



ST. JOHN'S
UNIVERSITY

THE PETER J. TOBIN
COLLEGE OF BUSINESS

Review of *Business*

Special Issue: Emerging Scholars

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FROM THE EMERGING SCHOLARS SPECIAL ISSUE EDITOR

The essay “In Defense of Academic Tenure,” among other arguments, reminds the reader that the existence of the tenure system tends to keep academic salaries lower than they would be otherwise.¹ Of course, an argument can be made that some tenured faculty are overpaid for their contributions, even at a relatively low salary. Such faculty are an acceptable consequence of maintaining a system that places the interest of the university ahead of the private interest of faculty. In “Incentives in Academics: Why Is There Tenure?,” Carmichael argues that the tenure system induces current faculty, who approve the hire of new faculty, to honestly judge the potential of recruits, and accept the best recruits even when the new recruits are better than the current faculty.² Today, tenured opportunities are declining, but the global output of qualified recruits is expanding, according to Yang and Fumasoli.³ In a systematic review of the literature, Chatzea et al.⁴ synthesize advice for how such new recruits can enhance their competitiveness in light of the tenure system. This cross-disciplinary review, among its other conclusions, strongly affirms that novice researchers should seek the guidance of a mentor.

This issue of *Review of Business* takes on the role of that mentor for four emerging scholars. After a blind review, the authors of promising manuscripts were invited to present in detail their revised manuscripts at a symposium at Kwansai Gakuin University in Japan. After the “no holds barred” discussion of these manuscripts, their authors made further revisions. Then an editorial decision was made on those manuscripts. The symposium could not have succeeded without the strong support of this journal’s editor, Professor Yun Zhu, Professor Yoshihiko Suzawa of Kyoto Sangyo University, and Professors Norlia Ahmad, Mohammad Badrul Haider, Keith Jackson, and Yuji Maeda of Kwansai Gakuin University.

For me, a common thread that emerges from reading the articles in this issue is how interconnected we are on this earth. While the articles are not about interconnectedness, their individual and unique themes, taken together, subtly underscore our togetherness. One of the articles highlights the global

¹Machlup, Fritz. 1964. “In Defense of Academic Tenure.” *AAUP Bulletin* 50, no. 2, 112–24.

²Carmichael, H. Lorne. 1988. “Incentives in Academics: Why Is There Tenure?” *Journal of Political Economy* 96, no. 3, 453–72.

³Yang, Yu, and Tatiana Fumasoli. 2024. “Occupational Choice, Satisfaction and Success of PhD Graduates in East Asia and the West: A Systematic Review.” *Higher Education Quarterly* 78, no. 2, 307–32.

⁴Chatzea, Vasiliki-Eirini, Enkeleint A. Mechili, Evangelos Melidoniotis, Eirini Petrougaki, George Nikiforidis, Alexandros Argyriadis, and Dimitra Sifaki-Pistolla. 2022. “Recommendations for Young Researchers on How to Better Advance Their Scientific Career: A Systematic Review.” *Population Medicine* 4, no. September, 24.

need for policies and practices to sustainably manage waste. The article draws lessons from how municipalities in Japan actively involve their citizens in the management of solid household waste. Another article examines the economic and behavioral motivation for issuing green bonds in the Asia-Pacific region. Funds from green bonds can only be used on projects that are deemed beneficial to the environment. Another article identifies how the on-pitch performance of soccer players in top European leagues influences their salaries. Soccer, or *football* to everyone outside the United States, is a global sport featuring teams with players from many different countries and cultures. Yet another article examines the comparative level of credit risk disclosures of banks in Japan, South Africa, and Mozambique. A large number of banks in Mozambique are subsidiaries of South African banks, while Japanese corporations are increasingly doing business with and investing in Mozambique's banks. So even though these articles examine diverse economic questions, at a fundamental level, these questions arise because groups of people are learning to accommodate each group's needs.

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The Relation of Salary to Players' On-Pitch Performance: The Economics of Football

James Liu

Abstract

Motivation: This paper aims to discover on-pitch performance data that contribute most to professional soccer players' annual salaries in top European leagues. This information is useful for both players and management. The study helps players optimize their salaries and performances, while it will aid club management's decision-making in sports policy, team management, and investment.

Premise: Soccer players and soccer management personnel do not understand what performance metrics directly affect their salaries.

Approach: This study consisted of three rounds of regression analyses using the backward elimination approach. Data were divided into three categories: General Data, On-Pitch Performance Data, and On-Pitch Performance (Per 90 Minutes) Data. Annual salary was normalized to Euros. Performance data was used from the previous season as current player contracts typically reflect the previous season's performances. This paper focused on players with the positions forward and midfielders.

Results: The three rounds of regression analysis revealed that threat-based xA (expected assists) was a salient predictor of a midfield player's annual salary with a low P value in three out of the five leagues tested. However, different leagues rewarded different styles of midfielders—English Premier League and Italian Serie A rewarded more goals scored and more forward passing (xA) while the Spanish La Liga rewarded more deep-lying midfielders who produced more tackles and aerial duels won in addition to the expected assists. The results for forwards were not as conclusive and require further research.

Conclusion: In conclusion, threat-based xA is a reliable predictor of a midfield player's annual salary in some top European leagues. Midfielders who make more dangerous passes into the opponents' half are more valued by clubs. Furthermore, different European leagues reward different statistics, and players need to understand the context that they're playing in to further optimize their salaries. Further research needs to be done using detailed positional classification such as strikers, wingers, central midfielders, attacking midfielders, and so on to get a more minute understanding of performance metrics and their relationship with player salaries.

Consistency: This research provides a new way to understand the importance of performance statistics and salary for soccer players. Club management staff may mold their sporting policies as well as salary policies around this finding.

Keywords: players, salary, soccer, statistics

JEL Classification Codes: Z20, Z22, Z23

INTRODUCTION

Professional soccer player salaries have risen rapidly in recent years—especially for players that are in the first division of European soccer. For example, the English Premier League saw their average salary increase from 630,000 GBP to 1,162,000 GBP from 2004 to 2010, according to research done by SportsLens.com using official Premier League data (Bilal 2011, 3). Furthermore, Capology’s database indicates that for the 2022/2023 season, the average salary increased further to 3,947,353 GBP. This means that the average salary for a Premier League player is doubling every 6 years. Regardless of the speed of wage growth, professional players still attempt to optimize their salaries to reflect their full earning potential because their careers are short. The average top-flight player’s professional career lasts between 10 to 15 years, and they must strive to raise their salary to maximize their career earnings as their earning potential post-football career is not as lucrative. So the question is: How does a player raise their salary?

This study aims to discover the on-pitch performance factors that positively affect a soccer player’s salary by quantifying the contribution of each on-pitch performance data to a player’s annual salary. Players’ performance statistics from the 2022/2023 season of the English Premier League, French Ligue 1, and German Bundesliga are used, along with their latest available salaries from the 2023/2024 season. By performing regression analysis on the player’s performance metrics along with the next season’s annual salary, the relationship between season-consistent performance and subsequent effect on their salary can be found. Performance metrics include aspects such as dribbles, shots, passing, goals, assists, and many other data points related to on-field performance.

Past literature on player salaries has been conducted with limited data sets about each player. For example, xG (expected goals), xA (expected assists), dribbles, shots, passes, and other on-pitch data have not been incorporated previously. This is mostly due to the lack of such data available. They are available for some high-value players, but they were often not available for all players within the same league, and such limitations made it impossible to conduct regression analyses. Past studies conducted their research using widely available metadata such as goals, assists, nationality, social media follower count, age, height, and weight, which limited the study’s relevance to both the players and club management as results were often not actionable. This study does not have such limitations, and all players in the analyzed leagues (English Premier League, French Ligue 1, and German Bundesliga) via regression analysis had full on-pitch performance data available.

The importance of on-pitch performance data is that it provides more context into a player’s consistent performance than typical metadata does. In soccer, matches are 90 minutes long but goals only happen an average of two to three

times each match. Therefore, typically only one to three players receive a goal or an assist to their name as part of official statistics. This is a very incomplete way of qualifying a player because goals and assists are naturally low sample size, and positions such as midfielders (especially defensive and box-to-box midfielders), defenders, and goalkeepers are not goal-producing positions. So the players in these positions will have no data that reflects their performances according to past studies. Therefore, we needed to find more data that reflects a player's overall performance during the 90 minutes that they're on the pitch. For example, Conor Gallagher—a Chelsea player who plays in the box-to-box midfield role—typically performs 1.48 dribbles per 90 minutes (an attempt to dribble past a player) and 0.99 of them are successful. He also performs 55.97 passes per 90 minutes with a completion percentage of 90.81percent. He also performs 1.56 key passes (also known as dangerous passes) per 90 minutes as well. These are excellent indicators of Conor Gallagher's abilities even if he does not produce goals on a regular basis because the sample sizes are far larger and it also includes data that signals quality in the middle and defensive parts of the pitch. The larger sample size also helps the players compare themselves to each other in a more accurate way. Generally speaking, this is a far more complete way of perceiving a player's quality on the pitch, rather than looking at simple metadata such as goals, assists, and nationality. This study will include these crucial on-pitch data, and for the purpose of this paper, metadata will be defined as data that are outside of player performance—such as age, height, nationality, and weight.

This study aims to provide more actionable insight into player salary determination and negotiations. There is a tremendous amount of public fascination with player salaries, and deconstructing the determinants of player salaries by player positions can be useful for professional football players. For example, players can focus on improving aspects of their game that improve their earnings. On the flip side, clubs can improve communication with their players by instructing them on which aspects of the game they need to focus on. Our understanding is that by creating a mutual understanding around salary determinants and its contributing statistics, player and club communication can be improved.

LITERATURE REVIEW

While past literature analyzed player metrics with annual salaries, we are not aware of any studies that use on-pitch performance metrics to perform a more holistic analysis. For example, Frick (2011), uses a combination of player age, appearances, international caps, goals scored, captaincy, and birth region to determine the player salaries for the German Bundesliga. Celik and Ince-Yenilmez (2017) also use similar variables: age, youth team cap, international cap, birth region, position, goals, assists, and the player's team. In these studies there is a significant lack of player performance variables. There are several reasons for this—for one, on-pitch performance data were not consistently collected until very recently. Companies such as Opta and Statsbomb began publishing their data publicly in the late 2010s and early 2020s. Even then, player action data such as shots, dribbles, and passes were not broadly collected for all players in each league until the 2020s.

This lack of performance data collection made comparing players in the same league much more difficult, and a proper regression analysis was nearly

impossible as less famous but still in-the-squad players would typically not be included in the dataset. Performing any analysis on salaries and player performances, under those circumstances, would skew the bias toward more notable and well-paid players. Due to this limitation, traditional research on player salaries often defaulted to using simple metadata such as age, height, weight, social media follower count, goals, assists, position, matches played, captaincy, team, and birthplace. This limits past studies in terms of their usefulness as most factors used in the studies were not within the control of either the players or the club management.

Overall, while previous studies into player salaries were somewhat useful, historically it was of limited relevance without performance data on the pitch. That being said, a few recent studies have used performance data to determine salaries. For example, Berri et al. (2023) were able to conduct salary-determinant research for goalkeepers using unique performance metrics specific to that position. Berri et al. found that better-passing rates and distribution ability indicated a positive relationship with goalkeeper salaries. While this is a positive step in utilizing more on-pitch data, the research into other positions—namely forwards, midfielders, and defenders is still severely lacking. The reason for a lack of studies in positions other than goalkeepers may be due to the variety of performance data required for the other positions. Goalkeeper performances are relatively straightforward—saves, passes, and shots faced are the main data used. However, the attributes that are collected for outfield players can be overwhelming. These include shots, dribbling, passing, movements, duels, blocking, and many more. There are studies such as those done by He and Cachucho (2015) that match forwards with goals, dribbles, and shots to player market value, but not salary. This study also admits that while they had arrived at some directionally accurate modeling of the player's market value, due to the lack of data variety the results were not satisfactory.

This study has a far more expanded dataset for all outfield players. While previous studies do provide some clarity into player salary compositions, crucially, the lack of outfield player's performance data variety reduces its usefulness for players and club management. Informing players on how to perform better, and therefore raise their annual salaries, is perhaps the most important factor that players and management are eager to learn from studies. Therefore, this paper will expand further than these previous studies using more advanced on-pitch data such as dribbles, shots, key passes, expected goals, expected assists, and more. Furthermore, these data will be available for all players that play in each competition.

DATA AND METHODOLOGY

Overview

This study used the stepwise multilinear regression analysis with backward elimination process. The data used for the analysis were accumulated from Sportmonks and Capology. Sportmonks provided performance and metadata for each player, while Capology was the source of annual salaries and contract data for the same set of players. Sportmonks is a Dutch data company that provides on-pitch performance data for players from over 300 soccer competitions across

the world. Additionally, Sportmonks also provide general data without on-pitch performance data for players for roughly 1,500 leagues. Capology is the widely accepted aggregator for the latest salaries for soccer players and contracts. Their work has been cited in numerous media outlets and research.

Data from both Sportmonks and Capology were fully available for the leagues covered in the study: English Premier League, French Ligue 1, German Bundesliga, Italian Serie A, and Spanish La Liga. Mining and collection of the data was done via Python and PHP for Sportmonks and Capology data were noted down manually. Player performance data from the 2021/2022 season was used as the independent variables and salaries from the 2022/2023 season as the dependent variable. Player inclusion criteria and final inclusion data are discussed in the next sections.

Data Points per Player and Data Definitions

All performance data used were those from the 2021/2022 season unless otherwise noted. There were more performance metrics provided by Sportmonks than used here. This study decided to use selected variables that are more universally applicable and perhaps the most obvious. More granular data—such as positioning on the pitch (i.e., Heatmap), pass distance, shot distance, etc.—are not included as they can be extremely contextual and therefore nearly impossible to compare between players on a standard basis. The 2022/2023 season salary was used in conjunction with performance data from the 2021/2022 season because the immediately preceding season often predicts the current season's salary very well.

This study also included expected goals and expected assists data from Sportmonks. These are very recent inventions in soccer analytics. *Expected goals* are calculated from shots taken by the player and its context—it's essentially the number of goals the player “should have” scored according to average scoring chances. Expected assists were included as threat-based expected assists—which are calculated by Sportmonks from a combination of key-pass, assist, and pass numbers. *Expected assists* is the number of goals that the player “should have” assisted under normal circumstances. Table 1, Table 2, and Table 3 show all the data included in this study.

In order to facilitate a more thorough analysis of the data, the points were divided into three distinct categories. The first of these categories comprises the *generic data points*. These consist of age, minutes played, and weight, which are important data but do not have a direct bearing on their performance on the pitch.

Second, the season-total performance statistics on the pitch for each player were used. This is an aggregate count of their performance statistics. For example, Erling Haaland may have scored as many as 20 goals in 10 matches. So his goals scored count will be 20. This is a simple measure of their aggregate performance during the entire season. The critical context here is that the season total data doesn't always correlate with the player's performance during each game. For example, some players may have had a total of 19 goals during the entire season while playing 38 matches. This brings his per-game goal-scoring record to 0.5 goals per game. However, another player who scored 15 goals in 15 games has scored 1 goal per game. Statistically speaking, the second player is a much better goal scorer on average than the first. However, sometimes the aggregate total is more important than the per-game statistic because per-game statistics

TABLE 1. General Data Points

General data attributes available for players, used for regression analysis, do not have a relationship with on-field performance. These data points are typically widely available for all players, and most of them were included in past studies involving salaries and player market values.

Variable Name	Type	Definition
annual_salary_euro	Salary	Annual salary from 2023 calendar year, in Euros
age	Non-performance-related metadata	Age in years
height (centimeters)	Non-performance-related metadata	Player height
weight (kilograms)	Non-performance-related metadata	Player weight
minutes_played	Non-performance-related metadata	Number of minutes player was in play
games_started	Non-performance-related metadata	Number of matches started
games_subbed_out	Non-performance-related metadata	Number of matches where the player was substituted out
games_subbed_in	Non-performance-related metadata	Number of matches where the player did not start but was substituted in
average_rating	Performance-related metadata	Average match rating in the season of the player, according to Sportmonks

can be skewed heavily by a small sample size. This paper shows how this data gets interpreted in the regression analysis. And lastly, the study will use per-90-minute statistics for every given total performance statistic.

Leagues and Player Inclusion

This study uses the salary data from the following leagues: English Premier League, French Ligue 1, German Bundesliga, Italian Serie A, and Spanish La Liga. Using statistics of the players from the 2021/2022 season, regression analysis was performed against the 2022/2023 season salary because the previous season's performance typically predicts the current season's performance. Players are usually rewarded retroactively instead of proactively due to their baseline ability not being clear until they perform at a certain quality regularly. This data filtering caused this study's dataset to reduce the number of players used in the regression analysis because some players have left the league or the team by the beginning of the next season. Table 4 shows the list of leagues selected, along with the number of players that have been used in the regression analysis.

The primary reason for using salary data from these soccer leagues is that reliable salary information is readily available for the players in these leagues. Another reason for these leagues being chosen is that these leagues are all top division leagues in globally prominent leagues. Players in these leagues are some of the best in the world, and their salaries are likely to be representative of what top players in the sport are earning. These leagues also pay relatively high salaries that are consistent with each other. In addition, the high profile of these leagues means that the players in them are some of the most well-known in the world, making their salaries a topic of significance to the media, clubs, and the industry itself. Overall, the availability of reliable salary data, the prominence of the leagues, and the popularity of the players make salary data from these first-division leagues more relevant and valuable.

TABLE 2. On-Pitch Performance Stats—Season Total

Season-total performance metrics used for the regression analysis are total counts from the 2021/2022 season. For example, a player may have taken 50 shots in 30 matches in the season, and therefore their shots_total will be 50. Furthermore, a minority of these data points were used in previous literature: goals, assists, penalty_goals, and cards being the most commonly analyzed against player salaries. All other data points are new or were seldom used in salary analysis. Expected goals, expected assists, and non-penalty expected goals can vary slightly between data providers, and this study uses the Sportmonks model. We've further categorized each data point as either offensive related (attacking) or defensive related to give more context.

Variable Name	Type	Definition
goals	Offensive metric	Number of goals scored by the player
penalty_goals	Offensive metric	Number of penalty kick goals scored by the player
assists	Offensive metric	Number of assists by the player
crosses_total	Offensive metric	Number of crosses performed by the player this season
key_passes_total	Offensive metric	Number of passes performed by the player this season that indirectly led to a goal
dribbles_total	Offensive metric	Number of dribble attempts performed by the player this season; dribbles are where the player attempts to dribble with the ball past an opposition player
dribbles_successful_total	Offensive metric	Number of successful dribble attempts by the player
shots_total	Offensive metric	Number of shots taken by the player
shots_on_target_total	Offensive metric	Number of shots made by the player that were on target
shots_off_target_total	Offensive metric	Number of shots made by the player that were off target
xg_total	Offensive metric	Expected goals for the player, total across the current season
npxg_total	Offensive metric	Non-penalty expected goals for the player, total across the current season
xa_total	Offensive metric	Total expected assists for this player this season
clean_sheets	Defensive metric	Number of clean sheets kept by the player's team
conceded	Defensive metric	Number of goals conceded by the player's team
cards	Defensive metric	Number of yellow and red cards for the player
aerial_duels_won_total	Defensive metric	Number of aerial duels won by the player where two or more players were competing for the ball
duels_won_total	Defensive metric	Number of ground duels won by the player where two or more players were competing for the ball
fouls_committed_total	Defensive metric	Number of fouls committed by the player
fouls_drawn_total	Defensive metric	Number of times the player was fouled by the opposition team
dispossessed_total	Defensive metric	Number of times this player was dispossessed (the ball was taken away from the player)
clearances_total	Defensive metric	Number of defensive clearances made by the player
blocks_total	Defensive metric	Number of defensive blocks made by the player
tackles_total	Defensive metric	Number of defensive tackles by the player
interceptions_total	Defensive metric	Number of defensive interceptions (intercepted an opponent's pass) made by the player

TABLE 3. On-Pitch Performance Stats—Per 90 Minutes (Per Game)

Ninety minutes is the length of an official soccer match. Per-90-minute performance data are important in soccer for the fact that it gives a picture of the player on their “average” matchday. Season total metrics show a player’s total contribution across the year that they played in, but per-90-minute data shows how well they perform on average in each match. Theoretically, per-90-minute data can be easier to attribute to a player’s quality and therefore their salary as well. The formula for calculating per-90-minute data is as follows:

$$t = (y / z) \times 90$$

Where

- t is the per-90-minute data
- y is the total number in the season (for example, total number of goals)
- z is the total number of minutes played in the season

This formula divides the number of the performance metric by the number of minutes the player has played and then multiplies it by 90 to find the occurrence per 90 minutes. Per-90-minute data is a more accurate representation of a player’s general performance than per-game (per-match) data, which is another commonly used metric. Per-game data can be unnaturally skewed for players who appear in many matches but only as substitutes, which is often known as the *super-sub phenomenon*.

Variable Name	Type	Definition
goals_per_90	Offensive metric	Goals scored per 90 minutes of play across the season
assists_per_90	Offensive metric	Goals assisted per 90 minutes of play across the season
passes_per_90	Offensive metric	Number of pass attempts by this player per 90 minutes of play
passes_completed_per_90	Offensive metric	Number of passes completed by this player per 90 minutes of play
crosses_per_90	Offensive metric	Number of cross attempts by this player per 90 minutes of play
key_passes_per_90	Offensive metric	Number of key passes by this player that indirectly led to a goal per 90 minutes of play
shots_per_90	Offensive metric	Number of shots on goal per 90 minutes by this player
shots_on_target_per_90	Offensive metric	Number of shots that were on target per 90 minutes by this player
shots_off_target_per_90	Offensive metric	Number of shots that were off target per 90 minutes by this player
dribbles_per_90	Offensive metric	Number of dribbling attempts per 90 minutes by this player
dribbles_successful_per_90	Offensive metric	Number of successful dribbling attempts per 90 minutes by this player
goals_involved_per_90	Offensive metric	Goals scored + assists per 90 minutes by this player
xg_per_90	Offensive metric	Expected goals per 90 minutes by this player
npxg_per_90	Offensive metric	Non-penalty expected goals per 90 minutes by this player
xa_per_90	Offensive metric	Threat-based expected assists per 90 minutes by this player
interceptions_per_90	Defensive metric	Number of interceptions (cutting opponent passes) per 90 minutes by this player
aerial_duels_per_90	Defensive metric	Number of aerial duel attempts per 90 minutes by this player
aerial_duels_won_per_90	Defensive metric	Number of successful aerial duel attempts per 90 minutes by this player
fouls_committed_per_90	Defensive metric	Number of fouls committed by this player per 90 minutes
fouls_drawn_per_90	Defensive metric	Number of times this player is fouled per 90 minutes
tackles_per_90	Defensive metric	Number of defensive tackles per 90 minutes by this player
blocks_per_90	Defensive metric	Number of times this player blocks an opponent’s shot per 90 minutes
conceded_per_90	Defensive metric	Number of goals conceded by this player’s team per 90 minutes
duels_per_90	Defensive metric	Number of ground duels (attempts to get the ball) per 90 minutes by this player
duels_won_per_90	Defensive metric	Number of successful ground duels (attempts to get the ball) per 90 minutes by this player
dispossessed_per_90	Defensive metric	Number of times this player was dispossessed per 90 minutes

TABLE 4. Players Included in the Study from Each League

This table shows the number of players that were included in the regression sample. A total of 1,607 players were included in the final regression analysis. Out of the 2,175 players who played in the 2021/2022 season, about 26.2 percent of them left the competition by the next season due to transfers, retirement, or injuries. Therefore, the players who left the competition were excluded from the study.

Country	League	Number of Players in 2021/2022 Season	Number of Players Who Continued onto 2022/2023 Season in the Same League
England	Premier League	397	285
France	Ligue 1	434	323
Germany	Bundesliga	418	331
Italy	Serie A	463	366
Spain	La Liga	463	302
	Total	2,175	1,607

Descriptive Statistics

Table 5, Table 6, and Table 7 report the summary statistics of the sample for all players that were used in the regression analysis.

