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THE PRINCIPLE OF COST-BASED SUPERVISION IN PRACTICE

LUIS DUMLAO

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A key response of financial regulators around the world to the financial and economic crises of ten years ago has been the formation of supervisory committees. Such committees now exist in several countries worldwide. Consequently, many regulators fund their supervisory function by charging their supervisees. The objective of this paper is to compare how these regulators charge fees, identify common practices, draw conclusions from observations, and provide relevant recommendations. This paper especially focuses on the Federal Reserve, the European Central Bank, and the Bank of England, which charge fees just enough to recover the cost of the supervisory function, or those that follow what this paper refers to as the "principle of cost-based supervision." A discussion on how selected examples of regulators practice the principle of cost-based supervision follows. Simulations of fees using selected procedures for supervisees in the Czech Republic and Greece follow. Then, this paper introduces the asset elasticity of cost, denoted as n, and simulates the hypothetical supervisory fee if n is constant.

Keywords:

Bank Supervision, Supervisory Fee, Cost-Based Supervision

JEL Classification: E50, E58, E59

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A key response of financial regulators around the world to the financial and economic crises of ten years ago has been the formation of supervisory committees. Such committees now exist in several countries worldwide. Consequently, many regulators fund their supervisory function by charging their supervisees. The objective of this paper is to compare how these regulators charge fees, identify common practices, draw conclusion from observations, and provide relevant recommendations. This paper especially focuses on the Federal Reserve, the European Central Bank and the Bank of England that charge fees just enough to recover the cost of supervisory function, or those that follow what this paper refers to as the "principle of cost-based supervision." A discussion on how selected examples of regulators practice the principle of cost-based supervision follows. Simulations of fees using selected procedures to supervisees in the Czech Republic and Greece follow. Then this paper introduces the asset elasticity of cost notated as n and simulates the hypothetical supervisory fee if n is constant.

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1 Introduction

"A key response of official sectors around the world to the financial and economic crises of ten years ago has been the formation of financial stability committees" (Aikman et al, 2019 page 107). Such committees now exist in over 40 countries worldwide (Edge and Liang 2017). Consequently, many regulators fund their supervisory function by charging their supervisees.

This paper covers six cases on how regulators finance their supervisory function. Among the six regulators covered in this paper, which include the Federal Reserve (the Fed), the European Central Bank (ECB), the Bank of England, the *Bangko Sentral ng Pilipinas* (BSP), and the Monetary Authority of Singapore (MAS), five fund their supervisory function by charging and collecting from supervisee institutions. Only one regulator which is the Financial Services Agency (FSA) which is under the Ministry of Finance of Japan funds its supervisory functions with government budget. The objective of this paper is to compare how the former five charge fees, identify common practices, draw conclusion from observations, and provide relevant recommendations.

This paper especially focuses on the Fed, the ECB, and the Bank of England that charge fees just enough to recover the cost of supervisory function or follow what this paper refers to as the "principle of cost-based supervision." In comparing how the regulators practice the principle of cost-based supervision, this paper answers arising nuanced questions. For example, in determining the aggregated cost, do supervisory authorities include supervisory cost only, or do they include additional regulatory cost? Do regulators primarily aggregate the cost, or do they exclude costs specific to certain supervisees such as site visits? How do regulators in practice distribute the charging to individual banks? Specifically, do regulators charge based on the size of the asset, weighted average between size of the asset and risk exposure, or some proxy of the actual cost associated with the size of the asset and risk exposure?

The rest of the paper is organized as follows. The second section covers a brief review of literature. The third section describes the methodologies of this study. The fourth section discusses the principle of cost-based supervision using selected case studies of supervisory authorities. Note that this is limited to how regulators fee supervision and does not cover the cost-benefit of bank supervision and the actual supervision. The fifth section reviews supervision in practice identifying the determinants of cost and nuances. The sixth section simulates hypothetical supervisory fees using selected procedures for specific supervisees in the Czech Republic and Greece. Note that the selection of Czech and Greek banks is due to the oral presentation in the Open Science Conference organized by the European Research Center based in the Czech Republic held in Athens, Greece. The comparison is just as applicable in other jurisdictions. The seventh section introduces the asset elasticity of cost notated as η and the simulated hypothetical supervisory fee if η is constant. The eighth and last section provide conclusions from observations and related recommendations on how regulators practice the principle of cost-based supervision.

2 Review of Literature

"A key response of official sectors around the world to the financial and economic crises of ten years ago has been the formation of financial stability committees" (Aikman et al, 2019 page 107). Such committees now exist in over 40 countries worldwide (Edge and Liang 2017). Consequently, some regulators fund their supervisory function from government budget, for example, the Financial Services Agency (FSA) of Japan. However, some regulators design their supervisory function independent of government (Amtenbrink and Markakis, 2019)[1]. Specifically, some fund their supervisory function by charging their supervisees, for example the Fed (Federal Reserve System, 2013, p. 52391).

[1] The motivation of regulators is to keep their supervisory function unbiased and neutral from governments (Amtenbrink and Markakis, 2019). For example, they can insulate themselves from political pressures for example from punishment with decrease budget or from reward with increase budget.

Among the latter, some regulators charge fees just enough to recover the cost of supervisory function. Such practice has no established term in literature. For lack of term, this paper will refer to the practice as the “principle of cost-based supervision.” How equal is the charging with the actual cost depends on some nuances. As will be seen in succeeding case studies, regulators often aggregate the cost of supervision and distribute the charging to individual supervisees. Hence, even if the aggregate fee equals the aggregate cost of supervision, the fee charged to a specific supervisee does not guarantee to equal the cost of supervising the same. Another angle is that supervision and regulation are different but there are overlaps (Eisenbach et al, 2016). Hence, some regulators include some regulation costs on the supervision fee. Another angle is that bank supervision has technological economies of scale (Eisenbach et al, 2016). This implies that supervision cost increase with the size of the supervisee, but that a percent change in size increases the cost by less than a percent. Succeeding simulations in this paper indicates the extent to which the charging reflects technological economies of scale.

This paper reviews nuances in the implementation of the principle of cost-based supervision, make conclusions out of observations, and give relevant recommendations on how charging of fees to specific supervisees can be more equal to the cost of supervision of the same.

