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研究課題名(和文) Dynamics of Regulation of Strategically Complex Financial Products

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研究成果の概要(和文)：This project furthered our understanding of the constraints that regulators face when regulating banks' use of complex financial products that have embedded moral hazard problems. In particular, it shows that financial crisis may be inevitable even under some optimal conditions.

研究成果の学術的意義や社会的意義

This project highlights the difficulties that regulators face as banks/bankers are potentially not punished for taking risky bets. Even in the best case this project is able to explore, it may not be possible for regulators to stop crisis, only to forestall them for a period of time.

研究成果の概要(英文)：This project solves the following model: a repeated game where each period a bank receives a new financial product, either good/riskless, or bad/risky with bailout risk, that is, bad products are a moral hazard problem. The bank can then choose to make bad products complicated, making it costly for regulators to monitor banks. The regulator faces limitations in designing its optimal regulation as they cannot use fines or monetary rewards to the bank. Under some parameter restrictions and under commitment the optimal solution is to promise a "reward" phase for banks which allows for a (extended) period where no risky products are used. But once this "reward" phase is reached, banks will continuously use bad products and financial crisis become a statistical inevitability. This project also shows how quantitative computational methods can be applied to the above theoretical results. And it explored how an empirical calculation of complexity might be achieved via NLP methods.

研究分野：Financial Macroeconomics

キーワード：Financial Regulation Financial Complexity Optimal Contracts

1 . 研究開始当初の背景

As was seen in the 2007-2008 global crisis and in prior crises, such as the Savings and Loan (S&L) crisis of the 1980s, many financial institutions are bailed out during crises. This creates a moral hazard issue between banks and regulators/governments, as banks have incentives to take risky bets that are profitable if successful, but upon failure, create large costs on regulators/society from bailouts. Furthermore, both of the above crises have been blamed, in part, due to the deliberate use of complex products to make risky bets. For example, Michael Lewis, a former banker, wrote of the S&L crisis: "Many 'new products' invented by Salomon Brothers were outside the rules of the regulatory game (...) to dodge new regulations, the market became ever more arcane and complex." There is also literature exploring how banks deliberately create complex products as a way of misleading customers, as can be seen in papers like Carlin (2009), Henderson and Pearson (2011) and Celerier and Vallee (2017), all of which find evidence that banks profit from customers by using complexity to mislead retail customers. Finally, Yotsuzuka (2013) reported that, although Japan did fairly well in the 2007-2008 crisis, the creation of complex structured products, especially non-credit ones, has been growing, meaning that this is likely to become an important issue of concern for Japanese regulators. Thus, the key scientific question of this study was: given the incentives for banks to create risky and complex financial products, how should regulatory agencies design their monitoring procedures over time, taking into account that banks can try to dodge oversight/regulations?

Carlin, Bruce I. "Strategic price complexity in retail financial markets." *Journal of Financial Economics* 91, (2009).

Célérier, Claire, and Boris Vallée. "Catering to investors through security design: Headline rate and complexity." *The Quarterly Journal of Economics* (2017).

Henderson, Brian J., and Neil D. Pearson. "The dark side of financial innovation: A case study of the pricing of a retail financial product." *Journal of Financial Economics* 100, (2011).

Lewis, Michael. *Liar's poker*. WW Norton & Company, 2010.

Yotsuzuka, Toshiki. "Complex Financial Products in Japan: Evolution of Structured Products and Regulatory Responses." *Current Developments in Monetary and Financial Law* (2013): 327.

2 . 研究の目的

This study aimed to find the optimal regulatory design when banks can use financial product complexity to dodge regulations. The main goal was both to find the optimal regulatory regime and to compare these results with what regulators have done in the past. This would be done in view of trying to help regulators avoid future crises. The project also aimed to provide ways of applying existing methods (dynamic games and NLP) that were previously unused to explore questions in financial regulation.

Formally stated, the core problem that was aimed to be solved was that of optimal dynamic (that is, over time) regulation of a bank, which is large enough to present a systemic risk and might try to avoid financial regulation by making its financial products complex enough to avoid regulatory scrutiny. This was to be done using the approach taken in the literature on dynamic games with one-sided private information, such as in Abreu, Pearce and Stacchetti (1990) and Li, Matouschek and Powell (2015). This was to be extended by using quantitative computational methods.

Finally, there was the intent to test theoretical results by collecting data on product complexity and regulatory intensity to compare regulators and banks' actions. This portion was extended and gained importance throughout the project and it became the baseline for for which to continue the theoretical portion of the paper; it became clearer that it was important to have clearer empirical foundation for the model assumptions.

In addition, there was an intent test the sensitivity of our results to our model and parameter assumptions, such as by adding the regulation of more than one bank, using both analytical and computational methods. In summary, the project was composed of three parts: a theory portion, a quantitative computational section, and an empirical component.