Stepwise Regression Analysis

For the regression methodology, this study used a stepwise regression analysis with a backward elimination process. This process was mainly chosen due to the largeness of the dataset as each player had 55 independent attributes and doing a straightforward multilinear regression analysis initially did not yield conclusive results. This study also avoided making a hypothesis for the results. In performing the stepwise regression, the player statistics were divided into three broad categories: general data (seven independent variables), season performance data

TABLE 5. Summary Statistics: General Data Points

The sum of the players from all five leagues included in this study was $N = 1602$. Numbers are rounded to the nearest two decimal places. The median age of the players regressed was 28 years old. The median player played 1730 minutes across the season, which is about half of the matches in a typical top league season. Minutes played were regressed using the log Base e log formula as its magnitude was too large compared to the other variables.

Variable	N	Minimum	Mean	Median	Maximum	SD
annual_salary_euro	1,602	6,000	3,012,399	1,517,369	72,000,000	4,726,391
age	1,602	17.0	27.97	28.0	42.0	4.15
height (centimeters)	1,602	163.0	182.35	183.0	202.0	6.63
weight (kilograms)	1,602	50.0	75.48	75.0	101.0	7.23
minutes_played	1,602	0.0	1,655.81	1,730.0	3,420.0	935.40
games_started	1,602	0.0	18.29	19.0	38.0	10.93
games_subbed_out	1,602	0.0	3.33	3.0	16.0	2.83
games_subbed_in	1,602	0.0	5.51	3.0	16.0	5.23
average_rating	1,602	0.0	5.75	6.76	8.48	2.40

TABLE 6. Summary Statistics: On-Pitch Performance Stats—Season Total

Most variables have a minimum of 0 as there are players who have never taken a shot, passed, or done any meaningful action even though they were on the pitch. For example, some players could have been substituted for several minutes during the season and therefore have made an appearance, but did not perform any action before the match ended. It is interesting that the median player takes a total of 11 shots each season. This is higher than expected, as most outfield players (defenders and midfielders especially) are not really expected to take shots on goal frequently. Due to the difference in magnitude, any variables where the maximum was over 50 were regressed with the Base e log.

Variable	N	Minimum	Mean	Median	Maximum	SD
goals	1,602	0.0	2.48	1.0	35.0	3.85
penalty_goals	1,602	0.0	0.24	0.0	8.0	0.87
assists	1,602	0.0	1.74	1.0	18.0	2.38
crosses_total	1,602	0.0	29.68	11.0	369.0	44.4
key_passes_total	1,602	0.0	16.08	11.0	123.0	16.90
dribbles_total	1,602	0.0	27.28	18.0	241.0	29.50
dribbles_successful_total	1,602	0.0	15.1	10.0	150.0	16.15
shots_total	1,602	0.0	15.9	11.0	129.0	16.98
shots_on_target_total	1,602	0.0	7.5	4.0	81.0	9.35
shots_off_target_total	1,602	0.0	8.4	6.0	56.0	8.31
xg_total	1,602	0.0	1.78	0.76	20.32	2.70
npxg_total	1,602	0.0	1.6	0.73	17.52	2.32
xa_total	1,602	0.0	1.78	0.76	20.32	2.70
clean_sheets	1,602	0.0	6.67	6.0	21.0	4.15
conceded	1,602	0.0	22.57	22.0	72.0	14.23
cards	1,602	0.0	3.62	3.0	16.0	3.02
aerial_duels_won_total	1,602	0.0	24.34	16.0	283.0	26.63
duels_won_total	1,602	0.0	84.48	81.0	371.0	58.65
fouls_committed_total	1,602	0.0	19.66	18.0	85.0	14.63
fouls_drawn_total	1,602	0.0	18.99	15.0	101.0	16.88
dispossessed_total	1,602	0.0	14.54	10.0	110.0	15.05
clearances_total	1,602	0.0	27.4	16.0	215.0	31.60
blocks_total	1,602	0.0	5.04	2.0	59.0	6.70
tackles_total	1,602	0.0	26.34	23.0	123.0	21.38
interceptions_total	1,602	0.0	16.36	12.0	105.0	15.75

(26 independent variables), and per-90-minute-performance data (22 independent variables). All regression analysis was done with each league separately as they are separate entities institutionally.

The backward elimination process was carefully considered, as one of the major challenges in conducting this study was selecting the appropriate data to include in the analysis. A significant portion of these data is not relevant to the regression analysis or is only applicable to players in specific contexts. For instance, a defender's salary is more likely to be based on their ability to make tackles rather than their ability to score goals. Therefore, the number of tackles made is a more important factor in determining a defender's salary compared to the number of goals scored. On the other hand, goals scored can be assumed to be a more accurate indicator of a forward's salary. This highlights the importance of carefully considering which data are relevant and appropriate for inclusion in the study.

TABLE 7. Summary Statistics: Per-90-Minute Stats

These are the statistics of the players when they are on the pitch for 90 minutes. Some of the maximums are unusually skewed by players who've played very few minutes. For example, `goals_per_90` has a maximum of 4.5 goals per 90 minutes, which is unusually high considering that Cristiano Ronaldo and Lionel Messi—the modern high scorers—typically averaged 1.00 to 1.50 goals per 90 minutes. This difference is produced by players who've been substituted into a match and scored a goal but rarely play the whole match. Therefore, there is a systematic bias toward higher maximums in all variables. For stages 1 and 2 of the stepwise regression, any variable where the maximum was over 50 was logged to $\ln(x)$ for regression purposes.

Variable	N	Minimum	Mean	Median	Maximum	SD
<code>goals_per_90</code>	1,602	0.0	0.14	0.06	4.5	0.24
<code>assists_per_90</code>	1,602	0.0	0.1	0.05	12.86	0.35
<code>goals_involved_per_90</code>	1,602	0.0	0.24	0.14	12.86	0.44
<code>conceded_per_90</code>	1,602	0.0	1.25	1.21	18.0	0.71
<code>crosses_per_90</code>	1,602	0.0	1.43	0.52	13.85	1.96
<code>key_passes_per_90</code>	1,602	0.0	0.79	0.64	11.25	0.90
<code>passes_per_90</code>	1,602	0.0	35.36	35.72	180.0	21.06
<code>passes_completed_per_90</code>	1,602	0.0	28.83	28.01	135.0	18.88
<code>tackles_per_90</code>	1,602	0.0	1.31	1.3	11.25	1.07
<code>shots_per_90</code>	1,602	0.0	0.79	0.54	15.0	0.93
<code>npxg_per_90</code>	1,602	0.0	0.09	0.04	2.88	0.15
<code>fouls_drawn_per_90</code>	1,602	0.0	0.95	0.84	7.5	0.84
<code>fouls_committed_per_90</code>	1,602	0.0	1.05	1.0	15.0	1.03
<code>blocks_per_90</code>	1,602	0.0	0.24	0.12	6.92	0.39
<code>dispossessed_per_90</code>	1,602	0.0	0.76	0.55	11.49	0.84
<code>dribbles_per_90</code>	1,602	0.0	1.43	1.02	22.5	1.66
<code>aerial_duels_won_per_90</code>	1,602	0.0	1.19	0.86	30.0	1.58
<code>shots_off_target_per_90</code>	1,602	0.0	0.42	0.31	11.25	0.56
<code>duels_won_per_90</code>	1,602	0.0	4.23	4.57	30.0	2.85
<code>interceptions_per_90</code>	1,602	0.0	0.75	0.66	10.0	0.75
<code>dribbles_successful_per_90</code>	1,602	0.0	0.8	0.55	22.5	1.07
<code>xa_per_90</code>	1,602	0.0	0.14	0.12	6.64	0.19
<code>xg_per_90</code>	1,602	0.0	0.1	0.04	2.88	0.15

However, we must not assume that players of x position should only be analyzed via y dataset. That means that we should not simply assume that forwards should have their tackle stats or shot-blocking stats removed from their regression analysis. We should first use all available data to do the regression analysis, and then start removing data that resulted in low correlation or extremely low confidence values. This should help zoom in on the data that are most important while not negating potentially relevant data.

The model used in this analysis is a multilinear regression model.

$$y = b_0 + b_1x_1 + b_2x_2 + \dots + b_n \times x_n$$

In this model, y is the annual salary (dependent variable), and independent variables are defined in Tables 1, 2, and 3.

As shown in Table 8, the first round of regression analysis was performed with all three categorical variables for all players. The second round in the stepwise regression eliminated the general data points so that the results focus more on the players' performance itself and not the metadata. The third round of stepwise regression

TABLE 8. Stepwise Regression Stages and Data Exclusion

This table shows which data and filtering were used in which round of the stepwise regression process. Data was removed as the steps went further to improve the regression quality.

Variables	First Round	Second Round	Third Round
General data points	Yes	No	No
Per 90 minutes	Yes	Yes	No
Season totals	Yes	Yes	Yes
Filter by position	No	No	Yes

separated all the players by positions and made the regression analysis separately: Forwards were regressed against other forwards, and midfielders were regressed against other midfielders. Several other aspects were removed to get clearer results: Defenders and goalkeepers were removed as they play a different role than the other outfield players and therefore are evaluated separately. The on-pitch performance stats—per 90 minutes category of data was removed to focus solely on the on-pitch performance stats—season totals data to get a consistent result across all leagues.

RESULTS

Three rounds of regression analysis with progressively less data were run. Initially, the regression analysis revealed that `minutes_played`, `height`, and `weight` had a strong correlation with salaries. These findings, while somewhat significant and consistent with past literature, lacked intrigue as the data points were relatively generic. This research intended to find more about a player's salary relationship with their on-pitch performance. Therefore general data points were removed, particularly the season totals, and then players from the same position on the pitch were compared. The results were significant with R-squared in each league reaching above 0.8. Consistently `xA` proved a superb indicator of salary.

First Round of Stepwise Regression

Regression analysis was run in a Python script using a CSV file containing all of the players. Each league was regressed separately, and the results showed that in every single league, minutes played often correlated with salary paid. In addition to this, the player's height is almost universally correlated with pay as well. As shown in Table 9, the first round included all variables in all categories (general data points, season totals, and per-90-minute stats). This was done to remove any bias and to start the stepwise regression process with all data included.

The R-squared results ranged from 0.4 to 0.7 for all leagues. The findings that age matters in terms of salary are consistent with previous literature (Iehl 2020). However, outside of variables that are conduits for more competence such as age and minutes played, there were not many consistent results for on-pitch performance stats across all five leagues that were regressed. Other results with low P value include, but not limited to: `duels_won_total`, `xa_total`, `passes_completed_per_90`, `xg_total`, `fouls_drawn_per_90`, `tackles_per_90`, and `dribbles_successful_total`. These correlations happened in different leagues, but

(text continues on page 20)

TABLE 9. First Round Regression Results by League

This table shows results from the first round of regression analysis. The standout variable is age. Four out of five leagues (all except for Spanish La Liga), show low P value and a positive coefficient. This result is consistent with past literature as age is an indirect indicator of experience and competence. Other variables such as minutes_played, weight, and fouls_committed had more than two leagues show a low P value. The minutes_played variable was consistently a positive factor in determining player salary but fouls_committed showed both a positive and a negative coefficient in different leagues. Because we already know that age and minutes_played are significant factors for player salary and player importance, the second round of regression analysis removed all variables under the category of general data points in order to focus solely on performance metrics. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Premier League (England)			
	Coefficient	Standard Error	P Value
age	1.8289***	0.363	0.000
height	-0.0778	0.202	0.701
weight	0.2039	0.176	0.249
minutes_played	1.3771*	0.739	0.064
games_subbed_in	-0.1872**	0.084	0.027
games_subbed_out	0.0248	0.078	0.751
games_started	-0.1991	0.554	0.720
goals	-0.1261	0.160	0.432
clean_sheets	0.2219	0.144	0.124
conceded	0.0824	0.388	0.832
assists	0.2660	0.136	0.052
penalty_goals	-0.0272	0.382	0.943
cards	-0.0417	0.083	0.615
average_rating	-0.3487	1.042	0.738
key_passes_total	0.0570	0.162	0.724
tackles_total	-0.0006	0.249	0.998
shots_total	0.4350	0.333	0.193
shots_on_target_total	-0.1789	0.198	0.368
shots_off_target_total	-0.0307	0.256	0.905
interceptions_total	0.0972	0.183	0.595
crosses_total	-0.0225	0.078	0.773
dispossessed_total	0.1451	0.157	0.358
dribbles_total	0.3571	0.253	0.159
duels_won_total	-0.9331**	0.419	0.027
dribbles_successful_total	-0.2903	0.237	0.222
xg_total	0.0169	0.313	0.957
blocks_total	-0.2370*	0.106	0.027
clearances_total	-0.0194	0.099	0.844
xa_total	-0.5999	0.287	0.038
npxg_total	-0.2648	0.305	0.386
fouls_drawn_total	-0.0465	0.170	0.785
fouls_committed_total	0.0907	0.199	0.649
aerial_duels_won_total	0.0450	0.154	0.770
assists_per_90	1.9745	0.588	0.852

(continues)

TABLE 9. First Round Regression Results by League (continued)

Premier League (England) (continued)			
	Coefficient	Standard Error	P Value
passes_completed_per_90	0.0172	0.024	0.483
goals_involved_per_90	-4.5802	0.585	0.666
goals_per_90	7.9677	1.090	0.473
conceded_per_90	-0.0427	0.314	0.892
passes_per_90	-0.0014	0.023	0.952
tackles_per_90	-1.1027	1.892	0.561
shots_per_90	0.0907	0.662	0.891
npxg_per_90	2.0379	4.744	0.668
fouls_drawn_per_90	-1.0551	1.916	0.582
fouls_committed_per_90	-0.1096	0.176	0.535
blocks_per_90	0.7057	0.281	0.013
crosses_per_90	-0.0313	0.049	0.523
key_passes_per_90	0.0333	0.269	0.901
dispossessed_per_90	-0.1256	0.198	0.526
dribbles_per_90	0.2200	0.168	0.192
aerial_duels_won_per_90	-1.0532	1.890	0.578
shots_off_target_per_90	-0.3577	0.688	0.604
duels_won_per_90	1.2379	1.903	0.516
interceptions_per_90	-0.2377	0.257	0.356
dribbles_successful_per_90	-1.3490	1.946	0.489
xa_per_90	5.5051	4.752	0.248
xg_per_90	-3.2293	8.731	0.712
Observations	284		
R-Squared	0.510		
Adj. R-Squared	0.389		
F-Statistic	4.224		
AIC	651.1		
Bundesliga (Germany)			
	Coefficient	Standard Error	P Value
age	1.4175***	0.424	0.001
height	0.0025	0.068	0.970
weight	0.0725	0.077	0.348
minutes_played	0.3384	0.206	0.102
games_subbed_in	-0.0379	0.084	0.652
games_subbed_out	0.2188**	0.090	0.016
games_started	0.1081	0.225	0.631
goals	0.0632	0.150	0.675
clean_sheets	0.2480*	0.129	0.055
conceded	-0.2331	0.233	0.318
assists	0.0201	0.154	0.897
penalty_goals	0.1067	0.333	0.749
cards	0.1322	0.109	0.227

Bundesliga (Germany)			
	Coefficient	Standard Error	P Value
average_rating	-0.4489	0.327	0.171
key_passes_total	0.0966	0.134	0.472
tackles_total	-0.1232	0.163	0.450
shots_total	0.1133	0.344	0.742
shots_on_target_total	0.0377	0.210	0.857
shots_off_target_total	-0.0366	0.268	0.892
interceptions_total	0.3625***	0.114	0.002
crosses_total	-0.0470	0.084	0.575
dispossessed_total	0.1552	0.128	0.228
dribbles_total	0.0672	0.235	0.775
duels_won_total	0.1402	0.232	0.546
dribbles_successful_total	-0.0121	0.204	0.953
xg_total	-1.3664	1.989	0.493
blocks_total	-0.0610	0.119	0.609
clearances_total	-0.0320	0.116	0.784
xa_total	0.1342	0.129	0.300
npxg_total	1.3702	1.993	0.492
fouls_drawn_total	-0.1838	0.120	0.127
fouls_committed_total	-0.4792***	0.142	0.001
aerial_duels_won_total	-0.1701	0.127	0.182
assists_per_90	7.6676	14.390	-0.595
passes_completed_per_90	0.0527	0.060	0.379
goals_involved_per_90	-6.7437	14.426	-0.641
goals_per_90	7.0710	14.421	-0.624
conceded_per_90	-0.0111	0.095	0.907
passes_per_90	-0.0238	0.058	0.681
tackles_per_90	1.9879	3.153	0.529
shots_per_90	0.5029	0.680	0.460
npxg_per_90	-5.7181	10.684	-0.593
fouls_drawn_per_90	1.8155	3.150	0.565
fouls_committed_per_90	0.4275**	0.197	0.031
blocks_per_90	0.8716	0.528	0.100
crosses_per_90	-0.1000	0.087	0.252
key_passes_per_90	0.2217	0.277	0.424
dispossessed_per_90	-0.3507	0.283	0.217
dribbles_per_90	-0.0785	0.341	0.818
aerial_duels_won_per_90	2.0740	3.156	0.512
shots_off_target_per_90	-0.8050	0.981	0.413
duels_won_per_90	-1.9449	3.135	0.536
interceptions_per_90	-0.7153***	0.263	0.007
dribbles_successful_per_90	2.5237	3.137	0.422
xa_per_90	-0.6015	1.574	0.703

(continues)

TABLE 9. First Round Regression Results by League (continued)

Bundesliga (Germany) (continued)			
	Coefficient	Standard Error	P Value
xg_per_90	4.1384	10.994	-0.707
Observations	327		
R-Squared	0.484		
Adj. R-Squared	0.377		
F-Statistic	4.529		
AIC	915.8		
Ligue 1 (France)			
	Coefficient	Standard Error	P Value
age	0.6002***	0.212	0.005
height	2.5201	2.460	0.307
weight	0.2327***	0.083	0.006
minutes_played	-0.2197	0.290	0.449
games_subbed_in	-0.1850**	0.095	0.053
games_subbed_out	-0.0563	0.091	0.535
games_started	0.8320**	0.398	0.037
goals	0.2005	0.180	0.267
clean_sheets	0.2458	0.166	0.140
conceded	-0.8031**	0.350	0.023
assists	-0.0585	0.187	0.754
penalty_goals	-0.0189	0.383	0.961
cards	0.3166***	0.117	0.007
average_rating	1.0391	0.640	0.106
key_passes_total	0.2118	0.221	0.339
tackles_total	-0.3876	0.256	0.132
shots_total	-0.3246	0.413	0.433
shots_on_target_total	-0.2367	0.246	0.336
shots_off_target_total	0.1515	0.301	0.615
interceptions_total	-0.2846	0.225	0.208
crosses_total	0.1850	0.117	0.116
dispossessed_total	-0.3376	0.205	0.100
dribbles_total	0.3399	0.366	0.354
duels_won_total	0.3970	0.325	0.223
dribbles_successful_total	-0.1955	0.279	0.485
xg_total	-0.4769	0.377	0.207
blocks_total	-0.2642**	0.127	0.039
clearances_total	-0.0396	0.122	0.745
xa_total	0.5037***	0.184	0.007
npxg_total	0.6225*	0.363	0.087
fouls_drawn_total	-0.5135**	0.241	0.034
fouls_committed_total	0.2481	0.282	0.380
aerial_duels_won_total	0.0723	0.186	0.698

Ligue 1 (France)			
	Coefficient	Standard Error	P Value
assists_per_90	-6.0996	19.772	0.758
passes_completed_per_90	0.1048***	0.030	0.001
goals_involved_per_90	7.0120	19.710	0.722
goals_per_90	-4.8518	20.371	0.812
conceded_per_90	0.2209	0.207	0.288
passes_per_90	-0.0734**	0.028	0.010
tackles_per_90	1.4679	0.952	0.124
shots_per_90	1.0609	0.738	0.152
npxg_per_90	-2.2885	4.380	0.602
fouls_drawn_per_90	1.8395	0.920	0.047
fouls_committed_per_90	-0.4933	0.232	0.034
blocks_per_90	0.0783	0.262	0.765
crosses_per_90	-0.0958	0.066	0.148
key_passes_per_90	0.2002	0.212	0.346
dispossessed_per_90	0.2491	0.186	0.182
dribbles_per_90	-0.1469	0.169	0.385
aerial_duels_won_per_90	1.3102	0.932	0.161
shots_off_target_per_90	-1.0461	0.690	0.131
duels_won_per_90	-1.4047	0.938	0.136
interceptions_per_90	0.2022	0.260	0.438
dribbles_successful_per_90	1.5022	0.947	0.114
xa_per_90	-3.7933**	1.910	0.048
xg_per_90	-0.8320	9.868	0.933
Observations	304		
R-Squared	0.584		
Adj. R-Squared	0.489		
F-Statistic	6.183		
AIC	906.7		
Serie A (Italy)			
	Coefficient	Standard Error	P Value
age	1.6150***	0.322	0.000
height	-0.1411	0.088	0.109
weight	0.1415*	0.077	0.067
minutes_played	0.5724***	0.189	0.003
games_subbed_in	-0.0486	0.069	0.485
games_subbed_out	-0.0561	0.067	0.402
games_started	0.5564**	0.238	0.020
goals	-0.0760	0.119	0.523
clean_sheets	0.3593***	0.078	0.000
conceded	-0.6419***	0.196	0.001
assists	0.0737	0.145	0.612
penalty_goals	0.7893**	0.348	0.024

(continues)

TABLE 9. First Round Regression Results by League (continued)

Serie A (Italy) (continued)			
	Coefficient	Standard Error	P Value
cards	-0.0848	0.095	0.373
average_rating	-0.0672	0.482	0.889
key_passes_total	0.0459	0.115	0.690
tackles_total	0.0217	0.154	0.888
shots_total	-0.0029	0.296	0.992
shots_on_target_total	0.0856	0.172	0.618
shots_off_target_total	-0.1463	0.213	0.492
interceptions_total	0.0873	0.115	0.447
crosses_total	-0.0574	0.080	0.472
dispossessed_total	-0.3055**	0.119	0.011
dribbles_total	0.1486	0.213	0.486
duels_won_total	-0.2950	0.221	0.182
dribbles_successful_total	-0.1090	0.194	0.575
xg_total	-1.5488**	0.638	0.016
blocks_total	-0.1357	0.093	0.148
clearances_total	-0.1072	0.085	0.206
xa_total	-0.0961	0.116	0.410
npxg_total	1.5244**	0.638	0.018
fouls_drawn_total	0.0007	0.127	0.996
fouls_committed_total	0.4265***	0.148	0.004
aerial_duels_won_total	-0.0547	0.092	0.550
assists_per_90	17.7691	13.234	0.180
passes_completed_per_90	0.0633***	0.022	0.004
goals_involved_per_90	-15.3495	13.155	0.244
goals_per_90	13.7805	13.253	0.299
conceded_per_90	0.1427	0.131	0.276
passes_per_90	-0.0403**	0.019	0.035
tackles_per_90	1.5497	1.058	0.144
shots_per_90	-0.1291	0.400	0.747
npxg_per_90	-1.1016	4.478	0.806
fouls_drawn_per_90	1.7110	1.069	0.111
fouls_committed_per_90	-0.2487***	0.073	0.001
blocks_per_90	0.2833***	0.103	0.006
crosses_per_90	0.0335	0.051	0.513
key_passes_per_90	0.1877	0.199	0.345
dispossessed_per_90	0.1745	0.090	0.054
dribbles_per_90	0.0318	0.108	0.769
aerial_duels_won_per_90	1.7730	1.062	0.096
shots_off_target_per_90	0.7799**	0.324	0.017
duels_won_per_90	-1.6275	1.061	0.126
interceptions_per_90	0.0136	0.074	0.854
dribbles_successful_per_90	1.6762	1.075	0.120

Serie A (Italy)			
	Coefficient	Standard Error	P Value
xa_per_90	-4.0691	4.422	0.358
xg_per_90	4.2027	7.243	0.562
Observations	356		
R-Squared	0.620		
Adj. R-Squared	0.548		
F-Statistic	8.698		
AIC	861.1		
La Liga (Spain)			
	Coefficient	Standard Error	P Value
age	0.3917	0.504	0.437
height	-1.3848	2.428	0.569
weight	0.0781	0.184	0.671
minutes_played	1.5823**	0.736	0.033
games_subbed_in	-0.1516	0.108	0.162
games_subbed_out	0.0260	0.099	0.793
games_started	-0.3550	0.571	0.535
goals	0.0808	0.195	0.679
clean_sheets	0.1142	0.219	0.602
conceded	0.0086	0.569	0.988
assists	-0.4955**	0.213	0.021
penalty_goals	-0.4424	0.506	0.383
cards	-0.0171	0.135	0.900
average_rating	-0.8040	1.756	0.647
key_passes_total	0.1422	0.239	0.552
tackles_total	-0.3700	0.296	0.212
shots_total	0.7362	0.477	0.124
shots_on_target_total	-0.0951	0.247	0.700
shots_off_target_total	-0.4649	0.337	0.169
interceptions_total	0.0739	0.239	0.757
crosses_total	0.0235	0.114	0.837
dispossessed_total	0.0093	0.198	0.962
dribbles_total	-0.4156	0.310	0.181
duels_won_total	-0.1134	0.448	0.800
dribbles_successful_total	0.6810**	0.308	0.028
xg_total	-0.6484*	0.372	0.083
blocks_total	0.0057	0.161	0.972
clearances_total	-0.0285	0.163	0.861
xa_total	-0.6819	0.421	0.107
npxg_total	0.6910*	0.359	0.055
fouls_drawn_total	-0.1551	0.248	0.533
fouls_committed_total	-0.4502	0.292	0.125
aerial_duels_won_total	0.2213	0.207	0.286

(continues)

TABLE 9. First Round Regression Results by League (continued)

La Liga (Spain) (continued)			
	Coefficient	Standard Error	P Value
assists_per_90	15.8116	19.080	0.408
passes_completed_per_90	0.0576	0.041	0.157
goals_involved_per_90	-8.7465	18.767	0.642
goals_per_90	13.8993	19.099	0.467
conceded_per_90	-0.6426	0.546	0.240
passes_per_90	-0.0105	0.039	0.789
tackles_per_90	-2.5464**	1.054	0.016
shots_per_90	0.8777	0.607	0.149
npxg_per_90	-5.9263	5.188	0.254
fouls_drawn_per_90	-2.4515**	1.110	0.028
fouls_committed_per_90	0.4065	0.232	0.082
blocks_per_90	0.5226	0.435	0.230
crosses_per_90	-0.0795	0.069	0.252
key_passes_per_90	0.5480	0.342	0.111
dispossessed_per_90	-0.3244	0.217	0.136
dribbles_per_90	0.3067	0.199	0.125
aerial_duels_won_per_90	-2.6617**	1.069	0.013
shots_off_target_per_90	-0.6591	0.583	0.260
duels_won_per_90	2.6637**	1.070	0.013
interceptions_per_90	-0.1259	0.262	0.632
dribbles_successful_per_90	-3.3519***	1.182	0.005
xa_per_90	-0.5876	3.969	0.882
xg_per_90	-3.1915	8.031	0.691
Observations	301		
R-Squared	0.516		
Adj. R-Squared	0.405		
F-Statistic	4.644		
AIC	922.6		

some of the correlations tended to be the inverse of what experts expect. For example, duels_won_total decreased salary in the English Premier League. Duels won is a positive metric, meaning that the player won possession of the ball, and therefore a negative correlation does not necessarily make sense. Other variables had similar outcomes: xg_total in Serie A had a negative relationship with salary, while fouls_drawn_per_90 and tackles_per_90 were negatively correlated with salary in La Liga. To arrive at more consistent results, the second round of regression analysis removed some variables.