3 Methodology

The fourth section uses case studies especially the case of the Fed, the ECB, and the Bank of England that follow the principle of cost-based supervision. The fifth section uses descriptive research on the nuances of charging supervisory fees. The sixth section uses simulation using the procedures of the Fed, the ECB, the Bank of England, and fixed rate to calculate the hypothetical fees among Czech and Greek banks. The seventh section uses mathematical proof on how one can charge supervisees reflecting constant technological economies of scale; it also uses simulation to calculate hypothetical fees and prove that it reflects the principle of cost-based supervision.

Note that the selection of Czech and Greek banks is due to the oral presentation in the Open Science Conference organized by the European Research Center based in the Czech Republic held in Athens, Greece. The comparison is just as applicable in other jurisdictions. The coverage of this study is limited to on how regulators fee supervision and does not cover the cost-benefit of bank supervision which is covered in Eisenbach et al (2016) and the actual supervision which is subject to discretion (Carbo-Valverde, 2015). This paper hopes to kindle regulators to find the real value of what this paper refers to as the “asset elasticity of cost” or η in their respective jurisdictions so that they may apply it in their charging.

4 The Principle of Cost-Based Supervision Fee

This section uses case studies especially the case of the Fed, the ECB, and the Bank of England that follow the principle of cost-based supervision.

In response to the financial and economic crises of ten years ago, governments in over 40 countries have formed financial stability committees to watch over and supervise financial institutions. This section focuses on regulators that fund their supervisory functions by charging its supervisee institutions. Some regulators charge fees just enough to recover the cost of supervisory function. Such practice has no established term in literature. For lack of term, this paper will refer to the practice as the “principle of cost-based supervision.” What follow are brief case studies of selected supervisory authorities whether they practice the said principle. Note that this is limited to how regulators fee supervision and does not cover the cost-benefit of bank supervision which is covered in Eisenbach et al (2016) and the actual supervision which is subject to discretion (Carbo-Valverde, 2015).

4.1 The Case of the Federal Reserve System

"Section 318 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) directs the Board of Governors of the Federal Reserve System (Board) to collect assessments, fees, or other charges (assessments) … equal to the expenses the Board estimates are necessary or appropriate to carry out its supervision and regulation of those companies" (Federal Reserve System, 2013, p. 52391). More so, "the Reserve Banks' operating expenses are determined through a cost accounting system that provides uniform methods of accounting for expenses, allowing each Reserve Bank to determine the full cost of its and all Reserve Bank services" (Federal Reserve System, 2013, p. 52396).

In determining the fee for each supervisee institution, each pay a fixed amount of 50 thousand USD plus a subset of its asset. Where r_n is the supervisory fee for supervisee n, a is the assessment rate or is the part of the fee that is a proportion of the asset, and b_n is the asset of supervisee n, the Federal Reserve charges supervisory n the amount of:

$$r_n = 50,000 + a \times b_n. \tag{1}$$

Where R is the total revenue from supervisory fees and N is the total number of supervisees, then R is:

$$R = N \times 50,000 + a \times \sum_{n=1}^{N} b_n. \tag{2}$$

In determining a, where S is the assessment basis or defined as "the expenses the Board estimates are necessary or appropriate to carry out its supervision and regulation of those companies" (Federal Reserve System, 2020), and B is the total assessable assets or the sum of assets of all supervisees, the Federal Reserve's a is:

$$a = \frac{S - N \times 50,000}{B}. \tag{3}$$

Rearranging the above gives:

$$S = a \times B + N \times 50,000. \tag{4}$$

Whether the Fed follows the principle of cost-based supervision, R must equal S. Juxtaposing equations (2) and (4) gives:

$$N \times 50,000 + a \times \sum_{n=1}^{N} b_n \langle ? \rangle a \times B + N \times 50,000 \quad \Rightarrow \quad a \times \sum_{n=1}^{N} b_n \langle ? \rangle a \times B \quad \Rightarrow \quad \sum_{n=1}^{N} b_n = B. \tag{5}$$

Hence, the revenue collected from supervisory fees mathematically guarantees to equal the assessment basis. Note, there is no theoretical guarantee that the assessment basis is the actual cost for supervising the banks for two reasons. First, the assessment basis is based on the amount "necessary or appropriate to carry out its supervision and regulation" (Federal Reserve System, 2020) and not on supervision only. Second, the Fed calculates the assessment basis through a cost accounting system, albeit the system can be set through public consultation.

4.2 The Case of the European Central Bank

The European Union uses the Single Supervisory System (Carbo-Valverde et al, 2015) and the Treaty on the Functioning of the European Union confers the supervisory tasks to the ECB on big banks or cross-border border groups in the Euro area (Amtenbrink and Markakis, 2019). "The total annual fees are based on the actual costs incurred, which are known following the closure of the ECB's financial accounts for the year concerned" (European Central Bank, 2022, see also Amtenbrink and Markakis, 2019). The ECB publishes "the total amount of annual supervisory fees and the related ECB Decision" in Annual Report on supervisory activities (European Central Bank, 2022). For example, the ECB publishes the total annual fees for 2021

in the Official Journal (European Central Bank, 2022). For example, the breakdown of the costs is in Table 1 (European Central Bank, 2021). Further, the ECB adjusts its fee from previous surpluses, for example, resulting in the "downward adjustment of the 2020 supervisory fee as a result of the surplus from the 2019 fee" (European Central Bank, 2022a).

Table 1: European Central Bank's Breakdown of 2021 Annual Supervisory Fee (in million EUR)

	Actual Expenditure 2021	Actual Expenditure 2020
Prudential supervision, of which	443.1	429.9
Off-site supervision and surveillance	243.4	249.3
On-site inspections	46.7	45.2
Policy, advisory and regulatory functions	151.6	130.6
Crisis management	1.3	4.7
Macroprudential tasks	22.4	12.4
Supervisory statistics	45.6	46.2
Supervisory Board, secretariat, supervisory law	66.4	47.0
Total expenditure for banking supervision tasks	577.5	535.3

Source: ECB, 2021

The ECB collects different fixed fees from significant and less significant banks. Where f_S is the fixed fee for "significant" banks, S is the assessment basis, and N, N_S and N_L are the number of supervisee institutions, the number of significant and less significant supervisee institutions respectively, the formula for f_S as derived from ECB (2022a) is:

$$f_S = \frac{0.1 \times S}{N} \quad \Rightarrow \quad f_S = \frac{0.1 \times S}{N_S + N_L}. \tag{6}$$

For less significant banks, the fixed rate or f_L is half that of significant banks' and is:

$$f_L = \frac{f_S}{2} = \frac{\left(\frac{0.1 \times S}{N}\right)}{2} = \frac{0.05 \times S}{N}. \tag{7}$$