Abreu, Dilip, David Pearce, and Ennio Stacchetti. "Toward a theory of discounted repeated

games with imperfect monitoring." *Econometrica: Journal of the Econometric Society* (1990): 1041-1063.

Li, Jin, Niko Matouschek, and Michael Powell. *The Burden of Past Promises*. working paper, Northwestern University, 2015.

3 . 研究の方法

As is partially explained above, the theoretical portion of the paper was based on using methods for solving repeated games to solve a baseline model. This consists of a repeated game where each period the bank receives a new financial product, either good/riskless, or bad/risky with bailout risk, that is, bad products are a moral hazard problem. The bank can then choose to make bad products complicated, making it costly for regulators to monitor banks. The regulator faces limitations in designing its optimal regulation as they cannot use fines or monetary rewards to the bank. Essentially, only by using costly, "full monitoring", which impedes banks from ever using bad products, can banks "punish" banks.

This can be feasibly solved under some parameter restrictions and under commitment and, indeed, was solved as is reported below; in summary, regulators can promise a "reward" phase for banks which allows for a period where no risky products are used. The project aimed to extend this solution method to other cases.

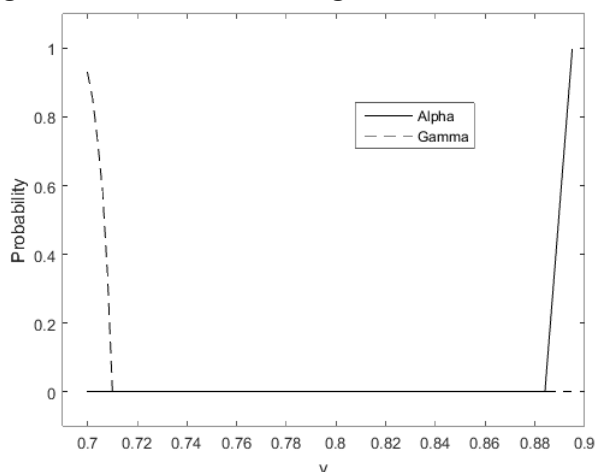
The use of a program like Matlab also allowed for optimal promised paths under specific parameter values. Again, the case under commitment was solved and paths were calculated, as can also be seen below and the plan was to use these methods for model extensions, including the no commitment case,

Finally, for the empirical side, there was much evolution of the strategy through the project. At the end, the focus became on finding a suitable database of financial prospectus that would allow for a broad measure of financial complexity using NLP methods to analyze the structure of these prospectus. In this respect, there was much development of the tools themselves, but finding a suitable database proved to be unfeasible.

4 . 研究成果

On the theory side, this project managed to find the optimal regulatory regime under full commitment analytically. The equivalent computational result may be seen below. The project also discussed extensively how to solve the model when there is no commitment, which using standard methods; this was deemed an important step as it would allow for a more realistic assumption that financial regulators face when devising incentives for banks.

For the quantitative computational part, this project simulated and checked the sensitivity of the regulatory plan to changes in parameters. An example of these results can be seen in the graph to the right, which shows the how, in the standard case where regulators can made commitments, the probability of bad complex products being used (Alpha) and the monitoring effort of regulators (Gamma) change over time. In summary, monitoring effort of regulators is essentially zero for the majority of time, until the promised continuation value (v , which in this context also represents a



non-linear passage of time) reaches a high enough value that banks, who have not used bad products up until this point, are now allowed to do so as a "reward" for their good behaviour. This result highlights how the limitations in rewarding and punishing banks means that at best, that is, when regulators are able to fully commit to past promises, it is possible to forestall any crisis for an extended period of time, but at some point, once the "reward" phase is reached, a crisis becomes a statically inevitably as banks will use bad products that will eventually fail. Further computational explorations of these results by changing parameter values, although producing more complex regimes, did not change the overall path found in the baseline case.

For the empirical portion, the development of understanding of NLP methods, such as Global

Vectors for Word Representation, TensorFlow and associated Deep Learning methods, allowed for an unrelated project in Political Science to proceed. It was also possible to much better develop, in a broad sense, a general understanding of the available databases and possible ways of measuring complexity in financial systems.

5. 主な発表論文等

〔雑誌論文〕 計0件

〔学会発表〕 計1件（うち招待講演 0件 / うち国際学会 1件）

1. 発表者名 Franco de Campos Pinto, Pedro
2. 発表標題 “Securitization, Non-Recourse Loans and House Prices”
3. 学会等名 EEA/ESEM（国際学会）
4. 発表年 2018年

〔図書〕 計0件

〔産業財産権〕

〔その他〕

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6. 研究組織

氏名 (ローマ字氏名) (研究者番号)	所属研究機関・部局・職 (機関番号)	備考
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7. 科研費を使用して開催した国際研究集会

〔国際研究集会〕 計0件

8. 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関
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