Second Round of Stepwise Regression

The first round of regression analysis revealed that consistency was not achieved across the five top leagues outside of age and minutes_played. Moreover, on-pitch performance was not consistently a high contributor to

salary when age and minutes_played were involved in the regression. The age variable being a nearly consistent factor across several leagues seems obvious: If a player has more experience they are more important to the team. However, it's important to analyze how a player can play more on the pitch. Regardless of which team the player plays for, optimizing for age and therefore having a long-surviving career is the most important factor in current earnings.

However, this paper seeks further answers about what exactly a player can do on the pitch itself. Most of the on-pitch data did not yield large correlations, and therefore another regression analysis removed general data points. The hypothesis is that the total return that a player gives to the team is more important than the per-90-minute performance given a longer period of time. However, to see the results, regression analysis for both sets of data must confirm. This gives only the performance data of the players to do regression from. The backward elimination process eliminated the general data points which involved metadata such as age, minutes_played, and games_started. Table 10 shows a regression analysis performed across all leagues again with season total performance data and per-90-minute data.

Aside from clean_sheets_overall, variables related to fouls often had relationships with a player's salary but not necessarily in the direction that experts would predict. For example, fouls_committed_per_90_overall had a negative correlation with salary for three leagues but had a positive correlation in the La Liga. The variable fouls_committed_total_overall had a relationship with salary for two leagues: negatively so in the German Bundesliga but a positive correlation in the Serie A. Nevertheless, because the most consistent result is clean_sheets_overall, and because it is a team-based data point, a final round of regression analysis was performed with just the season totals minus clean_sheets_overall. The conceded_overall variable was also removed as it measures the entire team's conceded goals.

Third Round of Regression Analysis

The second round of regression with season totals and per-90-minute stats gave answers such as the importance of clean sheets, but it did not give a consistent conclusion as to individual player performances and their effect on salary. There were two primary concerns: clean sheets is largely a team-based performance indicator, and per-90-minute data can be skewed heavily toward players who've played very few minutes but performed well. These two factors can cloud the results of the regression analysis. For the third round of regression, regression analysis was performed on players who play in the same position and focused only on forwards and midfielders. Players who play in similar positions can be evaluated with similar metrics and therefore can give a more focused regression result by being contextually accurate with comparisons. Uniquely, this round of the regression analysis did not $\ln(x)$ the season total values as per-90-minute, and general data points were not used, so most of the variables had similar magnitudes. Only the annual_salary_eur was set to $\ln(x)$ to reduce the magnitude of the coefficients. Table 11 and Table 12 show the results by forwards and midfielders.

(text continues on page 37)

TABLE 10. Second Round Regression Results by League

This table shows the regression results for all players in each league with just the season total and per-90-minute performance statistics. The study found that the `clean_sheets_overall` variable had the most consistency with salary as this was true for all leagues except Spanish La Liga. Clean sheets is when the player's team concedes 0 goals in a match. The more clean sheets there are, the more likely the player plays for an already strong team, and therefore it's less likely to be directly connected with the player's performance itself.

Premier League (England) (continued)			
	Coefficient	Standard Error	P Value
goals_overall	-0.2160	0.166	0.194
clean_sheets_overall	0.2961**	0.138	0.033
conceded_overall	0.7978***	0.296	0.008
assists_overall	0.2399*	0.140	0.088
penalty_goals	0.0576	0.406	0.887
cards_overall	-0.0093	0.084	0.912
average_rating_overall	1.6860*	0.940	0.074
key_passes_total_overall	0.0062	0.168	0.970
tackles_total_overall	-0.2807	0.242	0.247
shots_total_overall	0.4845	0.349	0.167
shots_on_target_total_overall	-0.1297	0.210	0.538
shots_off_target_total_overall	-0.0833	0.269	0.757
interceptions_total_overall	0.1161	0.190	0.541
crosses_total_overall	0.0079	0.082	0.924
dispossessed_total_overall	0.1391	0.166	0.403
dribbles_total_overall	0.2138	0.265	0.421
duels_won_total_overall	-0.7938*	0.420	0.060
dribbles_successful_total_overall	-0.2259	0.250	0.368
xg_total_overall	0.0092	0.325	0.977
blocks_total_overall	-0.2240**	0.108	0.038
clearances_total_overall	0.0466	0.102	0.648
xa_total_overall	-0.3210	0.260	0.218
npxg_total_overall	-0.2934	0.320	0.360
fouls_drawn_total_overall	-0.0535	0.178	0.764
fouls_committed_total_overall	0.3150*	0.178	0.078
aerial_duels_won_total_overall	0.0937	0.163	0.566
assists_per_90_overall	3.1631	11.228	0.778
passes_completed_per_90_overall	0.0017	0.026	0.948
goals_involved_per_90_overall	-4.9528	11.172	0.658
goals_per_90_overall	7.3059	11.678	0.532
conceded_per_90_overall	-0.5753**	0.271	0.035
passes_per_90_overall	0.0168	0.025	0.494
tackles_per_90_overall	-1.3090	2.005	0.514
shots_per_90_overall	-0.4670	0.689	0.498
npxg_per_90_overall	1.9856	5.044	0.694
fouls_drawn_per_90_overall	-1.4313	2.030	0.482
fouls_committed_per_90_overall	-0.3223**	0.134	0.017

Premier League (England)			
	Coefficient	Standard Error	P Value
blocks_per_90_overall	0.5002*	0.287	0.082
crosses_per_90_overall	-0.0518	0.052	0.320
key_passes_per_90_overall	0.1512	0.282	0.593
dispossessed_per_90_overall	-0.1035	0.207	0.618
dribbles_per_90_overall	0.2240	0.177	0.207
aerial_duels_won_per_90_overall	-1.3878	2.005	0.489
shots_off_target_per_90_overall	0.1165	0.719	0.871
duels_won_per_90_overall	1.5208	2.021	0.452
interceptions_per_90_overall	-0.3073	0.265	0.248
dribbles_successful_per_90_overall	-1.6722	2.065	0.419
xa_per_90_overall	2.9560	4.910	0.548
xg_per_90_overall	0.2399	9.102	0.979
Observations	284		
R-Squared	0.424		
Adj. R-Squared	0.304		
F-Statistic	3.518		
AIC	683.1		
Bundesliga (Germany)			
	Coefficient	Standard Error	P Value
goals_overall	0.1648	0.157	0.294
clean_sheets_overall	0.3669***	0.121	0.003
conceded_overall	0.2247*	0.131	0.087
assists_overall	-0.0248	0.158	0.875
penalty_goals	0.3672	0.350	0.296
cards_overall	0.1404	0.116	0.225
average_rating_overall	-0.2670	0.343	0.436
key_passes_total_overall	0.1814	0.142	0.201
tackles_total_overall	-0.0976	0.169	0.563
shots_total_overall	-0.1214	0.363	0.739
shots_on_target_total_overall	0.1142	0.222	0.607
shots_off_target_total_overall	0.0910	0.281	0.746
interceptions_total_overall	0.3298***	0.120	0.007
crosses_total_overall	-0.0363	0.088	0.679
dispossessed_total_overall	0.1225	0.135	0.365
dribbles_total_overall	-0.0133	0.245	0.957
duels_won_total_overall	0.2388	0.217	0.272
dribbles_successful_total_overall	-0.0404	0.212	0.849
xg_total_overall	-1.7512	2.087	0.402
blocks_total_overall	-0.1454	0.122	0.236
clearances_total_overall	-0.0115	0.118	0.922
xa_total_overall	0.0608	0.135	0.653
npxg_total_overall	1.6618	2.091	0.428

(continues)

TABLE 10. Second Round Regression Results by League (continued)

Bundesliga (Germany)			
	Coefficient	Standard Error	P Value
fouls_drawn_total_overall	-0.2188	0.125	0.082
fouls_committed_total_overall	-0.3952***	0.147	0.007
aerial_duels_won_total_overall	-0.1465	0.130	0.260
assists_per_90_overall	3.8919	15.137	-0.797
passes_completed_per_90_overall	0.0982	0.063	0.119
goals_involved_per_90_overall	-2.7166	15.192	0.858
goals_per_90_overall	2.9638	15.185	0.845
conceded_per_90_overall	-0.1240	0.089	0.164
passes_per_90_overall	-0.0657	0.061	0.281
tackles_per_90_overall	2.3507	3.313	0.479
shots_per_90_overall	0.7721	0.722	0.286
npxg_per_90_overall	-7.0873	11.234	0.529
fouls_drawn_per_90_overall	2.1857	3.310	0.510
fouls_committed_per_90_overall	0.2267	0.205	0.269
blocks_per_90_overall	0.6411	0.553	0.247
crosses_per_90_overall	-0.0976	0.093	0.293
key_passes_per_90_overall	0.2866	0.290	0.323
dispossessed_per_90_overall	-0.3837	0.297	0.197
dribbles_per_90_overall	-0.2811	0.354	0.428
aerial_duels_won_per_90_overall	2.3672	3.318	0.476
shots_off_target_per_90_overall	-0.8095	1.042	0.438
duels_won_per_90_overall	-2.2722	3.295	0.491
interceptions_per_90_overall	-0.5426**	0.275	0.049
dribbles_successful_per_90_overall	2.9991	3.293	0.363
xa_per_90_overall	-0.9472	1.628	0.561
xg_per_90_overall	5.2220	11.568	0.652
Observations	327		
R-Squared	0.399		
Adj. R-Squared	0.293		
F-Statistic	3.753		
AIC	951.9		
Ligue 1 (France)			
	Coefficient	Standard Error	P Value
goals_overall	0.1210	0.187	0.517
clean_sheets_overall	0.2662*	0.149	0.075
conceded_overall	-0.1778	0.249	0.476
assists_overall	0.0757	0.189	0.689
penalty_goals	-0.1719	0.392	0.661
cards_overall	0.4284***	0.120	0.000
average_rating_overall	1.6088**	0.640	0.013
key_passes_total_overall	0.3660	0.226	0.107
tackles_total_overall	-0.2596	0.260	0.320

Ligue 1 (France)			
	Coefficient	Standard Error	P Value
shots_total_overall	-0.7701*	0.419	0.067
shots_on_target_total_overall	-0.0105	0.252	0.967
shots_off_target_total_overall	0.3817	0.309	0.217
interceptions_total_overall	-0.3346	0.232	0.150
crosses_total_overall	0.1630	0.119	0.172
dispossessed_total_overall	-0.4662**	0.211	0.028
dribbles_total_overall	-0.0383	0.369	0.917
duels_won_total_overall	0.3440	0.309	0.266
dribbles_successful_total_overall	0.1471	0.278	0.597
xg_total_overall	-0.4135	0.391	0.292
blocks_total_overall	-0.3212**	0.129	0.013
clearances_total_overall	0.0259	0.121	0.831
xa_total_overall	0.3544**	0.176	0.045
npxg_total_overall	0.6136	0.376	0.104
fouls_drawn_total_overall	-0.3384	0.244	0.166
fouls_committed_total_overall	0.2239	0.281	0.427
aerial_duels_won_total_overall	0.0690	0.188	0.713
assists_per_90_overall	-3.9412	20.539	0.848
passes_completed_per_90_overall	0.1153***	0.030	0.000
goals_involved_per_90_overall	3.7874	20.476	0.853
goals_per_90_overall	-5.0093	21.182	0.813
conceded_per_90_overall	0.0219	0.192	0.909
passes_per_90_overall	-0.0834***	0.029	0.004
tackles_per_90_overall	1.5883	0.975	0.105
shots_per_90_overall	0.6540	0.764	0.393
npxg_per_90_overall	-5.4805	4.450	0.219
fouls_drawn_per_90_overall	1.8376**	0.931	0.049
fouls_committed_per_90_overall	-0.5437**	0.226	0.017
blocks_per_90_overall	0.2002	0.268	0.456
crosses_per_90_overall	-0.1102	0.067	0.102
key_passes_per_90_overall	0.0056	0.212	0.979
dispossessed_per_90_overall	0.1302	0.192	0.499
dribbles_per_90_overall	-0.0172	0.172	0.920
aerial_duels_won_per_90_overall	1.4984	0.950	0.116
shots_off_target_per_90_overall	-0.6905	0.713	0.334
duels_won_per_90_overall	-1.5643	0.956	0.103
interceptions_per_90_overall	0.2450	0.264	0.355
dribbles_successful_per_90_overall	1.5244	0.966	0.116
xa_per_90_overall	-1.5533	1.788	0.386
xg_per_90_overall	8.6907	10.042	0.388
Observations	304		
R-Squared	0.532		

(continues)

TABLE 10. Second Round Regression Results by League (continued)

Ligue 1 (France) (continued)			
	Coefficient	Standard Error	P Value
Adj. R-Squared	0.442		
F-Statistic	5.897		
AIC	928.1		
Serie A (Italy)			
	Coefficient	Standard Error	P Value
goals_overall	-0.0761	0.130	0.559
clean_sheets_overall	0.4781***	0.082	0.000
conceded_overall	0.0698	0.143	0.626
assists_overall	0.1629	0.155	0.293
penalty_goals	0.6320*	0.380	0.098
cards_overall	-0.0871	0.102	0.394
average_rating_overall	0.4489	0.509	0.379
key_passes_total_overall	0.0807	0.127	0.524
tackles_total_overall	-0.0506	0.169	0.765
shots_total_overall	-0.0991	0.314	0.753
shots_on_target_total_overall	0.1737	0.184	0.345
shots_off_target_total_overall	-0.1394	0.226	0.538
interceptions_total_overall	0.0424	0.125	0.735
crosses_total_overall	-0.0157	0.085	0.853
dispossessed_total_overall	-0.3419***	0.131	0.009
dribbles_total_overall	-0.0736	0.232	0.751
duels_won_total_overall	0.0294	0.213	0.890
dribbles_successful_total_overall	0.0756	0.211	0.720
xg_total_overall	-1.3501	0.704	0.056
blocks_total_overall	-0.1700*	0.100	0.089
clearances_total_overall	-0.0311	0.092	0.736
xa_total_overall	0.0933	0.123	0.447
npvg_total_overall	1.3385*	0.704	0.058
fouls_drawn_total_overall	0.0016	0.137	0.990
fouls_committed_total_overall	0.4517***	0.157	0.004
aerial_duels_won_total_overall	-0.1424	0.100	0.156
assists_per_90_overall	20.8028	14.484	0.152
passes_completed_per_90_overall	0.0381	0.024	0.113
goals_involved_per_90_overall -	18.4858	14.360	0.199
goals_per_90_overall	14.4477	14.479	0.319
conceded_per_90_overall	-0.0642	0.117	0.585
passes_per_90_overall	-0.0100	0.020	0.627
tackles_per_90_overall	1.8290	1.162	0.116
shots_per_90_overall	-0.3469	0.440	0.431
npvg_per_90_overall	-1.8313	4.937	0.711
fouls_drawn_per_90_overall	2.0393*	1.173	0.083

Serie A (Italy)			
	Coefficient	Standard Error	P Value
fouls_committed_per_90_overall	-0.2934***	0.076	0.000
blocks_per_90_overall	0.3153***	0.110	0.004
crosses_per_90_overall	-0.0254	0.055	0.646
key_passes_per_90_overall	0.1678	0.217	0.440
dispossessed_per_90_overall	0.1203	0.099	0.223
dribbles_per_90_overall	0.0972	0.116	0.404
aerial_duels_won_per_90_overall	2.0920	1.166	0.074
shots_off_target_per_90_overall	0.9754***	0.355	0.006
duels_won_per_90_overall	-1.9999*	1.164	0.087
interceptions_per_90_overall	-0.0111	0.081	0.891
dribbles_successful_per_90_overall	1.8341	1.179	0.121
xa_per_90_overall	-5.5686	4.834	0.250
xg_per_90_overall	9.1514	7.946	0.250
Observations	356		
R-Squared	0.524		
Adj. R-Squared	0.448		
F-Statistic	6.869		
AIC	927.1		
La Liga (Spain)			
	Coefficient	Standard Error	P Value
goals_overall	0.0285	0.192	0.882
clean_sheets_overall	0.1287	0.190	0.499
conceded_overall	0.5763	0.360	0.111
assists_overall	-0.4205**	0.207	0.043
penalty_goals	-0.5007	0.505	0.322
cards_overall	0.0068	0.134	0.960
average_rating_overall	0.9438	1.560	0.546
key_passes_total_overall	0.0664	0.232	0.776
tackles_total_overall	-0.4314	0.293	0.142
shots_total_overall	0.5710	0.464	0.219
shots_on_target_total_overall	-0.1007	0.243	0.679
shots_off_target_total_overall	-0.2751	0.321	0.392
interceptions_total_overall	0.1184	0.234	0.613
crosses_total_overall	0.0311	0.110	0.777
dispossessed_total_overall	0.0008	0.196	0.997
dribbles_total_overall	-0.4074	0.307	0.186
duels_won_total_overall	0.2566	0.405	0.527
dribbles_successful_total_overall	0.6164**	0.305	0.044
xg_total_overall	-0.6829*	0.367	0.064
blocks_total_overall	0.1008	0.156	0.519
clearances_total_overall	-0.0342	0.158	0.828
xa_total_overall	-0.3224	0.360	0.371

(continues)

TABLE 10. Second Round Regression Results by League (continued)

La Liga (Spain) (continued)			
	Coefficient	Standard Error	P Value
npxg_total_overall	0.7385**	0.356	0.039
fouls_drawn_total_overall	-0.1578	0.245	0.520
fouls_committed_total_overall	-0.5440*	0.286	0.058
aerial_duels_won_total_overall	0.2109	0.206	0.306
assists_per_90_overall	11.4262	18.886	-0.546
passes_completed_per_90_overall	0.0574	0.040	0.157
goals_involved_per_90_overall	-4.9372	18.606	0.791
goals_per_90_overall	10.4582	18.925	0.581
conceded_per_90_overall	-0.9985**	0.395	0.012
passes_per_90_overall	-0.0123	0.039	0.751
tackles_per_90_overall	-2.4766**	1.033	0.017
shots_per_90_overall	1.0818**	0.597	0.071
npxg_per_90_overall	-6.7724	5.167	0.191
fouls_drawn_per_90_overall	-2.3907**	1.094	0.030
fouls_committed_per_90_overall	0.4131**	0.230	0.073
blocks_per_90_overall	0.0592	0.388	0.879
crosses_per_90_overall	-0.0799	0.068	0.240
key_passes_per_90_overall	0.5851	0.334	0.081
dispossessed_per_90_overall	-0.2747	0.214	0.200
dribbles_per_90_overall	0.3229	0.198	0.104
aerial_duels_won_per_90_overall	-2.5628**	1.051	0.015
shots_off_target_per_90_overall	-1.1274**	0.546	0.040
duels_won_per_90_overall	2.5201**	1.047	0.017
interceptions_per_90_overall	-0.2468	0.246	0.317
dribbles_successful_per_90_overall	-3.3031***	1.156	0.005
xa_per_90_overall	-1.8105	3.645	0.620
xg_per_90_overall	-3.4559	7.969	0.665
Observations	301		
R-Squared	0.500		
Adj. R-Squared	0.403		
F-Statistic	5.128		
AIC	918.1		

TABLE 11. Third Round Regression Results: Forwards by League

This table shows the regression results for players who played as forwards in each league, using only season-total performance data. Unfortunately, for forwards, no variables were consistent in finding a relationship between it and salary. For some leagues such as French Ligue 1 and Italian Serie A, the number of goals scored had a clear positive correlation with salary, but not much else was found. This is likely the result of different forwards having different roles. For example, a winger and a striker are both considered forwards but are not expected to function the same way. A striker is expected to score goals, while a winger is expected to assist and occasionally score goals. The lack of clarity in this result shows how complex the issue of salary determination is for forwards.