The total receivable from fixed fees is:

$$F = N_S \times f_S + N_L \times f_L. \tag{8}$$

Where v_n, b_n and e_n are the variable fee, the asset and exposure of supervisee n, B is the total assessable assets, and E is the total exposure of all supervisees, v_n as derived from ECB (2022a) is:

$$v_n = \left(0.5 \times \frac{b_n}{B} + 0.5 \times \frac{e_n}{E}\right) \times \left(S - F\right). \tag{9}$$

The total receivable from variable fees only is:

$$V=\sum_{n=1}^{N} v_n=\sum_{n=1}^{N}\left[\left(0.5\times\frac{b_n}{B}+0.5\times\frac{e_n}{E}\right)\times\left(S-F\right)\right]=0.5\times\left(S-F\right)\times\left(\frac{1}{B}\sum_{n=1}^{N} b_n+\frac{1}{E}\sum_{n=1}^{N} e_n\right) \quad (10)$$
$$=0.5\times\left(S-F\right)\times\left(1+1\right)=S-F \quad \Rightarrow \quad V=S-F \quad \therefore \quad V+F=S.$$

Hence, the revenue collected from supervisory fees mathematically guarantees to equal the assessment basis. In addition, the ECB's determination of supervisory fee to individual supervisees is it is not just based on weighted asset; rather, the fee is fifty-fifty based on weighted asset and weighted exposure. Charging fee based also on exposure provides an incentive for supervisees to take on less risky positions.

4.3 The Case of the Bank of England's Proposal

At the onset of Brexit, the Bank of England has set out a consultation on how it intends to collect supervisory fees. Accordingly, "the Bank's annual financial market infrastructures 'FMI' supervisory fee includes the costs of FMI supervision staff together with relevant policy support, specialist resources, corporate services and other costs associated with the work of the FMI Directorate" (Bank of England, 2022). The computation of cost is specific. For example, Table 2 shows the cost for special project fees (SPF) per position and per GBP per hour.

Table 2: Bank of England Special Project Fees (GBP per hour)

	Previous rate	New rate from 2022/23 fee year
Administrator	55	60
Associate	115	130
Technical Specialist	170	190
Manager	215	250
Any other persons employed by the Bank	320	350

Source: Bank of England, 2022.

In determining the fee collected among specific supervisees, the Bank of England categorizes an FMI in one of the three.

"The FMI categories are described as follows: category one – most significant systems which have the capacity to cause very significant disruption to the financial system by failing or by the manner in which they carry out their business; category two – significant systems which have the capacity to cause some disruption to the financial system by failing or by the manner in which they carry out their business; and category three – systems which have the capacity to cause at most minor disruption to the financial system by failing or by the manner in which they carry out their business" (Bank of England, 2022).

After the categorization, the Bank assigns the fee ratios among UK central securities depositories (CSDs) as 1.5:1:2/3. In other words, per 100 GBP of assessment basis, the Bank collects about 47 GBP from category 1 CSDs, 32 GBP from category 2 CSDs, and 21 GBP from category 3 CSDs. Whether the Bank follows the principle of cost-based supervision, it addresses at the conclusion of the fee year through either a rebate or a request for additional fees "any variances" between the fee collected and the actual cost.

4.4 The Case of the *Bangko Sentral ng Pilipinas* (BSP)

The BSP has the mandate of "supervision over the operations of banks and exercise such regulatory and examination powers" (Republic of the Philippines, 2019, Section 2). With

supervision comes supervisory fee and “in determining the amount of the annual supervision fee, the Monetary Board shall consider the costs of supervision” (Republic of the Philippines, 2019, Section 11). In the implementation of the law, the BSP determined the supervisory fee for 2020 as a proportion of the Average Assessable Assets from the preceding year; and that the proportion is determined as 1/28 of 1% for Universal/Commercial Banks, Thrift Banks, and Non-Banks with Quasi-Banking (NBQB) functions; and 1/40 of 1% for Rural/Cooperative Banks (*Bangko Sentral ng Pilipinas*, 2020).

Note that the motivation for showing the practice of the BSP is to have an example case where an authority charges a fixed rate on asset.

Whether the BSP follows the principle of cost-based supervision, there is no mathematical way to prove that the fee which is a proportion of asset is equal to the advisory cost. Operationally, it is not clear whether the BSP follows the principle of cost-based supervision. In a BSP Circular (*Bangko Sentral ng Pilipinas*, 2020), in collecting the annual supervisory fees denoted as ASF, “the resulting over or under-payment of the 2019 ASF shall be deducted/added to the 2020 ASF” (*Bangko Sentral ng Pilipinas*, 2020). Assume that the BSP derives the over or under payment from the cost of supervision and not from a revenue target. Then while the principle of cost-based supervision is not a guarantee each year, the BSP can follow the principle through future deductions and credits. Still, the law states that the BSP is tax exempted from “income from its activities or transactions in the exercise of its supervision over the operations of banks” (Republic of the Philippines, 2019, Section 44.a) which implies that it can charge profit on top of the cost of supervision.

4.5 Others

In Singapore, “Prudential and Supervisory Requirements” is under the Monetary Authority of Singapore (Monetary Authority of Singapore, 2022). The requirements cover those related to Capital Adequacy, Asset Maintenance, Places of Business, Operations, Financial Statements, Statistical Returns, Anti-Commingling, Islamic Banking, Private Banking and Deposit Insurance. It is not explicit whether the Authority charges supervisory fee per se. The explicit charging is on annual license to operate fee as head office and per branch and application fee for new banks (Singapore Statues Online, 2022). The supervision cost is likely to be costlier if a bank is a head office or if a bank has more branches for example because of more site visits. However, there is no guarantee that the fees collected is equally identical to the supervisory cost, and hence, there is no guarantee that the Authority follows the principle of cost-based supervision.

In Japan, the supervision is the function of FSA which is under the Ministry of Finance which is under government. Note that the FSA does not collect supervisory fee; rather, it operates within the national budget. That is unlike the Fed, the ECB, the Bank of England, the BSP, and the MAS that collect and receive from supervisees to fund their supervisory functions, the FSA collects and receives from government to fund the same. The central bank which is the Bank of Japan does not supervise banks. However, the Bank functions as a lender of last resort and can provide liquidity to supervisees. When a supervisee borrows from the Bank, the latter gets the authority to audit the former.

