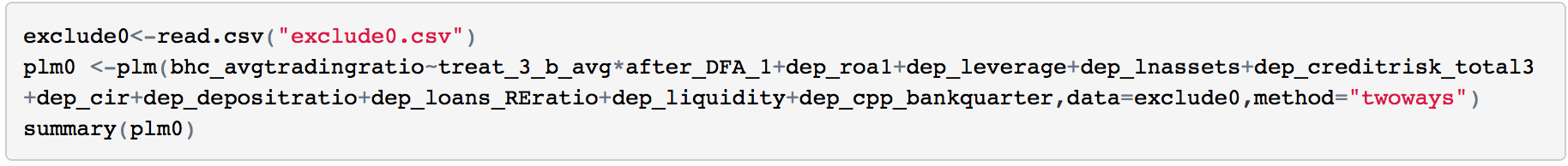


1. full sample

full<plm(bhc\_avgtradingratio~treat\_3\_b\_avg\*after\_DFA\_1+dep\_roa1+dep\_leverage+dep\_lnassets+dep\_creditrisk\_total3+dep\_cir+dep\_depositratio+dep\_loans\_REratio+dep\_liquidity+dep\_cpp\_bankquarter,data=data.plm,index=c("rssd9001","rssd9999"),method=“twoways”)

summary(full)

1. exclude zero avg. trading ratio



4. Matching for 2004,2007,2009 data. The difference lies in the data.csv