Premier League (England)			
	Coefficient	Standard Error	P Value
goals_overall	0.2576	0.409	0.532
assists_overall	0.1079	0.332	0.747
penalty_goals	0.1530	0.402	0.706
cards_overall	-0.0700	0.159	0.661
average_rating_overall	4.7414	2.961	0.118
key_passes_total_overall	-0.2935	0.461	0.529
tackles_total_overall	-0.2814	0.291	0.340
shots_total_overall	-0.0570	2.714	0.983
shots_on_target_total_overall	-0.4320	1.383	0.756
shots_off_target_total_overall	-0.0560	1.297	0.966
interceptions_total_overall	0.0030	0.194	0.988
crosses_total_overall	0.0410	0.136	0.765
dispossessed_total_overall	0.4906	0.316	0.129
dribbles_total_overall	0.7479	0.705	0.296
duels_won_total_overall	0.3420	0.679	0.617
dribbles_successful_total_overall	-0.3208	0.525	0.545
xg_total_overall	0.6472	1.166	0.582
blocks_total_overall	-0.2434	0.170	0.162
clearances_total_overall	0.1654	0.176	0.353
xa_total_overall	-0.0781	0.643	0.904
npxg_total_overall	-0.0740	1.130	0.948
fouls_drawn_total_overall	-0.6403*	0.312	0.047
fouls_committed_total_overall	-0.2803	0.360	0.441
aerial_duels_won_total_overall	-0.0325	0.291	0.912
Observations	62		
R-Squared	0.708		
Adj. R-Squared	0.519		
F-Statistic	3.741		
AIC	149.0		
Bundesliga (Germany)			
	Coefficient	Standard Error	P Value
goals_overall	0.5004	0.397	0.214
assists_overall	0.2828	0.308	0.363
penalty_goals	0.2384	0.571	0.678

(continues)

TABLE 11. Third Round Regression Results: Forwards by League
(continued)

Bundesliga (Germany) (continued)			
	Coefficient	Standard Error	P Value
cards_overall	-0.0517	0.302	0.865
average_rating_overall	-0.2056	0.249	0.412
key_passes_total_overall	0.2170	0.389	0.580
tackles_total_overall	0.0740	0.321	0.818
shots_total_overall	0.0482	0.820	0.953
shots_on_target_total_overall	-0.1366	0.607	0.823
shots_off_target_total_overall	0.2917	0.668	0.664
interceptions_total_overall	0.1311	0.247	0.598
crosses_total_overall	-0.2137	0.212	0.318
dispossessed_total_overall	-0.0014	0.388	0.997
dribbles_total_overall	0.0875	0.517	0.866
duels_won_total_overall	0.3406	0.498	0.497
dribbles_successful_total_overall	0.0640	0.403	0.874
xg_total_overall	0.1306	2.659	0.961
blocks_total_overall	-0.3405	0.383	0.379
clearances_total_overall	0.1781	0.277	0.523
xa_total_overall	-0.0741	0.330	0.823
npxg_total_overall	0.0716	2.782	0.980
fouls_drawn_total_overall	-0.1270	0.410	0.758
fouls_committed_total_overall	-0.2628	0.339	0.442
aerial_duels_won_total_overall	-0.3949	0.326	0.231
Observations	76		
R-Squared	0.489		
Adj. R-Squared	0.248		
F-Statistic	2.031		
AIC	252.9		
Ligue 1 (France)			
	Coefficient	Standard Error	P Value
goals_overall	0.7813**	0.372	0.040
assists_overall	0.2212	0.289	0.448
penalty_goals	0.7830	0.477	0.106
cards_overall	0.2301	0.297	0.443
average_rating_overall	-0.1833	3.032	0.952
key_passes_total_overall	0.6870	0.470	0.150
tackles_total_overall	-0.2125	0.279	0.449
shots_total_overall	2.0607	1.518	0.180
shots_on_target_total_overall	-0.8400	0.884	0.346
shots_off_target_total_overall	-1.0730	0.840	0.207
interceptions_total_overall	0.0089	0.283	0.975
crosses_total_overall	-0.2340	0.205	0.258

Ligue 1 (France)			
	Coefficient	Standard Error	P Value
dispossessed_total_overall	-0.3982	0.380	0.299
dribbles_total_overall	-0.1410	0.665	0.833
duels_won_total_overall	0.3239	0.673	0.632
dribbles_successful_total_overall	-0.2033	0.476	0.671
xg_total_overall	-1.4816	1.087	0.179
blocks_total_overall	-0.6373**	0.315	0.048
clearances_total_overall	-0.1159	0.178	0.517
xa_total_overall	0.1683	0.264	0.527
npxg_total_overall	1.3314	1.086	0.226
fouls_drawn_total_overall	0.6421*	0.345	0.069
fouls_committed_total_overall	-0.6981	0.446	0.123
aerial_duels_won_total_overall	-0.1773	0.273	0.519
Observations	79		
R-Squared	0.670		
Adj. R-Squared	0.523		
F-Statistic	4.563		
AIC	252.3		
Serie A (Italy)			
	Coefficient	Standard Error	P Value
goals_overall	-0.7277*	0.418	0.089
assists_overall	0.1540	0.233	0.513
penalty_goals	0.9382**	0.398	0.023
cards_overall	-0.1702	0.204	0.409
average_rating_overall	-2.8314	1.752	0.113
key_passes_total_overall	0.3502	0.341	0.310
tackles_total_overall	0.0569	0.241	0.814
shots_total_overall	0.1329	1.059	0.901
shots_on_target_total_overall	0.5707	0.653	0.387
shots_off_target_total_overall	0.6991	0.598	0.248
interceptions_total_overall	-0.1914	0.220	0.388
crosses_total_overall	-0.0269	0.161	0.868
dispossessed_total_overall	-0.4973*	0.275	0.077
dribbles_total_overall	-0.1736	0.593	0.771
duels_won_total_overall	0.3960	0.482	0.416
dribbles_successful_total_overall	0.0894	0.486	0.855
xg_total_overall	-1.4300	1.698	0.404
blocks_total_overall	0.2822	0.248	0.262
clearances_total_overall	-0.2780	0.209	0.190
xa_total_overall	-0.3278	0.258	0.211
npxg_total_overall	1.7965	1.654	0.283
fouls_drawn_total_overall	0.0405	0.303	0.894
fouls_committed_total_overall	0.0246	0.319	0.939

(continues)

TABLE 11. Third Round Regression Results: Forwards by League
(continued)

Serie A (Italy) (continued)			
	Coefficient	Standard Error	P Value
aerial_duels_won_total_overall	-0.1960	0.179	0.278
Observations	70		
R-Squared	0.620		
Adj. R-Squared	0.418		
F-Statistic	3.062		
AIC	182.7		
La Liga (Spain)			
	Coefficient	Standard Error	P Value
goals_overall	0.2445	0.413	0.556
assists_overall	0.1479	0.305	0.630
penalty_goals	-0.2040	0.500	0.685
cards_overall	-0.2178	0.254	0.395
average_rating_overall	-2.1454	2.900	0.462
key_passes_total_overall	0.3537	0.401	0.381
tackles_total_overall	-0.2979	0.309	0.339
shots_total_overall	2.7040	1.973	0.175
shots_on_target_total_overall	-0.5320	0.858	0.538
shots_off_target_total_overall	-1.2647	1.085	0.248
interceptions_total_overall	0.0940	0.260	0.719
crosses_total_overall	-0.0455	0.176	0.797
dispossessed_total_overall	-0.5143	0.404	0.207
dribbles_total_overall	-0.5717	0.505	0.262
duels_won_total_overall	0.9709	0.786	0.221
dribbles_successful_total_overall	0.1361	0.455	0.766
xg_total_overall	-0.1853	1.230	0.881
blocks_total_overall	0.0972	0.253	0.702
clearances_total_overall	-0.5888**	0.263	0.029
xa_total_overall	0.4394	0.445	0.327
npxg_total_overall	-0.2557	1.107	0.818
fouls_drawn_total_overall	-0.5256	0.423	0.218
fouls_committed_total_overall	0.2068	0.369	0.577
aerial_duels_won_total_overall	-0.0904	0.313	0.773
Observations	90		
R-Squared	0.462		
Adj. R-Squared	0.263		
F-Statistic	2.323		
AIC	297.8		

TABLE 12. Third Round Regression Results: Midfielders by League

This table shows the regression results for players who play as a midfielder in the five major leagues. A better correlation was generally found between midfielders and on-pitch performance data. However, each league had different focuses. For example, midfielders in the English Premier League were more likely to be rewarded for their goals scored and expected crosses. This creates a picture of a very attacking-focused midfielder who is rewarded better in salary. Midfielders in the German Bundesliga had a more diverse reward mechanism. More aggressive actions such as shots off target meant a lower salary, while defensive actions such as interceptions had a positive impact on salary. The French Ligue 1 was difficult to decipher as the only variable that had any meaningful relationship was the dispossession stats—which means the ball was taken from the midfielder. This was negatively correlated with salary and therefore it's likely that the French league rewards better possession play. The Italian Serie A had a very offensive-minded result: goals, xG, penalty goals, and npxG (non-penalty expected goals) were all correlated with salary at a low P-value. It is difficult to explain, however, that the xG was negatively correlated with salary while npxG was positively correlated with salary as they are nearly the same data point. npxG simply excludes penalty kick data from traditional xG. However, overall it is easy to see that the Italian league rewards attacking midfielders overall. Lastly, the Spanish La Liga seems to more often reward deep-lying players. The variables xa_total, tackles_total, and aerial_duels_won were positively correlated with salary. This describes a traditional number 6, who plays deep in the midfield and dictates play—an archetype similar to the playing style of Luka Modric, Dani Parejo, or Xabi Alonso.

Premier League (England)			
	Coefficient	Standard Error	P Value
goals_overall	0.5967***	0.199	0.004
assists_overall	-0.1878	0.221	0.398
penalty_goals	-0.4142	0.402	0.307
cards_overall	-0.1301	0.150	0.387
average_rating_overall	1.1276	1.795	0.532
key_passes_total_overall	0.2285	0.270	0.400
tackles_total_overall	-0.0008	0.356	0.998
shots_total_overall	0.8096	0.605	0.185
shots_on_target_total_overall	-0.2912	0.342	0.397
shots_off_target_total_overall	-0.4868	0.373	0.196
interceptions_total_overall	-0.1773	0.211	0.403
crosses_total_overall	-0.2261**	0.103	0.031
dispossessed_total_overall	-0.2526	0.257	0.328
dribbles_total_overall	0.4736	0.384	0.221
duels_won_total_overall	-0.2072	0.739	0.780
dribbles_successful_total_overall	-0.2529	0.381	0.509
xg_total_overall	-0.0294	0.346	0.932
blocks_total_overall	-0.0223	0.128	0.862
clearances_total_overall	-0.0654	0.168	0.699
xa_total_overall	0.6360*	0.334	0.061
npxg_total_overall	-0.3817	0.310	0.222
fouls_drawn_total_overall	-0.2268	0.250	0.367
fouls_committed_total_overall	0.4211	0.269	0.122
aerial_duels_won_total_overall	0.0381	0.209	0.856
Observations	100		
R-Squared	0.408		
Adj. R-Squared	0.219		
F-Statistic	2.153		
AIC	248.1		

(continues)

TABLE 12. Third Round Regression Results: Midfielders by League
(continued)

Bundesliga (Germany)			
	Coefficient	Standard Error	P Value
goals_overall	0.3755*	0.214	0.082
assists_overall	0.1242	0.177	0.485
penalty_goals	0.2519	0.544	0.644
cards_overall	-0.0430	0.173	0.804
average_rating_overall	0.2480**	0.121	0.043
key_passes_total_overall	0.2424	0.216	0.265
tackles_total_overall	-0.3192	0.261	0.224
shots_total_overall	1.2409	0.583	0.036
shots_on_target_total_overall	-0.5170	0.387	0.185
shots_off_target_total_overall	-1.0909***	0.411	0.009
interceptions_total_overall	0.4938***	0.175	0.006
crosses_total_overall	0.1304	0.132	0.327
dispossessed_total_overall	0.1337	0.200	0.505
dribbles_total_overall	-0.6163	0.410	0.136
duels_won_total_overall	0.6200	0.409	0.132
dribbles_successful_total_overall	0.2659	0.411	0.519
xg_total_overall	-1.2080	1.356	0.375
blocks_total_overall	0.1444	0.159	0.367
clearances_total_overall	-0.2308	0.202	0.256
xa_total_overall	-0.2823*	0.144	0.053
npvg_total_overall	1.1601	1.384	0.404
fouls_drawn_total_overall	0.0062	0.240	0.980
fouls_committed_total_overall	-0.0747	0.218	0.733
aerial_duels_won_total_overall	-0.3353*	0.190	0.080
Observations	120		
R-Squared	0.469		
Adj. R-Squared	0.335		
F-Statistic	3.494		
AIC	338.5		
Ligue 1 (France)			
	Coefficient	Standard Error	P Value
goals_overall	0.2289	0.355	0.521
assists_overall	-0.2832	0.333	0.398
penalty_goals	-0.2540	0.630	0.688
cards_overall	0.3739	0.275	0.179
average_rating_overall	-3.1006**	1.453	0.036
key_passes_total_overall	0.6191	0.416	0.141
tackles_total_overall	-0.1949	0.614	0.752
shots_total_overall	-0.9942	0.992	0.319
shots_on_target_total_overall	0.3387	0.417	0.419

Ligue 1 (France)			
	Coefficient	Standard Error	P Value
shots_off_target_total_overall	0.4133	0.600	0.493
interceptions_total_overall	-0.3394	0.344	0.327
crosses_total_overall	-0.1555	0.180	0.391
dispossessed_total_overall	-1.1602**	0.441	0.010
dribbles_total_overall	-0.0297	0.742	0.968
duels_won_total_overall	1.0151	1.039	0.332
dribbles_successful_total_overall	0.2630	0.690	0.704
xg_total_overall	0.3096	0.639	0.629
blocks_total_overall	-0.1829	0.230	0.430
clearances_total_overall	0.0245	0.317	0.938
xa_total_overall	0.4900	0.373	0.193
npxg_total_overall	-0.0028	0.560	0.996
fouls_drawn_total_overall	0.2468	0.355	0.489
fouls_committed_total_overall	-0.0984	0.444	0.825
aerial_duels_won_total_overall	-0.2851	0.362	0.433
Observations	99		
R-Squared	0.390		
Adj. R-Squared	0.192		
F-Statistic	1.969		
AIC	343.0		
Serie A (Italy)			
	Coefficient	Standard Error	P Value
goals_overall	0.5052**	0.232	0.031
assists_overall	0.0118	0.210	0.955
penalty_goals	1.2401*	0.658	0.063
cards_overall	-0.0779	0.192	0.685
average_rating_overall	0.7304	0.587	0.216
key_passes_total_overall	0.3844	0.258	0.139
tackles_total_overall	-0.2415	0.324	0.458
shots_total_overall	-0.2477	0.606	0.684
shots_on_target_total_overall	-0.0505	0.377	0.894
shots_off_target_total_overall	0.1983	0.375	0.598
interceptions_total_overall	0.0068	0.188	0.971
crosses_total_overall	0.0168	0.118	0.887
dispossessed_total_overall	-0.1885	0.207	0.364
dribbles_total_overall	-0.1635	0.394	0.679
duels_won_total_overall	0.4840	0.377	0.202
dribbles_successful_total_overall	0.0711	0.319	0.824
xg_total_overall	-3.2893***	1.083	0.003
blocks_total_overall	-0.0722	0.166	0.664
clearances_total_overall	0.0380	0.152	0.803
xa_total_overall	-0.0452	0.175	0.797

(continues)

TABLE 12. Third Round Regression Results: Midfielders by League
(continued)

Serie A (Italy) (continued)			
	Coefficient	Standard Error	P Value
npxg_total_overall	3.1642***	1.079	0.004
fouls_drawn_total_overall	0.2151	0.197	0.277
fouls_committed_total_overall	0.0245	0.245	0.921
aerial_duels_won_total_overall	-0.0305	0.156	0.846
Observations	124		
R-Squared	0.487		
Adj. R-Squared	0.362		
F-Statistic	3.910		
AIC	349.9		
La Liga (Spain)			
	Coefficient	Standard Error	P Value
goals_overall	0.0066	0.388	0.986
assists_overall	-0.5065	0.333	0.134
penalty_goals	-0.2752	0.663	0.680
cards_overall	-0.0842	0.344	0.807
average_rating_overall	10.8691***	3.313	0.002
key_passes_total_overall	-0.3079	0.400	0.444
tackles_total_overall	1.1833**	0.477	0.016
shots_total_overall	2.1310*	1.084	0.054
shots_on_target_total_overall	-0.6275	0.496	0.210
shots_off_target_total_overall	-1.5966**	0.771	0.042
interceptions_total_overall	-0.1781	0.330	0.591
crosses_total_overall	-0.1772	0.161	0.276
dispossessed_total_overall	-0.3461	0.337	0.309
dribbles_total_overall	-0.2588	0.751	0.732
duels_won_total_overall	-3.3800***	0.930	0.001
dribbles_successful_total_overall	0.5807	0.703	0.412
xg_total_overall	-0.1029	0.480	0.831
blocks_total_overall	0.0509	0.246	0.837
clearances_total_overall	-0.5698*	0.319	0.079
xa_total_overall	1.7936***	0.442	0.000
npxg_total_overall	0.3596	0.432	0.408
fouls_drawn_total_overall	0.7092	0.418	0.095
fouls_committed_total_overall	0.1187	0.324	0.715
aerial_duels_won_total_overall	0.7628**	0.370	0.043
Observations	92		
R-Squared	0.547		
Adj. R-Squared	0.384		
F-Statistic	3.367		
AIC	298.2		

CONCLUSIONS

The purpose of this research is to find out what on-pitch performance factors are the most significant in determining a soccer player's salary. In summary, this study initially found that generic stats such as age, minutes_played, and height had the most significant effect on a player's salary. This seems rather obvious in many ways and consistent with past literature. However, it is worth introspecting—for example, that minutes_played is a significant data point—in that players can often optimize their number of minutes on the field through actions such as: changing positions, changing clubs, or adjusting their style of play. This can have significant implications on their salary in a year or two as they are typically rewarded more for simply being utilized on the field more.

Furthermore, the research was narrowed to total on-pitch statistics and further filtered by position in the stepwise regression analysis. In the regression analysis of forwards and midfielders using total performance statistics across an entire season, forwards' salaries were difficult to determine. However, midfielder's salaries were a composition of what each league focused on more from their midfielders. The English Premier League and Italian Serie A clearly rewarded more goal scoring, forward passing, and chance creation while the Spanish La Liga rewarded defensive, deep-lying playmakers who made more tackles and played more dangerous passes (expected assists). This paper contributes to the literature by illuminating more reward characteristics for professional soccer players in these respective leagues. In particular, a diverse set of results was evident for midfielders in which they can study and mold their play.

Further research is needed in the future to gain a better understanding of salary reward mechanisms in professional soccer. Such research could modify the methodology and implement deeper player positional filtering. Players should be regressed against players from their specific positioning and not just general positioning. For example, forwards should be further divided into wingers, strikers, and center forwards, and the regression sample should only take players from the same specialization. Midfielders should then be divided into attacking midfielders, central midfielders, and defensive midfielders to see how these roles are rewarded differently. This system of classification should contribute to the literature on player salaries. Using data from multiple seasons rather than simply one season, thereby involving long-term consistency, is recommended.

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The Benefit to Shareholders from Corporate Green Bonds in the Asia-Pacific Region

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Abstract

Motivation: The green bond market has been actively growing since it was first issued in 2007, especially in the Asia-Pacific region. However, empirical analysis of green bonds, particularly from the equity investor's point of view, is still rare. This is the first empirical analysis focusing on the green bond in the Asia-Pacific and the behavior of equity investors.

Premise: Green bonds are essentially financial instruments issued to fund environmentally friendly projects, hence, it is expected to be positively evaluated by the market.

Approach: This study investigates how and to what extent the issuance of green bonds benefits equity investors in Asia-Pacific based on the data from 2013 to 2020 with event study and cross-sectional analysis.

Results: This study finds that there is a more positive cumulative average abnormal return (CAAR) of the listed corporate stocks around its green bond issuance announcement. Hence, green bond issuance is positively evaluated by equity investors. Secondly, from the cross-sectional analysis, we find that the market value of the company and the amount of green bonds issued per total debt are positively correlated, while profitability has an adverse relationship with CAAR. However, we find that book-to-market ratio, leverage, and whether or not the company publishes environmental, social, and corporate governance (ESG) reports are statistically insignificant.

Conclusion: Green bond benefits equity investors from the abnormal returns of the listed stocks.

Consistency: This paper has provided an empirical analysis and contributed to the extent of understanding in the limited yet developing green bond field of study.

Keywords: Asia-Pacific, equity investor, green bonds

JEL Classification Codes: Q01, G14, G41

INTRODUCTION

This study investigates whether the issuance of green bonds benefits equity investors in the Asia-Pacific region. The issuance of green bonds in the Asia-Pacific region is a growing share of the global issuance of green bonds. By 2022, just fifteen years after the first green bond, the issuance of green bonds in the Asia-Pacific region has surpassed all regions except Europe (Climate Bonds Initiative n.d.). Yet, there is no analysis of the market's reaction to green bonds issuance in the Asian-Pacific region. While Tang and Zhang (2020) and Flammer (2021) in their analysis include green bonds issued in the Asian-Pacific region, from their analysis, it is not possible to isolate the market's reaction to Asian-Pacific bonds (Tang and Zhang 2020). Thus, this study fills a gap in the literature. This study also adds to the literature as it clarifies why the market reacts positively to the issuance of green bonds as both Tang and Zhang (2020) and Flammer (2021) find.

Green bonds are fixed-income securities explicitly issued to finance projects that address climate change or improve the environment. For example, in 2023 Japan's Hitachi issued a green bond for 100 billion JPY to refinance and renovate the carbon-neutral building housing its central research institute. Issuing green bonds is more costly to a firm compared to issuing conventional bonds. The proceeds from green bonds are committed to specific projects that reduce a firm's investment flexibility, and to qualify as green a bond it needs to be certified through a third-party process which increases issuance cost. Precisely because of their comparative restrictions and certification costs, issuing a green bond may provide a credible signal to the market that a firm recognizes the tacit claims its stakeholders have on the firm's interaction with the environment. There is ample evidence to suggest that a firm can only maximize its shareholder value if it first commits to honor the tacit claims of its stakeholders. See for example Zingales (2000), Jensen (2001), and Porter and Kramer (2011).

If the issuance of green bonds signals a firm honoring its stakeholders' tacit claims on the environment, the positive market reaction should be stronger for a first-time issuer of green bonds, and for an issuer whose non-core operations directly and significantly interact with the environment. For example, the market is likely to react less to a strip-mining firm issuing a green bond since its core operations damage the environment. By comparison, the market is likely to show a stronger reaction to firms in industries like power generation, manufacturing, food production, and transportation. Such firms can reduce the impact of their operations on the environment and still maintain their ability to generate revenue.

However, the market may also react positively to the issuance of green bonds if green bonds are issued at a premium over comparable conventional bonds. The literature largely links green bonds selling at a premium to their undersupply relative to the demand for them. The literature attributes the demand for green bonds variously to their inclusion in green investment indexes, to their diversification benefits, or to investors' desire for green initiatives. However, there is no consensus in the literature on whether green bonds trade at a premium. For example, Ley (2017) and Baker et al. (2018) find that green bonds trade at a premium, but Zernin (2019), Flammer (2021) and Immel et al. (2021) find that green bonds trade at a discount. In fact, in a systematic review of the literature, MacAskill et al. (2021) conclude that the evidence is mixed.

We perform an event study and find that there is a more positive cumulative abnormal return. To explain the market's reaction to the issuance of green bonds, we continue with a cross-sectional regression analysis where we control for company size, leverage, book-to-market ratio, return on equity (ROE), amount of bond issued per total debt, and whether the company published an ESG report or not. Taken together, these results suggest that the company's market value and green bond issued per total debt are linked to the cumulative average abnormal return in a positive manner. Nonetheless, there are no notable associations found with variables such as the book-to-market ratio, leverage, profitability, and the company's publication of ESG reports.

The remainder of this paper is as follows: The next section reviews the literature of other green bond studies. The Methodology section outlines the primary methodology of this study, with an overview of formulas used and assumptions made, ending with a step-by-step example of a representative green bond issuance in Asia-Pacific from 2013. The Data and Results section shows the relevant findings and outcomes of the calculations for all green bond issuance in Asia-Pacific from 2013 to 2020. Lastly, the Cross-Sectional Analysis Results section compares the bond issuance to the characteristics of its issuer. We organize the results by country as well as industry. In the last part of this study, we conclude the paper and give recommendations for the future development and research of the green bond market. We hope this paper brings value to the future development and research of the green bond market, while at the same time promoting green investment and encouraging firms to use green bonds as a financing alternative.