4.6 General Observation

Especially the Fed, the ECB and the Bank of England, the principle of cost-based supervision is based on the aggregated cost of supervision of all supervisees. In all the three examples and the BSP, the bigger the supervisee’s asset, the bigger is the cost. The belief is that the bigger the supervisee’s asset, the more time spent on supervising it. But because the fee is asset based, then there is no guarantee that the additional supervisory fee on a specific supervisee compensates one-to-one with the additional cost. However, if the fee is cost-based on a specific supervisee, then the increasing supervisory fee is consistent with the cost whether the cost is increasing at an increasing, constant, or decreasing rate with asset.

Finally, the Fed, the ECB and the Bank of England’s methods have no inherent theoretical incentive to minimize the assessment basis for the supervisory operations, albeit that each regulatory authority can open its supervisory cost accounting to the public.

5 Supervision in Practice and Cost

This section uses descriptive research on the nuances of charging supervisory fees.

"Section 318 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) directs the Board of Governors of the Federal Reserve System (Board) to collect assessments, fees, or other charges (assessments) … equal to the expenses the Board estimates are necessary or appropriate to carry out its supervision and regulation of those companies" (Federal Reserve System, 2013, p. 52391); hence it is clear that the assessment basis covers supervision and regulation. For the ECB, Amtenbrink and Markakis (2019) point out that the law requires the ECB to report its cost from its supervisory tasks separately and identifiably within its entire budget. Moreso, they observe that the chair of the Supervisory Board which is under the ECB is fully aware of the limits of the mandate of supervision. For example, in meetings with members of the European Parliament, the chair retorts non-supervision issues to relevant authority like money laundering to national justice, bank resolution to the Single Resolution Board, and policy interest rates to the ECB. Hence, the assessment basis theoretically covers supervision only. For the Bank of England, "the Bank's annual financial market infrastructures 'FMI' supervisory fee includes the costs of FMI supervision staff together with relevant policy support, specialist resources, corporate services and other costs associated with the work of the FMI Directorate" (Bank of England, 2022); hence, the assessment basis is primarily based on supervision plus "other costs." And for the BSP, the central bank "shall have supervision over the operations of banks and exercise such regulatory and examination powers" (Republic of the Philippines, 2019, Section 2). Hence, the assessment fee is based on supervision and regulation.

Taking the context of Eisenbach et al (2016, p. 1), "regulation is 'coarse' and can only be contingent on verifiable information." "Regulation can therefore restrict banks' activities ex-ante (for example, a ban on the trading of physical commodities) and respond to asset payoffs ex-post (for example, the imposition of penalties after a breach of a capital requirement)" (pp. 2-3). In its purest form, regulation is law and enforceable through courts, and therefore requires verifiability (Maskin et al, 1982).

Further from Eisenbach et al (2016, p. 1), "supervision is 'discretionary' and can be contingent on non-verifiable information." Supervision can respond to interim signals about bank actions and influence asset payoffs before a suspected problem becomes reality. In practice, a gray area can exist between supervision and regulation, as exemplified by stress testing and the fact that some supervisory activities involve compliance with regulations (see for example Goldsmith-Pinkham et al, 2016). In practice, supervisory authorities address to supervisees of the required interventions by communicating "matters requiring attention" (MRAs)" and "matters requiring immediate attention (MRIAs)" (Eisenbach et al, 2016, p. 10).

One can divide supervisory efforts into two steps. First is supervisory monitoring which is the stage in which the supervisor collects data. Second is supervisory intervention which is the stage in which the supervisor if needed enforces corrective action. Table 3 summarizes the rationale and differentiate regulation from supervision according to the Federal Reserve Bank of St. Louis (2017), and similarly with other supervisory authorities.

Regulators supervise either "continuously" such that they do so over the year, or in a "punctuated" fashion such that they do so at a certain point of the year. While continuous supervision is more effective, resource constraints limits supervision to punctuated approach which in practice rotates focused attention from bank to bank, concentrating resources on the full scope examinations, which the law mandates to complete annually (Eisenbach et al, 2016). Therefore, if supervision occurs periodically, then one can measure the resource allocated and or devoted for specific banks. Evidence in the US suggests that "supervision for the larger BHCs (bank holding companies) is conducted mainly continuously, while for the smaller institutions attention is punctuated and displays periodic patterns" (Eisenbach et al, 2016, p. 28).

Eisenbach et al (2022) studied the Fed's determinants of supervisory cost. What follows is a paraphrase and simplified version of the stochastic equation they employed. Where s is the

assessment basis for a specific supervisee, *k* is a constant, *b* is asset, *e* are exposure or risk, and η and ρ are regression coefficients, the simplified and paraphrased regression equation they run follows:

$$\Delta Ln(s) = k' + \eta \Delta Ln(b) + \rho \Delta Ln(e) + \varepsilon_t, \quad \varepsilon \sim iid. \tag{11}$$

Table 3: Rationale for Regulation and Supervision

Rationale	Regulation	Supervision
Macro-prudential supervision: for example, to avoid financial crisis.	The government sets law for the entire industry and the authority polices bank compliance.	The authority looks for patterns for example credit bubbles and recommend for new regulation or have banks comply or explain.
Micro-prudential supervision: for example, to protect the deposit insurance corporations and government from having to cover bank runs.	The government sets minimum capital requirements.	The authority applies stress tests, determine whether the bank still meets the minimum capital requirements under "unlikely but plausible severe economic scenarios" (Tarullo, 2019, page 66), recommend, and have a supervisee comply or explain.
Consumer protection: for example, to give consumers as informed choices as they can have.	The government requires supervisee lenders to express interest rate uniformly for example in terms of the Annual Percentage Rate.	The authority examines supervisees' transparency, provide recommendation for new laws, and have a supervisee comply or explain.
Competition: for example, to keep a competitive market among banks.	The government sets rules that combat collusion and speculation.	The authority looks over, define, and police over practices that are anticompetitive and speculative; because it is impossible to pass a law for every anticompetitive and speculative practices, and that there is continuous "innovation" in anticompetitive and speculative practices; the authority can recommend new laws and/or have supervisee comply or explain.

Source: Author's summary.

Their finding and the implication follow.

1. As the bank size increases, the number of supervisory hours increase. This justifies for the supervisory fee to increase with bank asset.

2. The number of hours of allocation depends on supervisory technology. Because of technological economies of scale in supervision, a 100 percent increase in bank size increases the needed resource to supervise by less than 100 percent. In Eisenbach et al (2022), the percentage increase in the needed resource to supervise per percentage increase in bank size is 0.6 (page 3). The implies that the supervisory fee increase by less than 100 percent (say 60 percent) per 100 percent increase in asset.
3. The same with Hirtle et al (2020), Eisenback et al (2022) find that banks de-risk when supervision increases. This implies that it is beneficial to allocate more supervisory resources and hence fee to supervisees in riskier position.
4. The number of hours of allocation is a function of subjective preference. For example, being the biggest bank may subject that bank to disproportionate attention (Eisenbach et al, 2017, Hirtle et al, 2020). This implies that if one conducts a similar study, the regression requires fixed effects to obtain the true increase in supervisory cost with supervisee size and risk.

Another issue that Eisenbach et al (2016) raised is whether raising the minimum required bank capital reduce the supervisory cost. If raising bank capital and supervisory monitoring are substitutes, then raising bank capital or "bail in" reduce the supervisory cost because doing so contains the moral hazard of taking on excessive risk or distortion of risk-taking incentives (see Tarullo, 2019, Duffie, 2019, and Carbo-Valverde et al, 2015) reducing the optimal supervisory monitoring and the supervisory cost. However, if raising bank capital and supervisory intervention are complements, then raising bank capital can increase supervisory cost because the probability of the supervisee not meeting the requirement increases the optimal supervisory intervention and the supervisory cost. Whether the substitutability or complementarity outweighs one or the other is ambiguous (Eisenbach et al, 2016).

6 Comparative Fees Using Different Models

This section uses simulation using the procedures of the Fed, the ECB, the Bank of England, and fixed rate to calculate the hypothetical fees. This exercise takes the asset of selected banks in the Czech Republic and Greece from Wall Street Oasis and the Hellenic Bank Association, respectively. Note that the selection of Czech and Greek banks is due to the oral presentation in the Open Science Conference organized by the European Research Center based in the Czech Republic held in Athens, Greece on 27 May 2024. The comparison is just as applicable in other jurisdictions.

The Fed estimates that "the total costs necessary or appropriate to carry out its supervision and regulation of assessed companies for 2018, 2019, and 2020 were $599.7, $638.6 million, and $624.0 million, respectively. For the 2020 assessment period, the assessment basis is $617.4 million" which is the average of the last three supervision years (Federal Reserve System, 2020). According to the same source, the total assessable assets is 21.392 trillion USD. Dividing the former by the latter, the result is 0.0000289. That means that the Fed fees 2.89 USD per 100 thousand USD. The total ECB supervisory fee for 2021 is 577,462,903 EUR (European Central Bank, 2022a). The total assets of all its supervisees are 25,091.66 billion EUR (European Central Bank, 2022). Dividing the former by the latter, the result is 0.0000230. That means the ECB fees 2.30 USD per 100 thousand USD of asset.

Calculating from the Bank of England, its assessment basis is 6.73 million GBP; the exercise sums the date from Table 4. The total assets of the banking sector in England are 17.19 trillion USD (Statista, 2022) which at the exchange rate of 1.25 USD per GBP converts to 13.75 trillion GBP. Dividing the former by the latter (in GBP), the result is 0.0000004895. That means that the Bank of England fees 0.05 USD per 100 thousand USD of asset. The BSP charges a fixed rate of $1/28^{th}$ of 1 percent of a supervisee's asset (Bangko Sentral ng Pilipinas, 2020). That means that the BSP fees 35.71 USD per 100 thousand USD. Table 5 provides a summary of the said calculations.

Table 4: Assessment Basis of the Bank of England for 2022/23 (in million GBP)

	CCPs	CSD	Payment systems and service providers
Category one	2.71	1.33	0.68
Category two	1.55	n.a.	0.46
Category three	n.a.	n.a.	n.a.

Source: Bank of England, https://www.bankofengland.co.uk/paper/2022/fees-regime-for-financial-market-infrastructure-supervision-2022-23-consultation-paper-2022

Table 5: Calculation of Effective Rate of Supervisory Fee

	Assessment Basis	Total Assessable Assets	Effective Rate of Supervisory Fee
Federal Reserve System	617.40	21,392,000.00	2.89 per 100 thousand
European Central Bank	577.46	25,091,660.00	2.30 per 100 thousand
Bank of England	6.73	13,750,000.00	0.05 per 100 thousand
Bangko Sentral ng Pilipinas			35.71 per 100 thousand

Source of Assessment Basis and Total Assessable Assets of the US and Euro Area: Federal Reserve Bank (https://www.federalreserve.gov/supervisionreg/supervisory-assessment-fees.htm), European Central Bank (https://www.bankingsupervision.europa.eu/organisation/fees/total/html/index.en.html & https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2022.103.01.0014.01.ENG&toc=OJ%3AL%3A2022%3A103%3ATOC). Rest are author's estimates as explained in paper.

For the rest of the hypothetical assessment, this exercise assumes that the effective rate of supervisory fee is that of the ECB which is 2.30 per 100 thousand. Summing up the assets indicated in Table 6, the assessment basis is 156.722 million CZK and 6.689 million EUR, respectively.

The Fed has a fixed fee of 50 thousand USD. Following the formulation of the assessment rate expressed in equation (3) and using the exchange rates at the writing of this paper, then:

$$a = \frac{S - (N \times 1{,}135)}{B} = \frac{156{,}722 - (10 \times 1{,}135)}{6{,}814{,}000{,}000} = 0.0000213. \quad (12.1)$$

$$a = \frac{S - (N \times 46)}{B} = \frac{6{,}689 - (5 \times 46)}{290{,}806{,}000} = 0.000022. \quad (12.2)$$

Adding the fixed fees with variable fee which are 0.0000213 and 0.00022 respectively of asset of a supervisee, the hypothetical supervisory fee using the Fed formula is in Table 6 under the column with the label "Fed." Note again that the total of all assessment as indicated in the bottom of Table 6 are equal to the intended assessment basis which are 156,722 thousand CZK and 6,689 thousand EUR, respectively, which follows the principle of cost-based supervision.