LITERATURE REVIEW

According to the G20 Green Finance Synthesis Report (2016), green bonds are an integral component of green finance, which aims to internalize environmental externalities and adjust risk perceptions for the sake of increasing environmentally friendly investment. Green bonds are aimed to encourage awareness of the financial risks related to environmental change. Another advantage of this bond compared to other bonds is how the investors could benefit from tax incentives. Even though green bonds have some additional transaction costs because issuers must trace, monitor, and report on the use of proceeds, the issuance will eventually offset the higher initial cost. The green project categories included renewable energy, climate change adaptation, energy efficiency, sustainable water and wastewater management, clean transportation, environmentally sustainable management of living natural resources and land use, pollution prevention and control, terrestrial aquatic biodiversity conservation, eco-efficient and/or circular economy adopted products, production technologies and processes, and lastly, green building.

Green bonds have gained momentum with the broad uptake of capital markets regulations on their issuance in the Asia-Pacific region, having the second-largest volume in 2022 after Europe, according to data provided by Climate Bond Initiative (2023). In 2022 we saw issuance from Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, Singapore, South Korea, Taiwan, the Philippines, Saudi Arabia, Vietnam, Turkey, Israel, Lebanon, and Kazakhstan. Many debut issuers are also expected to join the market in the future. The top

three countries are China (USD 85.4 billion), Japan (USD 7.9 billion), and South Korea (USD 7.9 billion).

Several studies have been performed to investigate the premium and discount of Green Bonds compared to its conventional peers. The study done by MacAskill et al. (2021) explores the relationship between green bonds and financial markets, focusing on the diversification benefits of green bonds in investor portfolios and the potential impact of financial market price fluctuations on green bond prices. The empirical findings suggest a strong dependence between the green bond market and fixed-income markets, with symmetric tail dependence. However, this dependence reduces the diversification effects for investors in corporate and Treasury bond markets, as green bonds are influenced by substantial price spillovers from these markets. Additionally, green bond prices show weak co-movement with stock and energy commodity markets, providing limited diversification benefits for investors in those markets. Despite this, large price fluctuations in stock and energy markets have a negligible impact on green bond prices. The study's implications include considerations for building environmentally friendly portfolios and aligning private incentives with the mobilization of financial resources to support the transition to a climate-resilient economy.

Previous studies also conducted by Ley (2017) and Baker et al. (2018) state that green bonds, undeniably, are issued at a premium. These studies focus on the pricing differences between green bonds and conventional bonds, using the capital asset pricing model (CAPM), and the samples focus on a global basis.

The approaches used in premium or discount on green bond studies vary significantly, and the market's response in terms of premium or discount appears to differ from that of corporate bonds. A comprehensive analysis by Tang and Zhang (2018) does not find a significant premium for green bonds, suggesting that the positive stock returns around green bond announcements are not driven by the lower cost of debt. Their event study uses estimation windows starting from -300 to -50 trading days and -10 to 10 trading days, with results showing that the issuance of green bonds is advantageous to its existing shareholders.

Another set of event studies by Chin and Abdullah (2013) about the announcement effect of conventional corporate bond issuance, finds a positive cumulative average abnormal return following bond issuance, indicating that the market considers bond offers to be favorable news. Their investigation window is from -60 through +60 days, with a pre-event investigation window ranging from -60 to -1 days and a post-event investigation window ranging from +1 to +60 days, with size, profitability, asset tangibility, growth opportunity, and managerial ownership as their regression variables.

Cheng et al. (2005) also performed an event study and cross-sectional analysis of stock market reaction to the issuance of convertible bonds in Japan, with an estimated period ranging from -240 to -31 days, and an event window from -30 to 30 days of the event. They also conducted a cross-sectional analysis with size, leverage, and book-to-market ratio as their control variables. The evidence regarding premiums or discounts in the context of corporate green bond announcement event studies is notably inconsistent and sensitive to methodology. This rationalizes the research performed, for the methodology, event window, and regression variables in this paper are compared to the previous studies.

METHODOLOGY

Source of Data

We construct an event study analysis using a sample composed of observations from the green bonds issued in Asia-Pacific from 2013 to 2020. Because the security prices reflect all currently available information, price changes must reflect new information. Therefore, an event study is a suitable research methodology for this study. In this study, the data sources for the green bonds are from the Climate Bond Initiative (CBI) database. We chose CBI as the primary source because it has extensive coverage of available data, and all of them are aligned with the Green Bond Principles (GBP). This database provides most of the green bond information we need in this study including the issuer name, the amount issued, USD amount issued, currency, issue date, and country. The database also has a second opinion link that consists of extensive information, including the third-party bond ratings. We chose 2013 as the starting year of our study because the first labeled green bond issued by a public financial institution in Asia-Pacific was issued in that year; it was by the Export-Import Bank of Korea, ending in September 2020 for the recently available data purpose.

The second data source we use is DataStream, where we gather the stock prices, market indexes, and market information. Since our samples are constructed from different stock markets, additional financial information about the listed companies is generated from company annual reports published on their official websites.

Event Study Analysis

For the event selection of this study, we exclude the green bonds issued by the government and supranational organizations such as the World Bank and focus on the corporate-issued green bonds in which the company stock is listed on the stock market. Private placement green bonds are also excluded from the sample since the financial information is not publicly disclosed. The announcement date is used instead of the issue date. The announcement date is the date on which a company will announce the details regarding an issue of green bonds. We chose the announcement date for this study because it is the first day the public will receive information regarding a new bond issue.

In this study, we use $t = -300$ days to $t = -31$ days before the issue date as the estimation period, and an investigation window from day $t = -30$ through day $t = +30$, and day $t = -10$ and $t = +10$ to test the robustness of the data. We use the daily stock price data to facilitate for a more precise measurement of abnormal returns and better information studies about the abnormal effect.

To study the stock reactions to the issuance of the bond, we first use the market model to estimate abnormal returns. The decomposition return is as follows:

$$E[R_{i,t}|X_i] = \alpha + (\beta_i \times R_{m,t}|X_i) + AR_t$$

$$AR_t = E[R_{i,t}|X_i] - [\alpha + (\beta_i \times R_{m,t}|X_i)]$$

Because our samples are constructed from different stock markets, we use the index of the stock market or market return ($R_{m,t}$) on which the stock is listed. We estimate the beta and alpha of each firm using estimation windows starting from 300 to 31 days before the announcement date. The difference between the predicted return from the market model and the actual return is the abnormal return (AR_t). Then, from the generated expected return, we calculate abnormal returns for firm I and event day t with cumulated abnormal returns (CAR).

$$CAR_{t,t+K}^i = \sum_k AR_{i,t+k}$$

Where $e_{i,t}$ equals to abnormal return for the bond I and given day t . The abnormal returns are later to be summed as cumulated abnormal ($CAR_{t,t+K}^i$). Later, we perform a traditional parametric t -test for each of the events to see whether there is a significant effect due to the bond offers using the abnormal returns and cumulative abnormal returns ($CAR_{i,t}$). The null hypotheses are formulated as follows:

$$H_0: CAR_t = 0$$

$$H_1: CAR_t \neq 0$$

The null and alternative hypotheses are stated in terms of cumulative abnormal return, where it is expected the cumulative abnormal return to be zero in the absence of abnormal return around the announcement date.

According to MacKinlay (1997), to draw general inferences related to the event, the abnormal return observations must be aggregated. Therefore, we aggregate the samples across stocks and time by calculating the average abnormal return. The average abnormal returns for each stock are summed throughout the event days and form the cumulative average abnormal return.

$$CAAR_{i,t} = \frac{1}{N} \sum_{i=t}^N CAR_{t,t+K}^i$$

The second hypothesis of this study is cumulative average abnormal return, whether it is expected to be zero when there is no abnormal return around the event date. Hence, a t -statistics is performed on the CAAR. The null hypotheses are formulated as follows:

$$H_0: CAAR_t = 0$$

$$H_1: CAAR_t \neq 0$$

Cross-Sectional Analysis

The last section of the study is cross-sectional regression analysis. To explain the reactions of investors to bond issues, the previous study by Cheng, Visaltanachoti, and Kesayan (2005) focused on the various company characteristics that presumably contribute to such reactions, namely, size, leverage ratio, and the equity's book-to-market value. However, according to Tang and Zhang (2018), a green bond announcement involves two important aspects: the bond announcement effect and the "green label" effect. Therefore, we include additional independent variables in this regression, such as ESG coverage as a dummy

variable, whether the company published a sustainability or a triple bottom line report. The cross-sectional regression model is given as follows:

$$AAR_{i,t} = \frac{1}{N} \sum_{i=t}^N AR_{i,t}$$

$$CAAR_i^t = \beta_0 + \beta_1 GreenAmount/Debt_i + \beta_2 ESG_i + \beta_3 ROE_i + \beta_4 BM_i \\ + \beta_5 Leverage_i + \beta_6 Size_i + e_i$$

Where

$AAR_{i,t}$ is the average abnormal return for day t

$AR_{i,t}$ is the abnormal return to share i for day t

N is the number of securities in the sample

After the $(AAR_{i,t})$ is known, the cumulative average abnormal return $(CAAR_i^t)$ is calculated.

$CAAR_i^t$	is the cumulative average abnormal return for a firm i from ten days before the event and ten days after the event
$Size_i$	is the natural logarithm of market value equity in USD
$Leverage_i$	is the ratio of total debt to total assets
BM_i	is the ratio of the book value of equity to market value
ROE_i	is the ratio of return on equity
$GreenAmount/Debt_i$	is the ratio of total green bond issued divided by total liabilities
ESG_i	is a dummy variable, whether the firm publishes sustainable reporting in that event year. One for the company that published the report and zero if they did not.

From all of the studies performed, we group the results if we find a pattern. For example, we divide the group by financial issuers versus nonfinancial issuers. We also divide by market since the samples are generated from different parts of the Asia-Pacific. We group the results to create better interpretations and detailed analyses.

DATA AND RESULTS

Event Study Data

This event study analysis is constructed by sample observations from the green bonds issued in Asia-Pacific from the years 2013 to 2020. However, although the first green bond issuance in Asia was recorded by the Export-Import Bank of Korea in February 2013, we do not include the event since the company is

not listed on the stock exchange. We began our event study with the issuance from Toyota in March 2014. Therefore, the total observation is 151 of the first issuances by listed companies.

The observations are categorized by industry and country or region. For the industry split, the categorizations are based on the Standard Industrial Classification (SIC). Most of the companies listed under the construction variable are construction for low-energy buildings or properties. Similarly, transportation and public utilities are companies whose businesses are for low-energy or low-carbon emission transportation and power companies, for example, renewable energy firms. Most of the observations under the service industry are from environmental services, for instance, water and waste management businesses. While the mining industry consisted of only one company, the finance industry accounted for more than half of the total sample. Lastly, most of the manufacturing companies are automobile and machine makers.

The international split of bond issuance is divided into six categories. We group Australia and New Zealand because there are only two New Zealand issuers, and most of the big companies from New Zealand are also listed in the Australia Securities Exchange. Singapore, Malaysia, Thailand, the Philippines, and Indonesia are included in the Association of Southeast Asian Nations (ASEAN) since these countries share the same green bond principle, namely ASEAN GBP. Moreover, green bond issuance from China covers issuance not only from the mainland but also from Taiwan and Hong Kong.

Event Study Results

Our event study result interpretations are divided into two groups: positive and negative returns (Table 1). This is mainly because when we try to summarize all of the results into one aggregate conclusion per hypothesis, the results are calculated to be almost zero. The positive and negative proportions are almost equal and balanced each other.

TABLE 1. Event Study Result (–30 Days, +30 Days)

This table reports the CAR for green bond announcement returns. We calculate the cumulative abnormal return (CAR) and cumulative average abnormal return (CAAR) using the CAPM model. The stock price and market index are from Datastream and Yahoo Finance. (Robust *t*-statistics are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.)

	CAR	CAAR
Positive Return		
	3.43%**	2.32%
<i>t</i> -statistic	15.88	5.89
p-value	0.03	0.13
Observations	86	79
Negative Return		
	–5.02%**	–2.79%*
<i>t</i> -statistic	–17.02	–7.24
p-value	0.05	0.10
Observations	65	72
Total Observations	151	151

After calculating the event study for all the 151 observations, from the investigation period of 30 days before and 30 days after the announcement date, we find that the cumulative abnormal return is -5.02 percent to 3.43 percent, and that proved to be statistically significant at alpha 0.05 . This finding shows that there is a cumulative abnormal return from the green bond issuance. The cumulative average abnormal return also proved to be not zero—unlike our null hypothesis—it is -2.79 percent to 2.32 percent. Hence, there are more positive observations for the issuance of green bonds compared to the negative cumulative average abnormal return.

Daily Results by Industry and Country

The previous part explained the result in an aggregate manner. For the robustness of the study, we narrow down our observation period to ten days before and after the announcement date, in consideration of the effect of other companies' events outside the green bond issuance (Table 2). We split the daily cumulative abnormal return first by general effect, positive or negative, then by industry and geography to identify if the same grouped samples share the same pattern.

TABLE 2. Positive Cumulative Average Abnormal Return by Industry (Percent)

This table presents the positive CAAR of green bond by industries. We calculate the CAAR using the CAPM model. The stock price and market index are from Datastream and Yahoo Finance. (Robust t -statistics are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.)

Days	CAAR (+)	Service (+)	Transportation & Utilities (+)	Manufacturing (+)	Finance (+)	Construction (+)
[-11,-10]	0.01	1.12	0.91	0.69	0.09	-0.15
[-10,-9]	0.12	1**	1.34	1.11**	0.23	-0.19
[-9,-8]	0.31	1.22**	1.84	1.29	0.39	-0.27
[-8,-7]	0.41	1.13**	2.17	1.39	0.49	-0.14
[-7,-6]	0.56	0.98	2.48	1.79	0.7	-0.15
[-6,-5]	0.7	1.08	2.61	2.14**	0.91	-0.07
[-5,-4]	0.84	1.15	2.69	2.56	1.08	0.12
[-4,-3]	0.97	1.22	2.81	2.84	1.21	0.35
[-3,-2]	1.11	1.47**	3	3.12	1.34	0.63
[-2,-1]	1.26	1.55***	3.15	3.29	1.48	0.89
[-1,0]	1.39	1.58***	3.25	3.49	1.61	1.02
[0,1]	1.51	1.61***	3.36	3.74	1.71	1.16
[1,2]	1.64	1.57***	3.57	4	1.82	1.26
[2,3]	1.74	1.65***	3.77	4.18**	1.9	1.3
[3,4]	1.84	1.7***	3.94	4.36**	1.97	1.35
[4,5]	1.94	1.73***	4.15	4.59***	2.03	1.41
[6,7]	2.03	1.72***	4.29	4.74***	2.09	1.46
[7,8]	2.11	1.72***	4.37	4.82***	2.16**	1.49
[8,9]	2.19	1.74***	4.48	4.89***	2.23**	1.52
[9,10]	2.29	1.8***	4.57	4.92**	2.3**	1.55
[10,11]	2.41	1.84***	4.65	5.03**	2.39**	1.64
N	81	3	16	5	43	14

CAAR BY INDUSTRY

The cumulative abnormal return per industry is explained in Table 3 and Figure 1. There are more positive cumulative average abnormal returns (81 observations) compared to negative cumulative average abnormal returns (70 observations). The highest positive cumulative abnormal return effect is in the manufacturing industry at 5.03 percent followed by the transportation and utilities industry at 4.65 percent. Conversely, manufacturing also reported having the highest negative effect at -5.58 percent, followed by the transportation and utilities industry at -4.07 percent.

The finance industry accounted for almost half of the total samples. Of 75 financial corporations, 38 of them are banking corporations, followed by financial companies related to real estate and other investment institutions. Fundamentally, financial institutions that issue green bonds are allowed to invest in the whole range of GBP projects. However, more institutions choose to focus on renewable energy, green buildings, or both. From the event study results, there are more observations with positive CAAR (43 observations or 2.39 percent) than negative CAAR (32 observations or -2.62 percent). Therefore, there is a

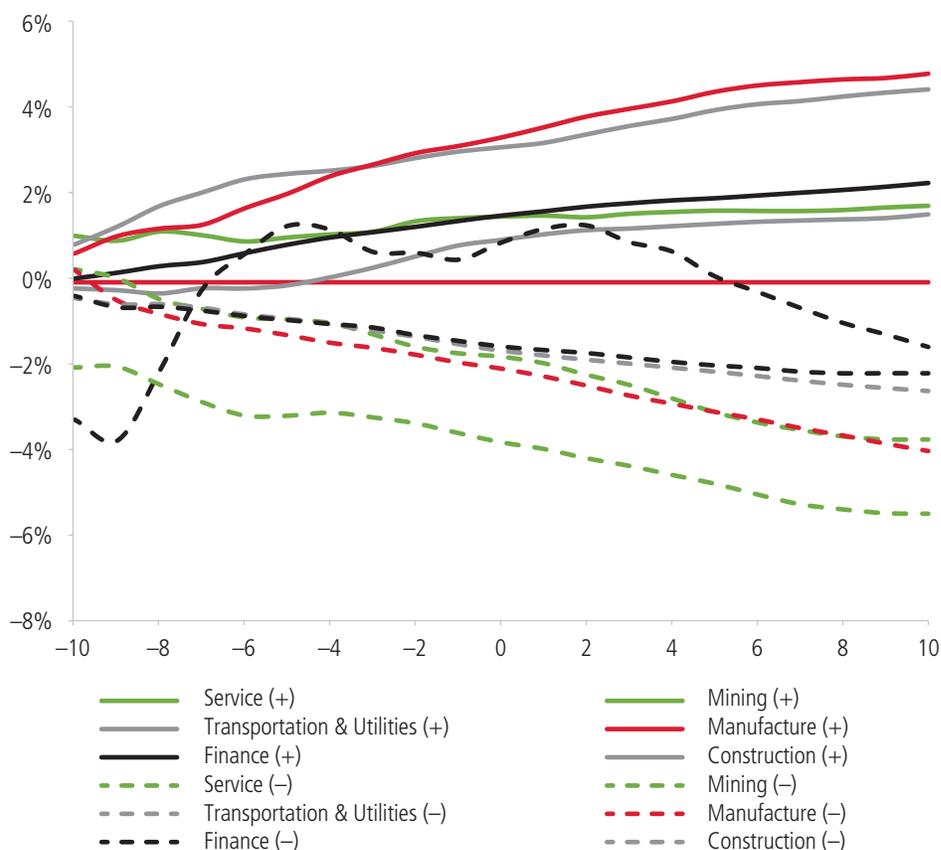
TABLE 3. Negative Cumulative Average Abnormal Return by Industry (Percent)

This table shows the negative CAAR of green bond by industries. We calculate the CAAR using the CAPM model. The stock price and market index are from Datastream and Yahoo Finance. (Robust *t*-statistics are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.)

Days	CAAR (-)	Service (-)	Mining (-)	Transportation & Utilities (-)	Manufacturing (-)	Finance (-)	Construction (-)
[-11,-10]	-0.08	0.32	-3.31***	0.3	-2.05	-0.38	-0.33
[-10,-9]	-0.32	0.1	-3.82***	-0.44	-2.04	-0.53	-0.6
[-9,-8]	-0.45	-0.41	-2.12	-0.76	-2.47	-0.52	-0.59
[-8,-7]	-0.56	-0.64	-0.16	-1.01	-2.89	-0.61	-0.68
[-7,-6]	-0.68	-0.85	0.69	-1.12	-3.22	-0.78	-0.82
[-6,-5]	-0.74	-0.89	1.36	-1.28	-3.22	-0.88	-0.91
[-5,-4]	-0.83	-0.99	1.26	-1.46	-3.14	-1.01	-1
[-4,-3]	-0.97	-1.26	0.73	-1.58	-3.26	-1.17	-1.09
[-3,-2]	-1.12	-1.56	0.71	-1.75	-3.4	-1.31	-1.28
[-2,-1]	-1.31	-1.71	0.55	-1.93	-3.64	-1.49	-1.41
[-1,0]	-1.47	-1.8	0.96	-2.08	-3.86	-1.65	-1.55
[0,1]	-1.62	-1.95	1.29	-2.27**	-4.02	-1.76	-1.63
[1,2]	-1.79	-2.23	1.37	-2.49**	-4.24	-1.87	-1.71
[2,3]	-1.96	-2.48	0.97	-2.73**	-4.43	-1.96	-1.81
[3,4]	-2.13	-2.8	0.74	-2.93**	-4.64	-2.06	-1.92
[4,5]	-2.3	-3.13**	0.14	-3.12***	-4.85	-2.15	-2
[6,7]	-2.47	-3.38**	-0.23	-3.3**	-5.11**	-2.26	-2.07
[7,8]	-2.66	-3.56***	-0.62	-3.51**	-5.35**	-2.37	-2.15
[8,9]	-2.82	-3.72***	-0.98	-3.69***	-5.47**	-2.47	-2.19
[9,10]	-2.96	-3.79**	-1.26	-3.89**	-5.56**	-2.55	-2.19
[10,11]	-3.09	-3.79	-1.56	-4.07**	-5.58***	-2.62	-2.19
N	70	5	1	14	7	32	11

FIGURE 1. Cumulative Average Abnormal Return by Industry

This figure illustrates the CAAR of green bond by industries. We calculate the CAAR using the CAPM model. The stock price, market index, and announcement data are from Datastream, Yahoo Finance, and official company websites.



possibility for a financial corporation to be positively evaluated by equity investors when they issue a green bond.

The rest of the non-finance corporates are from the service, mining, public transportation/utilities, manufacturing, and construction industries. There are 76 corporations in this category, with the highest number of issuances from public transportation and utilities with 30 observations, followed by construction with 25 companies. From CAAR results, manufacturing companies generate the highest positive CAAR, followed by transport and utilities, service, and lastly, construction. Most of the manufacturing companies are issuing green bonds to finance their low-carbon emission and low-energy automobiles and machinery. Manufacturers benefit most from green bond issuance compared to other industries because of market interest in purchasing certified sustainable products growing rapidly in this sector.

On the other hand, manufacturing has the highest negative CAAR, followed by the transportation and utilities industry. Public transportation and utilities accounted for the second highest negative CAAR because of the nature of its business and greenwashing. While some electric companies claim to have a clean energy brand, more claims of greenwashing came from electric utilities, which are most of our samples from the public transportation and utility industry.

CAAR BY GEOGRAPHY

Table 4 presents the CAAR of green bonds by geography.

Figure 2 shows the CAAR of green bonds by geography.

The second analysis is from the issuer's countries. It finds that there are more positive cumulative abnormal returns for Japan and more negative CAAR for China and the rest of Asia-Pacific countries. The most positive and negative CAAR found in the rest of Asia-Pacific countries were 3.41 percent and -4.39 percent, respectively.

As the leading Asia-Pacific green bond issuer, China accounted for more than one-third of our total sample. From the event study analysis, we find there is a more positive CAAR for investors than negative returns. This result implies that markets respond favorably to the Chinese green bond market. Compared to other issuing countries, Chinese issuers have more benefits and support from the government to issue this instrument, one of which is subsidized borrowing cost. Green bonds have been growing in the Chinese market because banks and businesses can obtain a lower borrowing cost from the central bank and receive up to 12 percent interest payments subsidized by the local government. Moreover, local regulators also allow companies that issue environmentally friendly loans

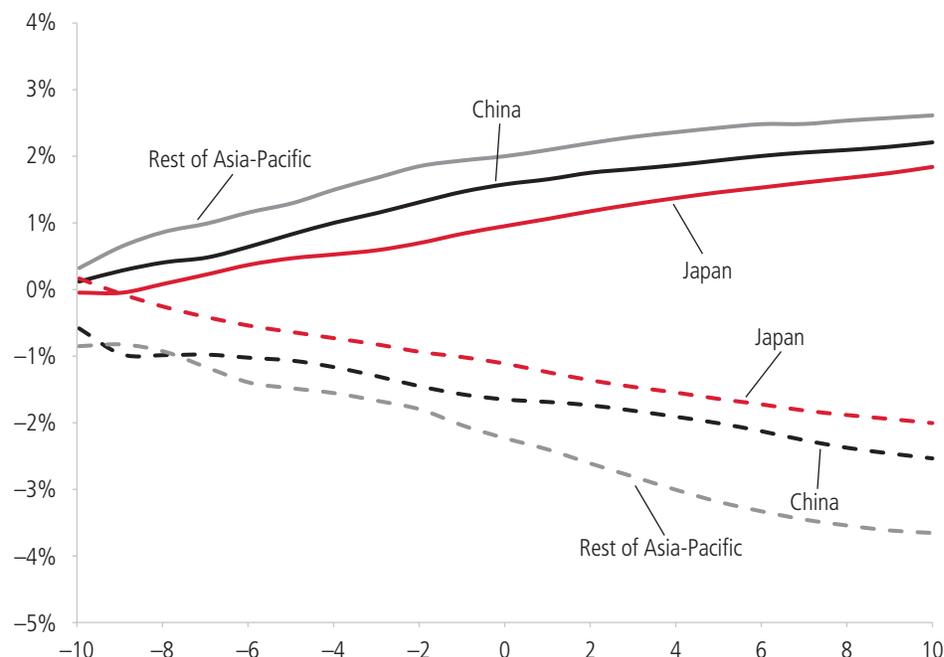
TABLE 4. Cumulative Average Abnormal Return by Country/Region (Percent)

We calculate the CAAR using the CAPM model. The stock price and market index are from Datastream and Yahoo Finance. China (CN), Japan (JP), the rest of Asia-Pacific (AP). (Robust *t*-statistics are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.)