Table 6.1: Comparative Fees Using Different Models Among Czech Banks (in thousand CZK), 2020

			ECB					Constant Elasticity w Risk	
	Asset	Fed	From	To	B of E	Fixed Rate	Constant Elasticity	From	To
Ceskoslovenska Obchodni Banka (CSOB)	1,756,000,000	38,598	22,891	32,660	24,746	40,388	31,047	18,135	28,583
Ceska Sporitelna	1,538,000,000	33,947	20,547	30,316	24,746	35,374	28,613	16,919	27,367
Komercni Banka	1,167,000,000	26,032	16,558	26,327	24,746	26,841	24,030	14,627	25,075
UniCredit Bank Czech Republic and Slovakia	664,000,000	15,301	10,366	20,135	12,373	15,272	16,521	10,872	21,320
Raiffeisenbank	411,000,000	9,903	7,645	17,414	12,373	9,453	12,065	8,644	19,092
Hypotecni Banka	346,000,000	8,517	6,946	16,715	12,373	7,958	10,843	8,033	18,481
Moneta money bank	301,000,000	7,557	6,462	16,231	12,373	6,923	9,950	7,587	18,035
PPF Bank	273,000,000	6,959	6,161	15,930	10,998	6,279	9,373	7,299	17,747
Fio Banka	183,000,000	5,039	5,194	14,963	10,998	4,209	7,238	6,231	16,679
J&T Banka	175,000,000	4,868	5,108	14,877	10,998	4,025	7,044	6,134	16,582
TOTAL	6,814,000,000	156,722	107,877	205,567	156,722	156,722	156,722	104,481	208,963
AVERAGE OF TOTAL				156,722					156,722

Source of Asset: Wall Street Oasis, https://www.wallstreetoasis.com/company/top-banks/the-czech-republic. Rest are author's calculations.

Table 6.2: Comparative Fees Using Different Models Among Greek Banks (in thousand EUR), 2022

			ECB					Constant Elasticity w Risk	
	Asset	Fed	From	To	B of E	Fixed Rate	Constant Elasticity	From	To
National Bank of Greece	75,816,000	1,730	1,112	1,964	1,158	1,744	1,697	1,071	1,963
Piraeus Bank	75,225,000	1,717	1,106	1,958	1,158	1,730	1,689	1,067	1,959
Alpha Bank	72,146,000	1,648	1,072	1,924	1,158	1,659	1,647	1,046	1,938
Eurobank	64,524,000	1,479	988	1,840	1,158	1,484	1,538	992	1,884
Attica Bank	3,095,000	115	280	1,132	2,058	71	119	283	1,174
TOTAL	290,806,000	6,689	4,559	8,818	6,689	6,689	6,689	4,459	8,918
AVERAGE OF TOTAL				6,689					6,689

Source of Asset: Hellenic Bank Association, https://www.hba.gr/En/Statistics/List?type=GreeceResults_EN. Rest are author's calculations.

The ECB distinguishes significant supervisees from less significant ones. This exercise assumes that supervisees with assets greater than 1 billion CZK and 50 billion EUR respectively as significant, and the rest as less significant. Among the supervisees in Table 6, 3 of 10 and 4 of 5 respectively are significant. Following equation (6) and (7), the fixed fee for significant supervisees is:

$$f_S = \frac{0.1 \times 156,722}{10} = 1,567 \quad \& \quad f_L = \frac{0.05 \times 156,722}{10} = 784. \tag{13.1}$$

$$f_S = \frac{0.1 \times 6,689}{5} = 134 \quad \& \quad f_L = \frac{0.05 \times 6,689}{5} = 67. \tag{13.2}$$

Following equation (8), the hypothetical fixed fees are[2]:

$$F = 3\times 1,567 + 7\times 784 = 10,187. \tag{14.1}$$

$$F = 4\times 67 + 1\times 34 = 301. \tag{14.2}$$

Following equation (9), the hypothetical variable fees are:

$$v_n = \left(0.5\times \frac{b_n}{6,814,000,000} + 0.5\times \frac{e_n}{E} \right) \times \left(156,722 - 10,187 \right). \tag{15.1}$$

$$v_n = \left(0.5\times \frac{b_n}{290,806,000} + 0.5\times \frac{e_n}{E} \right) \times \left(6,689 - 301 \right). \tag{15.2}$$

Eisenbach et al (2022) rate banks from 1 for least exposed to 5 from most exposed. This exercise has five iterations; in the first, a supervisee has effective exposure of 1, in the second 2, in the third 3, in the fourth 4, and in the fifth 5. Each of the supervisee gets a chance to be the least exposed and most exposed. Depending on one's exposure, the hypothetical range of supervisory fee using the ECB formula is in Table 6 under the column with the label "ECB." Note that the hypothetical average total fee is 156,722 thousand CZK and 6,689 thousand EUR respectively which follows the principle of cost-based supervision.

As stated above, the Bank of England categorizes FMIs in three. After the categorization, the Bank assigns fee ratios among UK CSDs as 1.5:1:2/3. Whether one distributes the assessment basis equally for each category among FMIs of the same category or distributes based on weighted average, for example weighted asset or weighted risk is not clear. In both approaches, it is possible for an FMI in category 1 to pay less than an FMI in category 2 and 3, and an FMI in category 3 to pay more than an FMI in category 1 and 2; however, from experience, this is less possible if the assessment basis for each category is distributed equally.

This exercise distributes the assessment basis equally for each category among FMI of the same category. This then assumes that the first 3, next 4, and the last 3 as categories 1, 2, and 3 in the Czech Republic, and the first 4 and the last 1 as categories 1 and 3 in Greece. The hypothetical supervisory fees are in Table 6 under the column with the label "B of E". Note that the total sum of all assessments is equal to the intended assessment basis which are 156,722 thousand CZK and 6,689 thousand EUR, respectively.

From Table 5, the effective rate of the supervisory fee of the BSP is 35.71 USD per 10 thousand USD whereas that of the ECB is 2.3 PHP per 100 thousand PHP. Using the methodology of BSP but using a fixed rate of 2.3 per 100 thousand of asset, the hypothetical supervisory fee using this formula is in Table 6 under the column with the label "Fixed Rate". Note again that the total sum of all assessment is equal to the intended assessment basis which are 156,722 thousand CZK and 6,689 thousand EUR, respectively.

7 Asset Elasticity of Cost (η)

This section uses mathematical proof on how one can charge supervisees reflecting constant technological economies of scale; it also uses simulation to calculate hypothetical fees and prove that it reflects the principle of cost-based supervision. Define the "asset elasticity of cost" or η as the percentage change in supervisory cost per percentage change in the asset. The term is not an established concept in literature. To be consistent with literature, this paper patterns the term on the established concept "price elasticity of demand" which is the percentage change in demand per percentage change in price.

"Larger companies are often more complex companies, with associated risks that play a large role in determining the supervisory resources necessary in relation to that company" (Federal

[2] Reader's answer may differ due to rounding.

Reserve System, 2013, p. 52397). Hence in principle, supervisory fee should increase with the size of the asset; hence, it should be that $0<\eta$. "However, hours increase less than proportionally with bank size, suggesting the presence of technological scale economies in supervision" (Eisenbach et al, 2017, Abstract). This means that a 100 percent increase in asset results in less than 100 percent increase in supervisory cost; hence, it should be that $\eta<1$. η decreases if technological economies of scale in supervision improves exponentially with the size of the asset. However, η increases if the size of the asset becomes sufficiently big as to threaten spillover to the financial system and then to the entire economy. What follows is a formulation of supervision fee that is $0<\eta<1$ and constant η.

Sorting the supervisees from the smallest to the biggest asset, let d_n and b_n be the fee ratio for and the asset of supervisee n, and η be the asset elasticity of cost, then:

$$d_1 = 1 \quad \& \quad d_n = d_{n-1} \times \left(1 + \frac{b_n - b_{n-1}}{b_{n-1}} \times \eta \right) \quad \forall n \geq 2. \tag{16}$$

Let a_n be the assessment rate of supervisee n, then:

$$a_n = \frac{d_n}{\sum_{n=1}^{N} d_n} \quad \Rightarrow \quad a_n = \frac{d_n}{D}, \quad D = \sum_{n=1}^{N} d_n. \tag{17}$$

Where r_n is the supervisory fee from supervisee n and S is the assessment basis, then:

$$r_n = a_n \times S. \tag{18}$$

An alternative way of expressing the supervisory fee is:

$$r = aS. \tag{19}$$

As implied from equations (17) and (16), the above implies:

$$r = \left(\frac{d}{D} \right) S \quad \Rightarrow \quad r = \frac{\left[d \left(1 + \frac{\Delta b}{b} \eta \right) \right]}{D} S = \frac{dS + d \frac{\Delta b}{b} \eta S}{D}. \tag{20}$$

The change in supervisory fee per peso change in asset is:

$$\frac{\partial r}{\partial b} = \frac{d \frac{1}{b} \eta S}{D}. \tag{21}$$

The asset elasticity of supervisory fee is:

$$\frac{\partial r}{\partial b} \frac{b}{r} = \frac{d \frac{1}{b} \eta S}{D} \left(\frac{b}{r} \right) = \frac{d \eta S}{D r}. \tag{22}$$

From equations (19) and (17), the above implies:

$$\frac{\partial r}{\partial b} \frac{b}{r} = \frac{d \eta S}{D(aS)} = \frac{d \eta}{D a} \quad \Rightarrow \quad \frac{\partial r}{\partial b} \frac{b}{r} = \frac{d \eta}{D(d / D)} \quad \therefore \quad \frac{\partial r}{\partial b} \frac{b}{r} = \eta. \tag{23}$$

This affirms that the asset elasticity of cost, η, is constant. For example, if one sets η=0.6, it becomes mathematically guaranteed that a 100 percent increase in asset results in 60 percent increase in supervisory fee.

Where R is the total revenue from supervisory fees, then:

$$R = \sum_{n-1}^{N} r_n. \tag{24}$$

Inserting equations (19) and (17) gives:

$$R = \sum_{n-1}^{N} \left(a_n S \right) = S \sum_{n-1}^{N} a_n \quad \Rightarrow \quad R = S \sum_{n-1}^{N} \left(\frac{d_n}{D} \right) \quad \therefore \quad R = S. \tag{25}$$

Thus, total revenue from advisory fee is equal the total supervisory cost, and thus the assessment basis follows the principle of cost-based supervision.

As in Eisenbach et al (2022), assume that η=0.6. The hypothetical supervisory fee using the constant η formula is in Table 6 under the column with the label “Constant Elasticity”. Note again that the total sum of all assessments is equal to the intended assessment basis which are 156,722 thousand CZK and 6,689 thousand EUR, respectively.

An alternative formulation of the fee adopting the ECBs model is that 50 percent is based on asset and 50 is based on risk. Where e_n is the exposure of supervisee n, and E is the total exposure of all supervisees, r_N is:

$$r_n = a_n \frac{S}{2} + \frac{e_n}{E} \frac{S}{2}. \tag{26}$$

The total revenue from supervisory fees becomes:

$$R = \sum_{n=1}^{N} r_n = \sum_{n=1}^{N} \left(a_n \frac{S}{2} + \frac{e_n}{E} \frac{S}{2} \right) = \frac{S}{2} \sum_{n=1}^{N} \left(a_n + \frac{e_n}{E} \right). \tag{27}$$

Inserting equation (17) gives:

$$R = \frac{S}{2} \sum_{n=1}^{N} \left[\left(\frac{d_n}{D} \right) + \frac{e_n}{E} \right] \quad \therefore \quad R = S. \tag{28}$$

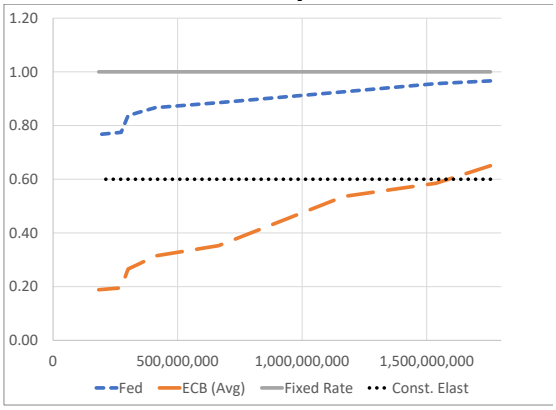
Thus, total revenue from advisory fees is equal to the total supervisory cost or the assessment basis following the principle of cost-based supervision. The hypothetical supervisory fee using the constant η with risk formula is in Table 6 under the column with the label “Constant Elasticity with Risk”. Note that the average total sum of all assessments are 156.722 million CZK and 6.689 million EUR respectively which equal to the intended assessment basis.