Days	CAAR (+)	CN (+)	JP (+)	AP (+)	CAAR (-)	CN (-)	JP (-)	AP (-)
[-11,-10]	0.01	0.31	0.1	0.56	-0.08	-0.57	0.36	-0.9
[-10,-9]	0.12	0.51	0.1	0.96	-0.32	-1.05	0.07	-0.87
[-9,-8]	0.31	0.67	0.27	1.24	-0.45	-1.07	-0.17	-1
[-8,-7]	0.41	0.76	0.44	1.39	-0.56	-1.06	-0.36	-1.3
[-7,-6]	0.56	0.96	0.62	1.6	-0.68	-1.12	-0.52	-1.58
[-6,-5]	0.7	1.19	0.74	1.77	-0.74	-1.17	-0.64	-1.69
[-5,-4]	0.84	1.41	0.81	2.03	-0.83	-1.3	-0.75	-1.78
[-4,-3]	0.97	1.59	0.89	2.25	-0.97	-1.46	-0.87	-1.92
[-3,-2]	1.11	1.79	1.03	2.47	-1.12	-1.65	-1.01	-2.08
[-2,-1]	1.26	1.99	1.2	2.57	-1.31	-1.8	-1.11	-2.38
[-1,0]	1.39	2.13	1.35	2.65	-1.47	-1.9	-1.23	-2.62
[0,1]	1.51	2.22	1.48	2.77	-1.62	-1.94	-1.39	-2.83
[1,2]	1.64	2.34	1.62	2.9	-1.79	-2.01	-1.54	-3.1
[2,3]	1.74	2.41	1.75	3.01	-1.96	-2.11	-1.66	-3.34
[3,4]	1.84	2.48	1.87	3.1	-2.13	-2.22	-1.77	-3.59
[4,5]	1.94	2.57	1.97	3.18	-2.3	-2.34	-1.89	-3.81
[6,7]	2.03	2.65	2.06	3.25	-2.47	-2.49	-1.99	-3.99
[7,8]	2.11	2.72**	2.16	3.25	-2.66	-2.66	-2.1	-4.14
[8,9]	2.19	2.77	2.24	3.31	-2.82	-2.8	-2.19	-4.25**
[9,10]	2.29	2.82**	2.33	3.36	-2.96	-2.9	-2.26	-4.34**
[10,11]	2.41	2.91**	2.45	3.41	-3.09	-3	-2.34	-4.39**
N	81	29	32	20	70	30	20	20

FIGURE 2. Cumulative Average Abnormal Return by Geography

We calculate the CAAR using the CAPM model. The stock price, market index, and announcement data are from Datastream, Yahoo Finance, and official company websites.



to use these assets as collateral. Local policies are making green bond issuance more flexible and relaxed due to the unspecified reporting and monitoring process. Moreover, green bonds are still allowed to fund projects with coal-based energy.

Regulations, guidelines, standards, and policies related to the issuance of green bonds in China are supervised by the People's Bank of China (PBoC), National Association of Financial Market Institutional Investors (NAFMII), China Securities Regulatory Commission (CSRC), and National Development and Reform Commission (NDRC). While most of the issued bonds in China are aligned with the international standard by the Climate Bond Institute, some are still not fully aligned. NDRC, as the policymaker for state-owned enterprises, is quite different in regulating this issuance. According to the NDRC green bond issuance standard, some state-owned enterprises can still issue green bonds to finance their coal-related projects while the global standard supports the clean coal initiative. Moreover, the management of proceeds and reporting from NDRC are unspecified, while the rest of the issuance mandates clear monitoring and periodic reports to the market: quarterly for the financial corporations, each semester for the nonfinancial corporations, and at least once a year for corporations with listed equity.

Japan comes second in Asia-Pacific after China for the leading issuer. The green bond is evaluated positively in Japan from their CAAR, volume, and percentage. This great response may be related to the well-developed Japanese bond market and local government supports this financing instrument by subsidizing the extra issuance cost of the third-party verification.

Since the green bond market remains relatively small, the Japanese government encourages both public and private sectors to scale up issuance and invest-

ments to meet the country's environmental targets. Financial Support Program for Green Bond Issuance provides subsidies for green bond issuers in the form of up to JPY 50 million grants per issuance. These grants are intended to help the issuers cover the additional costs and administrative burdens associated with gaining support from expert third parties such as external review entities, green bond consulting firms, and structuring agents.

The rest of the Asia-Pacific analysis is India, Australia-New Zealand, Korea, and ASEAN countries with a total of 40 events. In this sub-sample, Korea is the only country to have a more positive CAAR than a negative CAAR. While India and Australia-New Zealand have an equally positive and negative response, ASEAN countries are more negatively evaluated on this issue.

The Korean green bond market ranked third after China and Japan, despite being an early comer from the Asia-Pacific region since 2013 by Korea Export-Import Bank. Korea still has not published its country-specific guidelines to clarify some confusion regarding the precise definition of what type of assets or projects qualify. Also, the issuance transaction costs, mainly external review costs, are high. Furthermore, the lack of English information availability and foreign currency risk add challenges to international issuing. Despite the lack of government support for the local green bond, a positive response comes from this active investor base in Korea. Further assistance to push the development of this market is recommended for the local government to take advantage of this favorable market evaluation.

Our event study results show that issuing green bonds in India and Australia-New Zealand would result in an equal chance of the event being positively and negatively evaluated. In India, the green bond issuance policy follows the Securities and Exchange Board of India (SEBI) Green Bond Guidelines, which was published in 2016. The authority initiated a consultation process for disclosure requirements for public issue listing of green bonds and listing of privately placed green bonds. Although India has its regional guidelines, the disclosures are mainly based on the global Green Bond Principles.

India may be the early issuer in Asia; however, compared to the size of the total market, the proportion of green bonds is still small. This may be due to the lack of price advantage faced by issuers. According to the Observer Research Foundation's Special Report (Kumar, Vaze, and Kidney 2019), the pricing advantage for Indian issuers is not significant, typically between 7 and 14 basis points. Moreover, the current concerns about non-performing assets (NPA) writing off bad loans in India have dried up the market because of the fluctuating foreign exchange and interest rates. Despite the partially guaranteed mechanisms offered by the government to encourage green bond issuances, the charged fee is considered to be overpriced; it can be as high as 1.25 percent.

The equal positive and negative CAAR found in Australia-New Zealand can be related to the lack of clear guidelines and incentives from the government. On the other hand, they are the leaders in best practice and certification under the Climate Bond Standard, while most of the global issuer certifications are from second- or third-party ratings. All Australian green bond issuers also report post-issuance. Almost 80 percent of the issuers also provide voluntary reports for both use-of-proceeds and impact reporting. This high rate and full disclosure signal high awareness of green issues in Australia. From the policy point of view, clear guidelines and incentives from the policymaker are still less compared to

the market interest in green bonds for these two countries. A carbon pricing scheme was established in Australia in 2012, yet it was withdrawn in 2014. Despite the lack of governmental policy, high awareness of climate change and commitment to the ESG principles have been the main drivers for the high demand for green bonds.

The ten members of the Association of Southeast Asian Nations (ASEAN)—Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam—are the only group of regions to have more negative CAAR than the rest of the samples. This is a still new and growing market that only made up 12 percent of our total sample, with half of the issuers coming from Singapore. All ASEAN countries have the same ASEAN GBS as their guidelines, which were published in the ASEAN Capital Market Forum (ACMF) in November 2017. The key features of the ASEAN GBS are issuers must have a geographical or economic connection to the region, fossil fuel power projects are ineligible, project information is available and publicly accessible, and it recommends more frequent reporting and external review.

Even though ASEAN has its guidelines, some countries have their own regional and domestic measures supporting green bond issuance. Securities Commission Malaysia launched its own Sustainable and Responsible Investment (SRI) Sukuk framework in 2014. The commission later introduced a tax exemption in 2018 for recipients under the Green SRI Sukuk Grant Scheme for up to MYR 6 million (USD 1.5 million). In Singapore, the Green Bond Grant scheme was launched by the Monetary Authority of Singapore (MAS) in 2017, valued at up to SGD 100,000 (USD 72,460) per issuance. The grant applies to green bonds issued and listed in Singapore with a minimum size of SGD 200 million and tenor of at least three years. Both the Malaysia and Singapore schemes aim to offset the cost of obtaining an external review for green bonds (Rimaud et al. 2019).

Similarly, Indonesia, Vietnam, and the Philippine authorities set up regulations regarding such issuance. In 2014, the Indonesia Financial Services Authority launched the Roadmap for Sustainable Finance. The State Bank of Vietnam published a Directive on Promoting Green Credit and Managing Environmental and Social Risk in Lending Activities in 2015. Finally, at the end of 2018, the Securities and Exchange Commission Philippines established standards for the issuance of Green Bonds under the ASEAN GBS. Only Singapore and Malaysia give benefits in the form of grants for the issuer to offset the extra issuing cost. Thus, further promotion and support from the rest of the ASEAN nations to promote these financing tools already have a strong principle.

Cross-Sectional Analysis Results

Due to the global recession in 2019, we present the cross-sectional analysis in two periods: the first one is from 2013 to 2018, and the second one is from 2013 to 2020.

Green Bond Issuance before the Global Recession of 2019

See Table 5.

In the Asia-Pacific regression, the regression that contains all of our 100 samples, we find that there are two significant variables (see Table 6). The coeffi-

TABLE 5. Descriptive Statistics for Variables Included in Regressions, 2013–2018

This table reports summary statistics for green bonds. The sample consists of the first time issuance of green bond by listed companies in the Asia-Pacific and the sample period is from 2013 to 2018.

Variable	Mean	Median	Standard Deviation	Min.	Max.	N
<i>Green Amount/Debt</i>	0.04	0.01	0.09	0.00	0.67	100
<i>ESG (Dummy)</i>	0	0	0	0	1	100
<i>ROE</i>	9.84%	9.49%	5.94%	-19.63%	31.46%	100
<i>BM</i>	1.08	0.90	0.73	0.12	5.02	100
<i>LEVERAGE</i>	0.73	0.75	0.19	0.22	0.96	100
<i>LN_SIZE</i>	8.58	8.46	1.71	3.37	12.78	100
<i>CAAR</i>	-0.46%	0.06%	4.66%	-25.30%	16.94%	100

cient of the leverage is significantly negative at a 10 percent level. Using the same approach as for the amount issued, an increase of one percentage point in the leverage be associated with a decrease in CAAR of 4.82 percentage points. Conversely, we also find that the size variable has a positive coefficient, significant even at a 1 percent level. However, we find that the coefficient of the constant and the coefficient for the green bond issued to the total debt, ESG, ROE, and book-to-market ratio have a negative relationship with CAAR, but they are not significant.

TABLE 6. Cross-Sectional Regression Results, 2013–2018

This table shows cross-sectional analysis results for green bonds. The sample consists of the first-time issuance of green bond by listed companies in the Asia-Pacific in the sample period from 2013 to 2018. We group the sample by industries—finance and non-finance (manufacturing, service, transportation and utilities, mining, and construction), and by geography, China, Japan, and the rest of Asia-Pacific which are Korea, India, Pacific (Australia and New-Zealand), and ASEAN. (Robust t-statistics are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.)

Regression	Asia-Pacific	Industry		Geography		
		Finance	Non-Finance	China	Japan	Non-China-Japan
Dependent Variable	CAAR	CAAR	CAAR	CAAR	CAAR	CAAR
	(-10,10)	(-10,10)	(-10,10)	(-10,10)	(-10,10)	(-10,10)
Independent Variable						
<i>Green Amount/Debt</i>	-0.0167	-0.624	0.0141	0.0427	-1.0404**	-0.0667
<i>ESG</i>	-0.0117	-0.0079	-0.0166	0.0042	0.0097	-0.0464*
<i>ROE</i>	-0.0581	0.0818	-0.1087	-0.0546	-0.0148	-0.1469
<i>BM</i>	-0.0048	-0.0031	0.0013	-0.0023	0.0052	-0.0126
<i>LEVERAGE</i>	-0.0482*	-0.0855	-0.0272	-0.032	-0.0359	-0.1278**
<i>LN_SIZE</i>	0.0138***	0.0074	0.0218	0.0085*	-0.0086*	0.0301***
Observations	100	50	50	47	24	29
R-Square	0.2056	0.2586	0.2341	0.1260	0.2619	0.5082
Adjusted R-Square	0.1543	0.1551	0.1273	-0.0051	0.0013	0.3741
F-Statistic	4.0114***	2.4996**	2.1911*	0.9609	1.0051	3.7895***

TABLE 7. Descriptive Statistics for Variables Included in Regressions, 2013–2020

This table reports summary statistics for green bonds. The sample consists of the first time issuance of green bond by listed companies in the Asia-Pacific in the sample period from 2013 to September 2020

Variable	Mean	Median	Standard Deviation	Min.	Max.	N
<i>Green Amount/Debt</i>	0.04	0.01	0.09	0.00	0.67	147
<i>ESG (Dummy)</i>	0	0	0	0	1	147
<i>ROE</i>	7.47%	6.85%	6.11%	−19.63%	31.46%	147
<i>BM</i>	1.10	0.92	0.72	0.12	5.02	147
<i>LEVERAGE</i>	0.71	0.71	0.19	0.22	0.97	147
<i>LN_SIZE</i>	8.36	8.38	1.62	3.37	12.78	147
<i>CAAR</i>	0.04%	0.36%	4.57%	−25.30%	16.94%	147

The *F*-test for a regression was found to be significant at a 1 percent level, indicating that the null hypothesis is rejected. The adjusted R-squared is 0.1543, which means that the regression explains 15.43 percent of the variance in the cumulative average abnormal returns.

Green Bond Issuance from 2013 to 2020

See Table 7.

As seen from Table 8, in the Asia-Pacific regression, the regression that contains all our 147 samples, we find that there are three significant variables. We exclude 4 outlier observations for our cross-sectional samples. We find that

TABLE 8. Cross-Sectional Regression Results, 2013–2020

This table shows cross-sectional analysis results for green bonds. The sample consists of the first-time issuance of green bond by listed companies in the Asia-Pacific in the sample period from 2013 to September 2020. We group the sample by industries—finance and non-finance (manufacturing, service, transportation and utilities, mining, and construction)—and by geography, China, Japan, and the rest of Asia-Pacific which are Korea, India, Pacific (Australia and New-Zealand), and ASEAN. (Robust *t*-statistics are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.)

Regression	Asia-Pacific	Industry		Geography		
		Finance	Non-Finance	China	Japan	Non-China-Japan
Dependent Variable	CAAR	CAAR	CAAR	CAAR	CAAR	CAAR
	(−10,10)	(−10,10)	(−10,10)	(−10,10)	(−10,10)	(−10,10)
Independent Variable						
<i>Green Amount/Debt</i>	0.0921*	−0.6142	0.1309*	0.0404	0.4181***	0.0812
<i>ESG</i>	−0.0073	−0.0085	0	0.0055	−0.0033	−0.0181
<i>ROE</i>	−0.1266**	0.0287*	−0.1491	−0.0533	−0.0437	−0.1456
<i>BM</i>	−0.003	0.0059	−0.0013	−0.0001	0.0086	−0.0171
<i>LEVERAGE</i>	−0.0127	−0.0764***	0.031	−0.0322	0.0024	−0.0216
<i>LN_SIZE</i>	0.011***	0.0065**	0.0147**	0.008*	0.0073	0.0168**
Observations	147	73	76	57	51	39
R-Square	0.1159	0.1848	0.1441	0.1007	0.3339	0.2832
Adjusted R-Square	0.0780	0.1083	0.0697	(0.0072)	0.2431	0.1488
<i>F</i> -Statistic	3.0575***	2.4174**	1.9369*	0.9331	3.6766***	2.1067*

the green bond amount divided by total liabilities and size variable has a positive coefficient, and is significant at the 10 percent and 1 percent level respectively. The bigger the green debt proportion or the size of the company, the bigger the announcement effect is. However, we find that the coefficient of the constant for the ESG, book-to-market ratio, and leverage have a positive relationship with CAAR, where on the contrary the ROE variable has a negative relationship with CAAR, but they are not statistically significant.

The *F*-test for a regression was found to be significant at a 1 percent level, indicating that the null hypothesis is rejected. The regression explains 7.80 percent of the variance in the cumulative average abnormal returns.

The second and third regressions are categorized by industry. Because of the limited number of dependent variables, we separate the issuance into two groups: financial corporate and nonfinancial corporate. In both finance and non-finance corporations, we also find the company size variable to be significant at a 5 percent level, with a positive relationship with CAAR if everything else is constant. Every one-point increase in the amount emitted would increase CAAR by 0.65 percent for finance and 1.47 percent for non-finance. The larger the companies that issue a green bond, the more favorable the market responds to their share prices. The financial institution's green bond market is dominated by banks; hence, it attracts more attention when a big financial institution successfully joins the market.

For finance regressions, ROE and leverage are found to be statistically significant at 10 percent and 1 percent levels, respectively, while the rest of the variables, green bond amount to total debt, ESG, and book-to-market (BM) prove to be insignificant. On the other hand, besides the size of the company, another significant variable for this non-finance regression is the total of green bonds to the total liabilities at a 10 percent level, while the other four variables are insignificant.

Lastly, we divide the issuance based on geography for issuances from China, Japan, and Asia-Pacific countries outside China and Japan. Unfortunately, we find only one significant variable in China and the rest of Asia-Pacific countries: company size at 10 percent and 5 percent significance levels, respectively. Similarly, we find only amount of green bonds issued per total debt is the only significant variable at 1 percent in the Japan regression.

Further analysis of the relationship of CAAR with internal Chinese company characteristics reveals that company size has a statistically significant positive relationship with CAAR. Hence, the larger the company, the bigger the response. Half of the independent variables shared the same negative patterns. Companies that publish the triple bottom line report and have their companies evaluated for their ESG scores commit more to sustainability. The previously mentioned greenwashing issues coinciding with the rapid growth of the Chinese market suggest that there may be some public trust issues with the green movement. Publishing ESG reports may provide concrete proof and identify more committed companies. Therefore, companies that published ESG reports had more positive CAAR.

For the rest of Asia-Pacific and Japanese companies, the ESG variable in the cross-sectional analysis has the same negative patterns with CAAR, despite the adequate availability of guidelines and standards in most of these markets. To develop a green bond framework in Japan, several guidelines and standards are available to Japanese entities, for instance, international guidelines by Green

Bond Principles (GBP), Climate Bonds Taxonomy, and Climate Bonds Standard. ASEAN Green Bond Standards (ASEAN GBS) are also available for regional guidelines and Japan Green Bond Guidelines were issued by the Ministry of Environment Japan (MOEJ) in March 2017. One of several things that differentiate Japanese guidelines from other regions is that the negative impacts of the project should be disclosed to investors to prevent greenwashing. The lack of explicit language to exclude fossil fuel power-generation projects in this guideline is debatable; this makes Japan's guidance less credible than the ASEAN GBS.

CONCLUSIONS

The purpose of this study is to find if the Asia-Pacific public responds well to the issuance of green bonds. Stocks with positive abnormal returns from the event announcement benefit the firms' equity investors. Over a long period, we find there are more positive abnormal returns around the announcement date. Furthermore, when we cumulated the abnormal return, we found a more positive cumulative abnormal return. This result is also consistent in the shorter period, where there is more positive cumulative abnormal return. Therefore, the issuance of green bonds benefits equity investors in Asia-Pacific.

Additionally, the relationships between short-term stock cumulative average abnormal return and the firm size, leverage, growth options, amount of green bond issued per total company debt, and whether the company publishes ESG reports of the green bond issuance firms are tested by the cross-sectional regression for listed Asia-Pacific companies from 2013 to 2020. The firm size is evidenced by increasing the cumulative average abnormal stock return, which is consistent with the study of Cheng, Visaltanachoti, and Kesayan (2005), however, contradicting Myers's (1984) study that the larger the company size, the larger the adverse effect is to the stock price. Other statistically significant variables are the green bond amount per total debt and company leverage. Moreover, we find leverage, book-to-market ratio, and availability of ESG reports are not significantly related to the CAAR.

This paper provides a reasonable basis for further study of green bond issuance, specifically in the Asia-Pacific region. Some limitations of this event study include the reactions of the stock market that could not be solely caused by the announcement effect, but instead other elements around the events. Moreover, as this study investigates the effect of the first-time issuance of each firm, it could be of interest in future research to expand the samples to include the companies reissuing green bonds. Also, as the Asia-Pacific green bond market expands, a more extensive set of samples with a more extended time horizon is recommended to generate a more precise and detailed analysis, as, in this study, we group some different countries and industries into one category because of the limited number of samples. Lastly, further research comparing the green bond and conventional bond announcement effect is needed to get a better understanding of the benefits of green bonds.

Overall this paper has contributed to the extent of understanding in the limited yet developing green bond field of study. The study is noteworthy for being the first Asia-Pacific green bond paper to comprehensively analyze each of the Asia-Pacific markets, by also bridging it with logical reasoning of the industry's characteristics and local green bond policies.

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Appendix: Correlation Coefficients

This appendix provides the descriptive statistics and correlations matrix between the independent variables. Correlation coefficients range between -1.0 and 1.0 , and the closer the coefficient is to -1.0 or 1.0 , the stronger the correlation.

TABLE 9. Correlation Matrix

Data for the total sample from 2013 to 2020. The matrix indicates that company size variable has a low to medium correlation with other independent variables. The rest of the variables consist of low to no correlation coefficients.

Variables	Green Amount/Debt	ESG	ROE	Book-to-Market	LEVERAGE	LN_SIZE
Mean	0.04	0.37	0.07	1.10	0.71	8.36
Standard Deviation	0.09	0.48	0.06	0.72	0.19	1.62
<i>Green Amount/Debt</i>	1					
<i>ESG</i>	-0.24	1				
<i>ROE</i>	-0.09	0.07	1			
<i>BM</i>	-0.02	-0.03	-0.14	1		
<i>LEVERAGE</i>	-0.28	0.08	0.18	0.07	1	
<i>LN_SIZE</i>	-0.45	0.47	0.28	-0.25	0.27	1

Measuring Bank Credit Risk Disclosure: A Cross-Country Index-Based Approach

Do Rosario Arafate Joao and Yuji Maeda

Abstract

Motivation: Banks are among the most important institutions in the financial sector and are moving toward solid international coordination. This motivates the examination of how credit risk is disclosed by these institutions in multiple countries.

Premise: As international standards such as Basel and the International Financial Reporting Standards (IFRS) are continuously improved and adopted by countries around the world, we assume that the degree of credit risk disclosure of banks is comparable and at about the same level.

Approach: We scrutinized the number of pages dedicated to credit risk in annual reports and built a disclosure score that captures the qualitative and quantitative aspects of the risk information present in those documents. The score was inspired by Scannella and Polizzi (2020), and further, Welch's *t*-test was used to compare disclosure practices both within and between countries.

Results: The results indicate that there is no significant difference in the credit risk disclosure score of the three countries examined (Japan, South Africa, and Mozambique). However, within each country, we found that larger banks tend to disclose significantly more pages than smaller banks, particularly in Japan.