Using the data from Table 6, this exercise calculates and graphs the asset elasticity of the hypothetical cost in Figure 1. In the case of the Bank of England (not in the graph), the exercise distributes the assessment basis equally within categories. The result is 0 elasticity within a category, and then spiking from one category to another. In the cases of the Fed and the ECB, the elasticities are less than unity; hence the treatment is as if supervision has technological economies of scale. However, the elasticities are increasing with the size of the asset; hence the treatment is as if supervision’s technological economies of scale are decreasing with the size of the asset. In the case of the Fixed Rate, elasticities are unity and are constant; hence the treatment is as if a 100 percent increase in asset results in 100 percent increase in supervisory cost ignoring technological economies of scale in supervision. The Constant Elasticity of Cost is exactly that; it has constant elasticity of 0.6; hence the treatment is as if supervision has constant technological economies of scale.

Eisenbach et al (2016) theorizes that when a supervisee becomes “too big to fail,” the cost of supervision increases disproportionately more. However, they empirically find that technological economies of scale in supervision outweighs the increase concern on the largest banks. Thus, this exercise applies a constant $0<\eta<1$ for all. However, if regulators decide that larger banks should have higher η and they still want to follow the principle of cost-based supervision, they

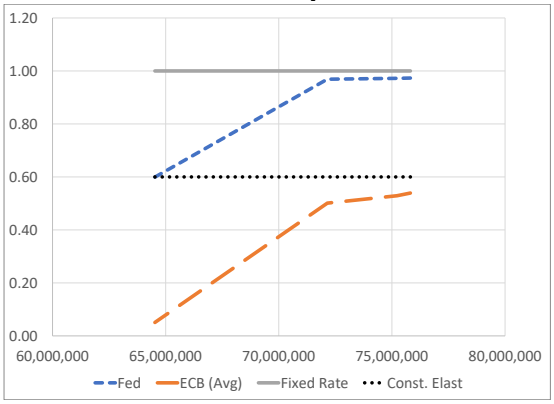
can do so by separating the aggregated costs between groups, and apply the same exercise in each group but with different η's.

Figure 1.1: Asset Elasticity of Cost vis-à-vis Asset in Czech per 1,000 CZK



Source: Author's Calculations.

Figure 1.2: Asset Elasticity of Cost vis-à-vis Asset in Greece per 1,000 EUR



Source: Author's Calculations

8 Conclusions and Recommendations

In this paper, I compare selected regulators on how they formulate supervisory fees and try to identify common practices. This paper focuses on those that follow the principle of cost-based supervision.

The first finding and conclusion is that regulators that practice the principle of cost-based supervision aggregate significant amounts of cost of its activities, and then distribute the costing to its supervisees. The related recommendation is to use the principle of cost-based supervision per supervisee whenever applicable and feasible. If a regulator can supervise smaller institutions in a punctuated and periodic basis, then it is fairer to apply the principle of cost-based supervision on per supervisee. As for those with bigger assets, the recommendation is to apply principle of cost-based supervision on an aggregated cost. Similarly, regulators apply the principle of cost-based supervision per supervision activity, for example on punctuated site visits. On the other hand, the regulators apply the principle based on aggregated cost, for example on continuous use of software and fixtures.

The second conclusion is that specific costing of the Fed, the ECB, and the Bank of England is not universal. For example, the BSP and the MAS practices do not guarantee that the amount they fee matches the actual supervisory cost or does not follow the principle of cost-based supervisory. The relevant recommendation is for others to set a cost accounting system or a specific fee per position per hour or both through public consultation with supervisee institutions. Moreso, the ideal cost should be at par with the costing of supervisory authorities or even better with competitive local rates.

This paper also provides a review of how regulators implement supervision in practice.

The third conclusion is the clarity in literature and lack of demarcation in practice between regulation and supervision. The relevant recommendation is to differentiate the revenue generation from these two functions. The revenue from violation from regulation is not a fee but a fine. This implies that the amount should commensurate the severity of violation and or the damage and not the cost of regulating. This also implies that the amount collected can be greater than the regulatory cost which can be a source of profit. The revenue from supervision is a fee and not a fine. This implies that the amount commensurate the cost thus following the

principle of cost-based supervision. Still, there are overlaps between regulation and supervision (Goldsmith-Pinkham et al, 2016). For example, authorities collect data to verify whether a supervisee follows regulation and for a supervisory exercise such as stress testing. Hence another recommendation is to consult stakeholders and hold research on how to treat overlaps.

The fourth conclusion is that there are pros and cons to charging fee based on risk. The ECB's determination of supervisory fee to individual supervisees is not just based on weighted asset; rather, the fee is fifty-fifty based on weighted asset and weighted risk. According to the Fed, a drawback could be "if an assessed company publicly reported the amount of its assessment, a system of allocating the assessment basis that is not relatively straightforward and objective could cause market participants and counterparties to draw incorrect inferences" (Federal Reserve System, 2013, p. 52398). On the other hand, charging fee based also on exposure provides an incentive for supervisees to take on less risky positions. In the US, banks de-risk when supervision increases (Eisenbach et al, 2022). The implication is that there is benefit in allocating more supervisory resources and hence fee to supervisees in riskier position. The related recommendation is to consult stakeholders and hold research on how to incorporate risk related costs without sending to the market signals that can potentially cause speculation.

This paper simulated hypothetical supervisory fees for specific supervisees using different procedures.

For many, the basis for the asset is on a specific period. For example, according to the BSP (*Bangko Sentral ng Pilipinas*, 2020), the basis for the asset is the end of the month average assessable assets (AAA) from the preceding year. This can be harmfully procyclical. In years in which the financial system is healthy, the cost may tend to be minimal so that banks will pay minimum fees. On the other hand, in years in which there is financial crisis, there needs more supervision than usual and hence the cost will be higher than usual so that banks will pay bigger fees which puts additional cost when many of them are under financial stress. The same rationale why monetary authorities have Countercyclical Capital Buffers (CCyB), there should be an effort to avoid procyclical consequences. Regulators can smoothen the procyclicality of the assessment basis by extending for longer period the basis for the AAA. For example, the Fed's assessment basis is based on three-year average. Hence, the related recommendation is for regulators to extend the basis of the AAA for a longer period, for example three years.

Finally, this paper introduced the asset elasticity of cost notated as η.

The fifth conclusion is that observed supervisory authorities justly increase fee with asset but with arbitrary increments. Supervisory fee should increase with the size of the asset. However, due to technological economies of scale in supervision, a percentage increase in supervisory fee should increase by less than a percentage increase in asset. A related recommendation is to set $0<\eta<1$. In the short run, regulators and stakeholders can assume and apply a constant η, for example $\eta=0.6$. In the long run, regulators should go beyond the limit of this study which is to find the real value of η in their specific jurisdiction and apply it.

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