Conclusion: Our results underscore the need for standardized reporting formats and improved tools for disclosure, especially electronic filing systems. Secondly, there is room for improving comparability in credit risk disclosure practices.

Consistency: This paper contributes to the understanding of risk disclosure among banks from different countries, which can benefit audiences such as regulators and investors. Furthermore, our score contributes by reducing the subjectivity associated with the content analysis methodology.

Keywords: bank, credit risk, disclosure index, Japan, Mozambique, South Africa

JEL Classification Code: G21

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INTRODUCTION

Credit risk, which refers to the risk of borrowers defaulting on their debt obligations, directly impacts the financial stability of lenders. By disclosing credit risk information, banks enable investors, regulators, and other stakeholders to assess their risk profile and make informed decisions. Moreover, the level of risk disclosure has a significant effect on a bank's credit rating (Elamer et al. 2021, 1272).

The Bank of Japan (BOJ) (1997) appoints three major functions of risk disclosure: (1) to help market participants judge each other and select their counterparties, (2) help pricing in financial markets as the prices of financial instruments are adjusted to reflect the risk of the counterparty, thus enhancing the efficiency of the market, and (3) help increase management discipline as the institutions will improve their policies and risk techniques so as to get better assessments from the market.

The literature defines risk reporting as informative news in annual financial reports concerning managers' estimates, judgments, and reliance on market-based accounting policies, such as impairment, financial instruments, derivative hedging, political, economic, financial, management of risks, and internal control of risks (Hassan 2009; Miihkinen 2012). It serves to inform the reader of "any opportunity or prospect, or of any hazard, danger, harm, threat or exposure, that has already impacted upon the company or may impact upon the company in the future or of the management of any such opportunity, prospect, hazard, harm, threat or exposure" (Linsley and Shrives 2006, 3).

With this in mind, this study aims to compare the level of credit risk disclosure among three countries: Japan, South Africa, and Mozambique. The rationale for this comparison rests on two key assumptions. First, as Japanese investors seek overseas investment opportunities, Mozambique emerges as a potential target for direct investment through new ventures, partnerships with local businesses, or extending credit to local financial institutions. This assumption finds support in the presence of representative offices of Japanese banks, such as SMBC and Mizuho Bank, in Mozambique. As Japan's interest in Mozambique, particularly in the energy sector, grows, it is expected that further investment will follow (The Japan Times 2023). Second, it is assumed that Japanese investors place trust in the level of credit risk disclosure by domestic banks. This assumption implies that to explore a new market, Japanese investors would seek a comparable level of disclosure in that market to ensure trust and confidence.

While analyzing credit risk disclosure is just one aspect investors consider when assessing a country's financial sector, this study primarily focuses on Japanese and Mozambican banks. However, the inclusion of a third country, South Africa, provides valuable context for evaluating the disclosure practices of Mozambican banks. Notably, nearly one-third of Mozambique's banks are subsidiaries of South African banks, making it essential to understand the comparative levels of risk disclosure between the two countries.

The regulatory landscape in Mozambique mandates banks submit meticulous quarterly (Basel) Pillar 3 reports, aligning with a prescribed format that underscores market discipline as per the disclosure requirements laid out by the central bank in 2017, superseding those of 2013 (Imprensa Nacional de Moçambique 2017). Annual reports exhibit a remarkable semblance, particularly among larger banks. Notably, as the scale of banks diminishes, the annual

reports are condensed both in terms of page count and information content. In instances of financial distress, banks may be granted leeway to forgo the publication of their annual reports to the general public. A telling incident from 2016 exemplifies this, where a distressed bank omitted its quarterly and annual disclosures, prompting the regulator to issue a public note elucidating the bank's precarious financial situation (Agência Lusa 2017).

Similar to the Mozambican scenario, South Africa's financial sector falls under the regulatory purview of the central bank, the South African Reserve Bank (SARB). Concurrently, the Financial Sector Conduct Authority (FSCA) oversees market conduct related to the provisioning of financial products and services within the country (Baker Mackenzie n.d.). Risk disclosures, encapsulated in Pillar 3 reports, constitute a mandatory stipulation for all banks and are guided by five principles: (1) clarity, (2) comprehensiveness, (3) meaningfulness to users, (4) consistency over time, and (5) comparability across banks. Thus, the reports are to be presented in standardized templates and tables, promoting coherence and comparability of disclosed information as per SARB Prudential Authority guidelines. The reports are either published as standalone documents or appended to the annual reports, ensuring easy identification for users (South African Reserve Bank 2019).

Diverging from the regulatory models of Mozambique and South Africa, Japan's financial institutions fall under the jurisdiction of the Financial Services Agency (FSA), as dictated by the Banking Act. The FSA shoulders the responsibility of authorization and supervision, while the macro-supervision of the financial sector rests with the Bank of Japan (BOJ). However, the BOJ also conducts on-site examinations based on bilateral agreements with financial institutions (Financial Services Agency 2022).

In stark contrast to the other two nations, Japan seems to lack a standardized risk reporting format for its banks. The Banking Act stipulates that banks should strive to disclose information serving as a reference for depositors and customers, with (major) banks mandated to disclose their balance sheets accompanied by explanatory notes and encouraged to voluntarily disclose risk information (Financial Services Agency 2022). Although evidence of Pillar 3 reports exists for City Banks, the mandatory nature of these reports for all banks remains ambiguous. Regional Banks, especially the second tier, exhibit a lack of specific format in their annual reports, containing fewer pages and less information compared to their counterparts.

Remarkably, Japan adopted an approach to centralized reporting with repositories such as the Electronic Disclosure for Investors' NETWORK (EDINET) and the Timely Disclosure Network (TEDnet), operated by the FSA and the Tokyo Stock Exchange, respectively. However, it's important to note that a significant portion of risk disclosure in Japan remains voluntary, contributing to a distinctive regulatory landscape.

Although research papers have explored the comparison of risk disclosure in banking sectors of various countries (Lajili et al. 2022; Linsley, Shrivess, and Crumpton 2006), limited studies have specifically examined the credit risk disclosure of Japanese banks in comparison to banks from other countries (Frolov 2006). Similarly, studies analyzing credit risk disclosure in Mozambique are scarce or nonexistent. Therefore, this study aims to fill the gap in the literature

by providing an analysis of the credit risk disclosure levels of Japanese banks in comparison to banks from other countries.

By undertaking this comparative analysis, we seek to contribute to the literature and enhance our understanding of credit risk disclosure practices in different banking systems. This research will not only benefit academics but also provide valuable insights for policymakers, regulators, and banking institutions. Ultimately, our objective is to promote transparency, strengthen risk management frameworks, and foster stability in the banking industry.

The content of this paper is structured as follows: the next section presents the literature on risk disclosure; then follows the section presenting methodology, which includes sample selection, the procedure employed in data collection, the content analysis technique, and hypotheses. Next is a section showing the results of the empirical analysis, and the paper ends with a conclusion.

LITERATURE REVIEW

The burgeoning interest in risk disclosure research underscores its growing significance within the academic landscape. A comprehensive review of the literature on this topic conducted by Mbithi, Moloji, and Wangombe (2022) and Ibrahim et al. (2022) reveals that the majority of research in this domain, constituting almost two-thirds, is directed toward nonfinancial institutions. These studies predominantly delve into risk disclosure practices and characteristics, determinants of risk disclosure, and the economic consequences associated with risk disclosure. Interestingly, the focus on financial institutions skews toward exploring the determinants and economic implications of risk disclosure, with less emphasis on regulations' compliance and risk disclosure practices and characteristics. This prompts an opportunity for our contribution to risk disclosure research by analyzing how banks divulge credit risk information across diverse countries.

The landscape of risk disclosure studies is marked by diverse findings. Early studies, exemplified by Roulston (1999) and Solomon et al. (2000), highlighted firms' preference for voluntary market risk disclosure and that the majority of those firms had disclosed both quantitative and qualitative information, however with little context or further details (Roulston 1999), i.e., firms preferred complicated formats to simpler and more revealing risk disclosure formats. Additional findings highlighted that institutional investors agree that increased risk disclosure would help them in their portfolio investment decisions (Solomon et al. 2000). However, the current system does not provide comprehensive credit risk information to market participants in Japan, as evidenced by Frolov (2006). The study, which focused on the quality of disclosed information about Japanese banks' lending assets, revealed that those banks utilize multiple channels for information disclosure, including mandatory reports, securities reports, business result briefs, and company presentations. Commercial banks disclose more voluntary information, while credit associations and cooperatives, which lack unprotected creditors, and financially weak banks primarily rely on mandatory reports and disclose less information.

More recent investigations, such as Kang and Gray (2019) and Elamer et al. (2020), uncover insights such as firms being less inclined to voluntarily disclose risk information in regions characterized by high country-specific risk and the nuanced impact of governance structures on the informative effect of risk

disclosure on banks' credit ratings. Another study by Lajili et al. (2022) found that cross-border differences between Italian and Canadian banks are insignificant despite the former providing more comprehensive disclosures, and the latter offering a more holistic view of credit risk.

Methodologies employed in measuring risk disclosure exhibit variability. According to Do Rosario (2022), past studies have often utilized manual or computerized content analysis. While computerized analysis facilitates the processing of large volumes of data swiftly, it has historically suffered from the limitation of merely counting keyword occurrences without considering their contextual relevance. Anticipating future advancements, we foresee the integration of Natural Language Processing (NLP) models in research methodologies, enhancing the precision of computerized content analysis by assigning values based on the contextual nuances of words in the text.

Manual content analysis, though a slower method, offers a more profound understanding by allowing researchers to capture intricate details that automated processes might overlook.

Utilizing disclosure indices, researchers can construct analytical frameworks amenable to various statistical analyses, offering insights into risk disclosure practices. In this regard, Scannella and Polizzi (2020) suggested a methodological tool to measure and evaluate credit risk disclosure in the banking sector. The data source remains the same as other previous studies—annual reports (management commentaries and notes to the accounts) and Basel Pillar 3 reports, but their mixed index is a considerable improvement from the binary index. They use a mix of binary indexing for items of non-mandatory disclosure contained in one checklist and assign a score between 0 and 5 (severe lack of information and excellent information disclosure, respectively) to indicate the degree of quality based on a judgment analysis of the researchers. Using this approach with a sample of Italian banks allowed them to conclude that there is high comparability of disclosure, especially over time, but the differences in their credit risk disclosure are significant. However, there was an improvement of risk disclosure quality throughout the period of study.

Although the type of indexing used by Scannella and Polizzi (2020) is a considerable improvement from a simple binary index, there is a shortcoming—the researchers do not make it clear as to how to assign the interval [0, 5] score, which makes it difficult to replicate the study. Notwithstanding, our paper aligns with this methodological approach, adopting and adapting it to simplify the process of assigning multi-level scores as the original methodology gives leeway for subjectivity by not clarifying the criteria for assigning the scores [0, 5]. This adaptation seeks to offer a practical means of evaluating risk disclosure practices and contribute to the ongoing discourse on refining methodologies in the realm of risk disclosure research.

METHODOLOGY AND RESULTS

This study employs a quantitative approach using content analysis to compare the level of credit risk disclosure among banks in Mozambique, South Africa, and Japan. *Level*, in this context, refers to how much credit risk information is disclosed and the way it is disclosed. The desired quality of disclosure involves the combination of quantitative information on specific items with narrative explanations.

Data

The study used a sample consisting of a total of 45 banks from the three countries, presented in Table 1. Each country's contribution to the sample comprises 15 banks. The top five banks from each country, as mentioned in the Introduction, are included at the country level. The remaining ten banks were selected randomly. Overall, the sample represents over two-thirds of the total bank assets, with 97 percent for Mozambique, 93 percent for South Africa, and 77 percent for Japan.

The data were extracted from banks' annual reports (or their equivalent SEC Form 20-F, which is an annual filing for foreign companies traded in the United States) and integrated reports, paying special attention to the Management Commentary of the Annual Reports and the Notes sections as most risk information is disclosed there, as highlighted by Lajili et al. (2022).

Additionally, Basel Pillar 3 reports, also known as Market Discipline reports, were examined, as the Pillar 3 framework mandates banks to publicly disclose information pertaining to their risks, capital adequacy, and risk-management policies to promote market discipline.

It is worth noting that while all banks in Mozambique disclosed standalone Pillar 3 reports, only six South African banks published Pillar 3 reports that were less than four pages long. Similarly, only six Japanese banks (four of which belong to the five major banks) published concise standalone Pillar 3 reports. However, this discrepancy is not of major importance, as no additional information was found in the Pillar 3 reports that was not already included in the annual reports of the banks that published them. All the documents used in this study were retrieved from the official websites of the respective banks.

Content Analysis

This study employs content analysis as the methodology to extract credit risk information from banks' reports. Content analysis is chosen due to its ability to handle both qualitative and quantitative data, its sensitivity to content, and its widespread use by researchers for coding reports. However, it requires the appropriate information to be coded from the risk and capital reports of the sampled banks.

To analyze the credit risk disclosure of the selected samples, an adapted version of the methodology developed by Scannella and Polizzi (2020) was utilized. First, specific information on credit risk, as outlined in Table 2, was identified. Then, a four-level ordinal measure was applied to assess the quality of the specific disclosure. The levels of the index were defined as follows: 0 for no disclosure, 1 for qualitative or narrative disclosure, 2 for quantified (tabular/numerical) and/or graphical information disclosure, and 3 for items with both qualitative and quantitative/graphical disclosure. Quantitative information was given a higher value than narrative information, reflecting the assumption that quantitative information is more specific.

The content analysis method aims to attenuate the subjectivity associated with index assigning. The rationale behind the four-level index aligns with the qualitative features specified by the Financial Stability Board (FSB 2012, 6), which include understandability, relevance, comparability, and reliability. A

TABLE 1. Sample Data

The table presents the details of the sample used in the study. The banks are ordered from the largest to the smallest total assets. Est. is the establishment date of the financial institution. Dep/Liab is the ratio of deposit to total liability. D/E is the debt-to-equity ratio. FS indicates whether the bank has at least one foreign subsidiary or not. This table is based on banks' FY2019 annual reports.

No.	Mozambique	Employees	Est.	Assets (USD mil)	Dep/Liab	D/E	Capital	FS
1	Millenium Bim	2,524	1995	2,608	0.94	3.67	45.8%	No
2	BCI	2,841	1996	2,516	0.92	8.27	25.8%	No
3	Standard Bank MZ	1,198	1967	1,941	0.97	3.79	29.3%	No
4	Moza Banco	919	2008	680	0.87	4.37	23.8%	No
5	Barclays MZ (Absa)	756	1977	670	0.94	4.54	20.8%	No
6	FNB	298	2001	267	0.97	9.20	19.4%	No
7	BancABC	109	1999	243	0.88	6.01	19.6%	No
8	Letsego	215	2011	140	0.49	2.22	45.4%	No
9	Societe Generale	57	1999	148	0.97	4.62	17.7%	No
10	BNI	59	2010	99	0.30	0.83	44.5%	No
11	UBA	25	2010	53	0.95	1.51	138.0%	No
12	Banco Mais	86	1999	43	0.88	1.88	38.3%	No
13	First Capital Bank	107	2013	86	0.90	3.11	37.0%	No
14	MBC	258	2005	43	0.56	3.96	13.6%	No
15	BIG	38	2016	48	0.93	0.82	194.7%	No
No.	South Africa	Employees	Est.	Assets (USD bln)	Dep/Liab	D/E	Capital	FS
16	Standard Bank SA	31,734	1862	156.48	0.86	12.88	14.0%	Yes
17	FirstRand	38,328	1838	118.17	0.89	11.99	16.8%	Yes
18	Absa Group	28,296	1888	97.47	0.65	10.45	16.7%	Yes
19	Nedbank	29,403	1888	77.99	0.87	10.61	14.8%	Yes
20	Investec Ltd	8,700	1974	76.80	0.86	10.39	15.8%	Yes
21	Capitec Bank	14,590	2001	6.17	0.95	4.26	30.5%	No
22	African Bank	3,500	2016	2.22	0.13	1.71	40.7%	No
23	Grindrod Bank	190	1994	1.18	0.87	8.86	9.3%	No
24	Mercantile Bank	520	1965	0.91	0.96	4.86	21.3%	No
25	Bidvest Bank	1,124	1998	0.60	0.89	2.61	31.7%	No
26	Sasfin Bank	616	1951	0.55	0.39	7.22	17.1%	No
27	Albaraka Bank	300	1989	0.42	0.94	8.56	16.0%	No
28	Ubank	320	2008	0.08	0.97	6.41	25.3%	No
29	HBZ Bank	140	1995	0.08	0.99	10.36	14.1%	No
30	Grobank	159	1947	0.04	0.96	10.34	14.3%	No
No.	Japan	Employees	Est.	Assets (USD bln)	Dep/Liab	D/E	Capital	FS
31	MUFJ	133,200	2006	3,121	0.65	20.07	15.9%	Yes
32	JP Bank	12,477	1875	1,956	0.91	22.43	15.6%	No
33	Sumitomo MFG	86,443	1925	2,039	0,66	19.39	18.8%	Yes
34	Mizuho FG	55,174	2002	1,991	0.70	23.78	17.3%	Yes
35	Norinchukin Bank	3,588	1923	978	0.67	13.53	23.0%	Yes
36	Resona Holdings	20,760	1918	561	0.91	25.12	11.2%	Yes

TABLE 1. Sample Data (*continued*)

No.	Japan	Employees	Est.	Assets (USD bln)	Dep/Liab	D/E	Capital	FS
37	Sumitomo Mitsui Trust Holdings	13,527	1900	524	0.68	20.81	16.9%	Yes
38	Fukuoka FG	6,717	2007	232	0.71	25.81	8.1%	No
39	Mebuki FG	6,419	2007	165	0.87	19.18	11.0%	No
40	Chiba Bank	4,154	1943	145	0.90	15.80	12.1%	Yes
41	Hokuhoku FG	4,683	1877	127	0.89	21.92	8.9%	Yes
42	Gumna Bank	3,030	1932	77	0.91	16.25	12.0%	Yes
43	Shinsei Bank	5,340	1952	94	0.68	10.25	11.2%	No
44	Haishi Hokuetsu FG	2,095	2018	82	0.86	21.06	8.9%	No
45	San-in Good Bank	1,992	1941	52	0.73	14.74	13.0%	No

score of 3 indicates that the disclosure item possesses all four attributes. For example, the clarity of the disclosure on nonperforming loans is enhanced when accompanied by a narrative explanation.

The FSB (2012, 6) emphasizes the importance of achieving an appropriate balance between qualitative and quantitative disclosures, utilizing text, numbers, and graphical presentations. The inclusion of fair and balanced narrative explanations provides insight into the implications of the quantitative disclosures and any changes or developments they depict. Presenting information in a classified, clear, and concise manner enhances the reliability of the disclosure, enabling comparisons over time for the same company or across different companies.

Disclosure Score

In this paper, a distinction is made between a score and an index in the following way: an index refers to the value assigned to a disclosure item, whereas a score is a composite measure calculated from the indexes using Equation (1).

$$absolute_score_i = \sum Index_i \quad (1)$$

The absolute score is then normalized within a range of [0 – 100] according to the Equation (2) to facilitate comparison.

$$relative_score_i = \frac{absolute_score_i}{42 \times 3} \quad (2)$$

The denominator in Equation (2) represents the maximum score a bank can achieve, which is the product of the number of items in the checklist (42) and the maximum index (3). This value ($42 \times 3 = 126$) represents the ideal scenario where a bank provides complete disclosure of credit risk information.

Since this study focuses on analyzing bank credit risk disclosure at the country level rather than the individual bank level, these measures are aggregated accordingly. Thus, at the country level, the indexes are presented as frequencies, indicating the number of times banks disclosed in each of the four categories. The country score is then calculated as the simple average of the credit risk disclosure scores of all banks within the country.

TABLE 2. Analytical Grid of Credit Risk Disclosure Indicators

Adapted from Scannella, Enzo and Salvatore Polizzi. 2020. "How to Measure Bank Credit Risk Disclosure? Testing a New Methodological Approach Based on the Content Analysis Framework." *Journal of Banking Regulation* 22, 73–95. <https://doi.org/10.1057/s41261-020-00129-x>.

1. Section A—Key aspects of credit risk management in banking

- 1.1 Credit risk definitions and explanation of credit risk management strategies
- 1.2 Explanation of credit risk management goals, procedures, processes, and policies
- 1.3 Explanation of credit risk measurements (including definition of credit risk components, such as probability of default, loss given default, and exposure at default)

2. Section B—Credit risk management decision disclosure

- 2.1 Information on credit risk assumption and retention
- 2.2 Information on credit risk prevention and protection
- 2.3 Information on credit risk transfer
- 2.4 Information on credit risk elimination and avoidance

3. Section C—Credit risk components

- 3.1 Insolvency risk
- 3.2 Migration risk
- 3.3 Recovery risk

4. Section D—Information of credit risk exposures

- 4.1 Current credit risk exposures (on-balance sheet)
- 4.2 Potential credit risk exposures (on-balance sheet)
- 4.3 Current credit risk exposures (off-balance sheet)
- 4.4 Potential credit risk exposure (off-balance sheet)
- 4.5 Accuracy of potential credit risk exposure assessment

5. Section E—Loan losses measurement models

- 5.1 Credit risk: expected loss (including definitions)
- 5.2 Credit risk: unexpected loss (including definitions)
- 5.3 Measurement models for expected loss (including limitations)
- 5.4 Measurement models for unexpected loss (including limitations)
- 5.5 Model risk

6. Section F—Credit risk mitigation/transfer instruments

- 6.1 Information on collateral
- 6.2 Information on personal guarantees and insurance contracts
- 6.3 Information on credit risk derivatives and loan securitization

TABLE 2. Analytical Grid of Credit Risk Disclosure Indicators
(continued)

7. Section G—Other key elements of bank credit risk
7.1 Provisioning for loan losses
7.2 Definitions and analysis of non-performing loans
7.3 Information on specialized lending
7.4 Credit risk: balance sheet ratios
8 Section H—Bank loan portfolio disclosure
8.1 Loan portfolio composition
8.2 Loan portfolio correlation
8.3 Loan portfolio concentration
8.4 Credit risk: aggregation and methodologies
9. Section I—Credit rating disclosure issues
9.1 Information on internal/external credit rating
9.2 Rating assignment, quantification, and validation
9.3 Information on accuracy of internal/external credit rating models
9.4 Implications of internal/external credit rating for the bank management
10. Section L—Bank credit risk capital requirements disclosure
10.1 Credit risk-weighted assets (on- and off-balance sheet)
10.2 Measurement models for credit risk capital requirements and economic capital for credit risk (internal and managerial perspectives)
10.3 Capital adequacy for credit risk (regulatory perspective)
11. Section M—General credit risk disclosure issues
11.1 Backward-looking information on bank credit risk
11.2 Forward-looking information on bank credit risk
11.3 Provision on an integrated perspective on bank credit risk

Hypotheses

Based on the literature review, three main hypotheses will be tested in the subsequent sections.

1. Within each country, banks do not have a preference between not disclosing any information (index 0), disclosing only qualitative/quantitative information (index 1/index 2), or fully disclosing both qualitative and quantitative information (index 3). The difference in the average percentage of bank items disclosed between two different indexes (index i and index j) is the same for each country.

Hypothesis H_0 : $index_{iz} - index_{jz} = 0$, where i, j are disclosure indexes [0, 1, 2, 3] and z represents the country.

2. On a country level, banks from Mozambique, Japan, and South Africa disclose information in the same manner. The difference between the average percentage of bank items disclosed on the same index i in country x and country z is zero.

Hypothesis H_0 : $index_{ix} - index_{iy} = 0$, where x and y represent different countries.

3. On a country level, the overall credit risk disclosure quality or score does not differ significantly between Mozambique, Japan, and South Africa.

Hypothesis H_0 : $score_x - score_y = 0$, where x and y represent different countries.

Data Analysis

A preliminary analysis within each country and across countries was conducted to determine whether the samples (indexes and the disclosure score) were normally distributed and then examined their variances. This step was necessary to determine whether the variances differed significantly, which is one of the prerequisites for deciding whether to use Student's t -test. Since the preliminary analysis revealed significant differences in sample variances in most cases, the choice was to employ Welch's t -tests.

Normality Test

To examine the assumption that the data was drawn from a normal distribution, researchers typically utilize the Kolmogorov–Smirnov test for samples larger than 50 and the Shapiro–Wilk test for samples smaller than 50. In this study, the Shapiro–Wilk test is employed due to the limited sample size. The Shapiro–Wilk test requires more than two observations and assumes the independence of the samples, continuity, absence of outliers, and insignificant skewness or kurtosis. The test statistic is given by the Equation (3).

$$W = \frac{(\sum_{i=1}^n a_i x_{(i)})^2}{\sum_{i=1}^n (x_i - \bar{x})^2} \quad (3)$$

Where

$x_{(i)}$ represents the ordered random sample values

a_i denotes constants generated from the covariances, variances, and means of the sample (size n) from a normally distributed sample

\bar{x} represents the sample mean

a_i are coefficients determined by Equation (4)

$$a_i = \frac{m^T V^{-1}}{(m^T V^{-1} V^{-1} m)^{1/2}} \quad (4)$$

Here, m denotes a vector of the expected values of the order statistics of independent and V identically distributed random variables sampled from the standard normal distribution, and represents the covariance matrix of those normal order statistics. It is worth noting that, like most statistical significance

tests, the Shapiro–Wilk test exhibits a bias due to sample size, meaning that statistically significant results are more likely to occur with larger sample sizes (Dudley 2015).

Equality of Variance

To test whether the sample variances were equal, i.e., $H_0: \sigma_{sample1}^2 = \sigma_{sample2}^2$, the F -test was applied. It was conducted for all pairs of samples for both within- and cross-country comparisons.

The F -test statistic, represented by the Equation (5) is the ratio of two variances.

$$F_{stat} = \frac{S_1^2}{S_2^2} \quad (5)$$

Where the numerator is the larger sample variance, and the denominator is the smaller sample variance. The null hypothesis that the samples have the same variance is rejected if F_{stat} is greater than the critical value (F_a) for $n_1 - 1$ and $n_2 - 1$ degrees of freedom where n_1 and n_2 are the sample 1 and sample 2 sizes, respectively.

Welch's T-Test for Equality of Means

Welch's t -test for equality of means is an adaptation of Student's t -test, a well-known statistical test for comparing sample means. Like Student's t , it is applicable to continuous variables, assuming that the samples are (nearly) normally distributed and that they are independent of each other. Unlike Student's t -test, Welch's t -test does not assume equality of sample variances and yields robust results even when the variances of the datasets are unequal. Additionally, Welch's t -test produces the same p -value as Student's t -test when the sample variances are equal (Navarro 2018).

Welch's t -test is employed to assess the hypothesis that the means of two populations are equal, i.e., $H_0: \mu_x - \mu_y = 0$ and $H_1: \mu_x \neq \mu_y$. Similar to a regular Student's t -test, the null hypothesis is rejected when Welch's statistic, given by Equation (6) or a two-tailed test with a significance level of α and r degrees of freedom (Equation [7]), is greater than the t -critical value or the p -value is less than the significance level. In other words, H_0 is rejected if $W > t_{critical}$ or $pvalue < \alpha$. It should be noted that the integer part of r , along with the significance level, is used to locate the t -critical value in Student's t -table (Navarro 2018).

$$W = \bar{X} - \bar{Y} \pm t_{\alpha/2,r} \sqrt{\frac{S_X^2}{n} + \frac{S_Y^2}{m}} \quad (6)$$

$$r = \frac{\left(\frac{S_X^2}{n} + \frac{S_Y^2}{m}\right)^2}{\frac{(S_X^2/n)^2}{n-1} + \frac{(S_Y^2/m)^2}{m-1}} \quad (7)$$

RESULTS

This section presents the results of the analysis of bank credit risk disclosure in three countries.

Number of Pages in the Annual Reports

As mentioned previously, the annual reports and integrated reports were the primary source of data. The decision to analyze these reports was based on the fact that they generally contain the same information disclosed elsewhere, at least for the banks included in the sample.

The number of pages disclosed by banks on a country level was also examined and presented in Section a) and b) of Table 3. The results indicate that Mozambican banks disclosed an average of 78 pages, Japanese banks 207 pages, and South African banks 181 pages. Statistical analysis revealed significant differences in the number of pages published by Mozambican banks compared to Japanese banks (significant at the 0.1 significance level) and Mozambican banks compared to South African banks (significant at the 0.05 significance level). However,

TABLE 3. Descriptive Statistics and Cross-Country Comparison

The table presents the descriptive statistics of the number of pages in the annual reports published by the banks (section A) and the credit risk disclosure measure (section C). The second section of the table shows the comparison of the number of pages disclosed between countries. *, ** significance level at 0.1 and 0.05, respectively.

(A) Descriptive statistics of the number of pages published by banks							
Country	N	Total	Mean	Median	Std	25%	75%
MZ	15	1176	78	48	78	18	102
SA	15	2722	181	110	181	75	246
JP	15	3107	207	89	207	61	220

(B) Cross-country analysis of the number of pages disclosed by banks											
Country pair	No. pages Country 1	No. pages Country 2	Diff	Country 1 variance	Country 2 variance	Banks per country	Degrees of freedom	Pooled variance	T	t-critical	p-value
MZ-JP	78	207	-129	5803	61129	15	28	33466	-1.927	2.048	0.064*
MZ-SA	78	181	-103	5803	27452	15	28	16627	-2.189	2.048	0.037**
JP-SA	207	181	26	61129	27452	15	28	44291	0.334	2.048	0.741

(C) Descriptive statistics of the credit risk disclosure measures												
	INDEX = 0			INDEX = 1			INDEX = 2			INDEX = 3		
	MZ	SA	JP	MZ	SA	JP	MZ	SA	JP	MZ	SA	JP
N	15	15	15	15	15	15	15	15	15	15	15	15
Total	540.5	447.6	552.4	435.7	411.9	428.6	116.7	171.4	126.2	407.1	469	392.9
Mean	36	29.8	36.8	29	27.5	28.6	7.8	11.4	8.4	27.1	31.3	26.2
Median	33.3	26.2	26.2	28.6	28.6	28.6	7.1	9.5	7.1	26.2	31	31
Std	9.8	15.3	21.4	7.9	8.5	9.3	4.8	7.8	5.5	7.4	13.1	15.2
25%	28.6	21.4	19	23.8	23.8	23.8	4.8	7.1	4.8	21.4	21.4	11.9
75%	42.9	33.3	50	33.3	33.3	35.7	9.5	14.3	11.9	31	42.9	38.1

there was no significant difference between Japan and South Africa. Japanese and South African banks jointly disclosed an average of almost 200 pages, more than double the average number of pages published by Mozambican banks.

Furthermore, the analysis indicated that Japan had relatively high within-country variability. This means that the number of pages disclosed by Japanese banks varied significantly from each other. This variability was primarily observed because, similar to South Africa but to a much higher extent, the top five banks, which correspond to the city banks, tended to disclose extensive volumes of pages compared to the remaining banks. It is important to note that the Japanese banking sector consists of nearly 200 banks, while the sample size in this study only included 15 banks. For instance, all three banks listed on the NYSE (MUFG, Sumitomo MFG, and Mizuho FG) had annual reports that were more than 450 pages long, whereas San-in Godo, a smaller regional bank, published only 53 pages in its annual report. In contrast, in Mozambique, the top five banks did not necessarily disclose more pages than the rest of the banks. For example, Standard Bank Mozambique disclosed only 28 pages, while Banco Mais, which is 45 times smaller, disclosed 101 pages. Additionally, the sample size about the population represents approximately 75 percent.

The patterns for the difference in the number of pages published in the annual reports are not clear, but we can conjecture. Japanese city banks, which also have a major international footprint, plus the JP Bank published more pages than the remaining banks in the sample despite all banks but one (Norinchukin Bank) being listed in the stock exchange. In South Africa, the pattern is the same although only ten of the fifteen banks were listed. In Mozambique, where none of the banks were listed, being a major bank did not necessarily mean publishing more pages. This leads to the second conjecture which has to do with complexity. The complexity of operations does not necessarily mean that the bank is large, it just attends a much broader business segment or market most of the time facilitated by the development of the domestic economy and financial sector. For example, Japanese and South African banks have a much broader range of stakeholders, especially institutional ones that may demand more disclosure from the banks; while most of the Mozambican banks deal more with individuals and much less with other institutions.

Also, a common finding across all three countries was that, contrary to the findings of Lajili et al. (2022), credit risk information was not concentrated in a specific section of the annual report. Instead, it was scattered throughout the entire report, including both the Management Discussion and Analysis (MD&A) section and the notes to the accounts section.

Credit Risk Disclosure

Two types of samples were used to compare the bank credit risk disclosure of Mozambique, Japan, and South Africa: indexes (index 0, index 1, index 2, index 3) and the disclosure score, of which the descriptive statistics are shown in the last section of Table 3. Both measures were normalized to a range between 0 and 100 to facilitate the comparison. The comparative analysis performed is suitable for Welch's *t*-test as explained in the methodology. The tests performed to ensure that the assumptions of Welch's *t*-test are valid and can be employed with the data are summarized next.

Independence of the Samples

All samples used in this study are independent of each other. Each bank belongs to only one country, and each disclosure item is counted only once and assigned an index value of 0, 1, 2, or 3.

Random Sampling

The sampling approach employed in this study was not entirely random. One-third of the sample for each country was selected based on a quota system to represent the five most important banks in the respective countries, while the remaining two-thirds were selected randomly. This approach was chosen to ensure a balanced representation of the banking sector in each country while still incorporating some element of randomness.

Normality Check

The Shapiro–Wilk normality tests were conducted to verify the assumption that the samples were drawn from normally distributed populations for each index and the overall disclosure score in each of the three countries.

The results of the normality tests, shown in Table 4—almost all the p -values are greater than the significance level of 0.05—indicate that, except for South Africa’s index 0 (significant at 0.05) and index 2 (significant at 0.01), all samples were drawn from a normal distribution.

Based on the results obtained from the normality checks, we can confidently proceed with further analysis of credit risk disclosure for the three countries, as the majority of the samples demonstrate normal distribution characteristics.

Variance Test (F-Test)

The equality of sample variances within each country and across countries was tested using the F -test and presented in Table 5. For the within-country test, pairwise comparisons of sample variances were performed for the indexes. That is, index 0 was compared to indexes 1, 2, and 3; index 1 was compared to indexes 2 and 3; and index 2 was compared to index 3. This is shown in the lower section of Table 5. The within-country comparisons found that more than half of the sample pairs have unequal variances, i.e., their p -values are less than the significance level. For Mozambique, two pairs (index 0–index 2 and index 1–index 2) have unequal variances, while for Japan, all pairs except one (index 0–index 3) have unequal variances, and for South Africa, half of the pairs are unequal (index 0–index 1, index 0–index 2, and index 2–index 3).

TABLE 4. Shapiro–Wilk Normality Test

The table displays the results of the Shapiro–Wilk normality test conducted on the data. The test assesses the distributional normality of the variables under study. The null hypothesis is that the data was drawn from a normal distribution, and it is rejected if the p -value is less than the cutoff value of 0.05.

Country	idx0		idx1		idx2		idx3		score	
	stat	p -value								
MZ	0.966	0.797	0.944	0.433	0.947	0.485	0.920	0.190	0.959	0.672
JP	0.923	0.212	0.969	0.840	0.928	0.259	0.906	0.119	0.908	0.127
SA	0.879	0.047	0.950	0.530	0.726	0.000	0.954	0.594	0.943	0.421

TABLE 5. Sample Variances and Comparison of Sample Variances

This table comprises three sections, each section presenting a distinct set of sample variance comparisons. At the top, the variance indexes and score variances are shown for each country. The next section displays the comparison of variance in credit risk disclosure indexes within each country. Finally, the results of the cross-country comparison of the credit risk disclosure indexes are presented at the bottom.

The values marked with an asterisk (*) indicate significance at 0.1, suggesting that the variances of the respective sample pairs are not equal.

(A) Sample variances					
Country	idx0	idx1	idx2	idx3	score
MZ	96.26	62.52	23.05	54.1	52.23
JP	458.27	86.65	29.86	230.81	295.28
SA	235.56	72.78	60.9	170.77	150.98

(B) Within-country F-test for equality of sample variances							
Country		idx0 vs idx1	idx0 vs idx2	idx0 vs idx3	idx1 vs idx2	idx1 vs idx3	idx2 vs idx3
	Sample size	15	15	15	15	15	15
	df	14	14	14	14	14	14
	F critical	2.979	2.979	2.979	2.979	2.979	2.979
MZ	F critical	1.54	4.176	1.779	2.712	1.156	2.347
	<i>p</i> -value	0.429	0.011*	0.293	0.072*	0.79	0.122
JP	F critical	5.288	15.349	1.985	2.902	2.664	7.731
	<i>p</i> -value	0.004*	0.00*	0.212	0.055*	0.077*	0.00*
SA	F critical	3.237	3.868	1.379	1.195	2.346	2.804
	<i>p</i> -value	0.036*	0.016*	0.555	0.743	0.122	0.063*

(C) Cross-country F-test for equality of sample variances						
Pair		idx0	idx1	idx2	idx3	score
	Sample size	15	15	15	15	15
	df	14	14	14	14	14
	F crit	2.979	2.979	2.979	2.979	2.979
MZ vs JP	F	4.761	1.386	1.295	4.266	5.653
	<i>p</i> -value	0.006*	0.549	0.635	0.01*	0.003*
MZ vs SA	F	2.447	1.164	2.642	3.157	2.891
	<i>p</i> -value	0.106	0.78	0.08*	0.039*	0.056*
JP vs SA	F	1.945	1.191	2.04	1.352	1.956
	<i>p</i> -value	0.225	0.749	0.195	0.581	0.222

For cross-country comparisons (section C of Table 5), the score was also included, and the comparison was pairwise, but only sample variables were compared. We found that the samples mostly have unequal variances when Mozambique is compared to other countries because it has the lowest variability, while Japan and South Africa have statistically equal variability across all the variables.

Cross-Country Differences in the Disclosure Indexes and Overall Credit Disclosure Score

Welch's *t*-tests were utilized to test multiple hypotheses in this study. The first hypothesis aimed to determine if banks within each country displayed a preference for different levels of disclosure, specifically between not disclosing any information (index 0), disclosing only qualitative or quantitative information (index 1 or index 2), or fully disclosing both qualitative and quantitative information (index 3). The null hypothesis stated that the difference in the average percentage of bank items disclosed between index *i* and index *j* is the same within country *z*: $H_0: \overline{index}_{iz} - \overline{index}_{jz} = 0$.

The second hypothesis focused on a country-level comparison, examining whether banks from Mozambique, Japan, and South Africa disclosed information in a similar manner. The null hypothesis stated that the difference between the average percentage of bank items disclosed on index *i* in country *x* and country *y* is zero: $H_0: \overline{index}_{ix} - \overline{index}_{iy} = 0$.

The third hypothesis aimed to compare the overall credit risk disclosure level or score between the three countries: $H_0: score_x = score_y$. Pairwise comparisons were conducted between Mozambique and Japan, Mozambique and South Africa, and Japan and South Africa.

All tests were performed as pairwise comparisons. In test (i), index 0 was compared to index 1, index 2, and index 3, while index 2 was compared to index 3. For test (ii), which involved cross-country comparisons, a similar procedure was followed, but only the same indexes were compared. For example, Mozambique's index 0 was compared to Japan's index 0 and South Africa's index 0, and so on.

The results presented in Table 6 revealed the following pattern: the differences between Mozambique and Japan were relatively small, less than 1 percentage point, with Mozambique disclosing slightly more than Japan. In contrast, the differences between Mozambique and South Africa or South Africa and Japan were larger, typically approximately 6 percentage points. The credit risk disclosure level of South African banks tended to be greater than that of Japanese and Mozambican banks.

For instance, Mozambican and Japanese banks disclosed fewer credit risk items or primarily provided narrative disclosures, while an average South African bank tended to disclose more quantitative information or a combination of qualitative and quantitative information. Despite these differences, based on Welch's *t*-test, there was no evidence to suggest that banks from the three countries in the sample differed significantly on how credit risk was disclosed or the overall level of credit risk disclosure.

The results from Welch's *t*-test analysis indicate that at the country level, there is no evidence of significant differences in the level of bank credit risk disclosure among Mozambique, Japan, and South Africa. The overall result for the three countries indicates that at the 95 percent confidence level ($t_{0.05} = 2.015$), the score of credit risk disclosure of banks falls within the range of 40 to 70, with an average of 44.

These results tell a lot. The variance of disclosure level is rather high, particularly among Japanese banks. It may be due to the fact that the Japanese regular does not impose a strict disclosure format on banks. Rather, banks are

TABLE 6. Welch's *T*-Test for Equality of Sample Means (Pairwise Comparisons)

The table presents the output of the Welch's *t*-test or unequal variances *t*-test, which compares the sample means for the variables studied. The null hypothesis is that the two populations have equal means, which is rejected when the *p*-value is less than the significance level (0.05).

In this context, the population refers to the individual indexes (idx0, idx1, idx2, idx3) and the overall score for each country.

The labels *x* and *y* refer to the left and right operand of the pair, their difference is shown in the *Diff* column, and the variances are labeled as *Var(x)* and *Var(y)*, respectively.

The degrees of freedom of the pairs are shown in the column labeled *DoF* and the *t*-statistic and *p*-values are shown in the last two columns.

All the *p*-values in the *p*-value column are greater than the significance level of 0.05, indicating that the means of all the compared pairs are not significantly different.

Measure: Pair	<i>x</i>	<i>y</i>	Diff	Var(<i>x</i>)	Var(<i>y</i>)	DoF	<i>t</i> -stat	<i>p</i> -value
idx0: MZ-JP	36.03	36.82	-0.79	96.26	458.26	19.63	-0.13	0.89
idx0: MZ-SA	36.03	29.84	6.19	96.26	235.55	23.80	1.31	0.20
idx0: JP-SA	36.82	29.84	6.98	458.26	235.55	25.38	1.02	0.31
idx1: MZ-JP	29.04	28.57	0.47	62.52	86.65	27.28	0.15	0.88
idx1: MZ-SA	29.04	27.46	1.58	62.52	23.05	27.84	0.52	0.60
idx1: JP-SA	28.57	27.46	1.11	86.65	23.05	27.79	0.34	0.73
idx2: MZ-JP	7.77	8.41	-0.63	23.05	29.85	27.54	-0.33	0.73
idx2: MZ-SA	7.77	11.42	-3.65	23.05	60.90	23.27	-1.54	0.13
idx2: JP-SA	8.41	11.42	-3.01	29.85	60.90	25.06	-1.22	0.23
idx3: MZ-JP	27.14	26.19	0.95	54.09	230.80	20.22	0.21	0.82
idx3: MZ-SA	27.14	31.27	-4.12	54.09	170.77	22.06	-1.06	0.29
idx3: JP-SA	26.19	31.27	-5.07	230.80	170.77	27.38	-0.98	0.33
score: MZ-JP	42.01	41.32	0.68	52.23	295.27	18.80	0.14	0.88
score: MZ-SA	42.01	48.04	-6.03	52.23	150.98	22.65	-1.63	0.11
score: JP-SA	41.32	48.04	-6.72	295.27	150.98	25.35	-1.23	0.22

simply encouraged to disclose as much information as possible, but they have the option to choose how much information is actually disclosed. This is in contrast with the disclosure requirements in South Africa and Mozambique where the regulator makes it clear what kind of information should be included in the annual and market discipline reports. However, as the analysis showed, having those requirements in place does not guarantee that all banks will have the same disclosure level. Finally, when banks disclose a large number of pages in their annual reports, a great deal of it is dedicated to narrative disclosure. A large narrative disclosure can be time-consuming to digest by a human being, but it is easily processed by a language model.

CONCLUSION

In conclusion, this study aimed to compare bank credit risk disclosure practices in Japan, Mozambique, and South Africa. The analysis focused on the number of pages disclosed in annual reports, as well as the indexes and overall credit risk disclosure scores. The results of Welch's *t*-tests provided insights into the similarities and differences in credit risk disclosure across the three countries.

The findings revealed that Mozambican banks generally disclosed fewer pages in their annual reports compared to Japanese and South African banks. Japanese and South African banks, on average, published more extensive re-

ports, with an average of almost 200 pages. However, it is important to note that within-country variability existed, particularly in Japan, where the top five banks tended to disclose a significant volume of pages compared to the remaining banks, which may be because they have a significant international footprint.

Regarding credit risk disclosure indexes, the study found that there were no significant differences in the level of disclosure preferences among banks within each country. This suggests that banks within Mozambique, Japan, and South Africa generally follow similar patterns in regard to disclosing credit risk information.

At the country level, the results indicated that South African banks tended to disclose better and provide more quantitative credit risk information than Mozambican and Japanese banks. However, based on Welch's *t*-test analysis, there was no significant evidence to suggest that the overall credit risk disclosure quality differed among these countries. The credit risk disclosure scores for banks in Mozambique, Japan, and South Africa fell within the range of 40 to 70 out of 100, suggesting a comparable level of disclosure quality.

Based on these findings, it is recommended to promote greater consistency in credit risk disclosure practices within each country, ensuring standardized reporting formats and definitions. Additionally, efforts should be made to enhance the cost-efficiency of disclosure tools, such as implementing electronic filing of reports with publicly accessible centralized storage systems.

Overall, this study provides valuable insights into the current state of bank credit risk disclosure at an international level comparing the disclosure level of countries in different stages of financial sector development. By improving the transparency, comparability, and accessibility of credit risk information, stakeholders can make more informed decisions, regulators can enhance oversight, and the banking systems in these countries can strengthen their resilience.

In light of the study findings, several suggestions emerge. First, it is crucial to encourage greater consistency in credit risk disclosure practices across banks within each country to facilitate meaningful comparisons. Second, there is a need to enhance the comparability of disclosure data by establishing standardized reporting formats and definitions across the three countries.

Furthermore, it is recommended to improve the cost-efficiency of disclosure tools. One proposal is to adopt electronic filing of disclosure reports with a publicly accessible centralized storage system. This would streamline the disclosure process, enhance accessibility, and reduce administrative burdens for both banks and regulatory authorities.

By implementing these suggestions, the transparency and comparability of credit risk disclosure could be enhanced, benefiting stakeholders such as investors, regulators, and the public and contributing to the overall stability and soundness of the banking systems in Mozambique, Japan, and South Africa.

Limitations of the Study

The sample size is a limitation of this study. It should be noted that there is a chance that the variability observed in the Japanese and South African disclosure indexes and scores could be due to sample sizes. The sample ratio was approximately 15 percent for Japan (considering only city and regional banks) and 25 percent for South Africa.

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Solid Waste Management Policies and Practices: A Case Study of Citizen Participation in Rural Japan

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Abstract

Motivation: Household waste is a major global issue, and its management is crucial for public health. In Japan, municipal governments are legally responsible for managing waste for the public good. Citizen participation (CP) enhances solid waste management (SWM) effectiveness, strengthens democratic legitimacy, and safeguards public health.

Premise: Japan is a global leader in SWM, with its municipalities implementing daily waste management methods that encourage citizen participation and engagement, and this study explores the role of citizen participation in SWM.

Approach: This study tests the ladder theory of citizen participation, focusing on group dynamics and voluntary engagement. Using a case study method, a mixed-method approach was used to gather empirical data. Two survey questionnaires were designed, piloted, and fine-tuned, with participant responses categorized and presented. Qualitative data was analyzed using thematic analysis, and quantitative data was analyzed using descriptive statistics.

Results: This study reveals that Japanese municipalities engage in initiatives that promote positive, voluntary, and collaborative CP in SWM. It also observes a level of Japanese-style partnership between local government and citizens.

Conclusion: Local governments can enhance the quality and effectiveness of SWM in rural communities by actively encouraging and facilitating CP processes. This not only leads to positive outcomes in public health and civil education but also legitimizes the role of municipal governments and democratic processes.

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Consistency: Current SWM policies and practices in Japan can serve as a good example of effective public sector management both in general and for SWM specifically in the rural areas of other countries where effective SWM policies and practices are currently lacking.

Keywords: citizen participation, Japan, public sector management, solid waste management

JEL Classification Codes: H79, H83, Q53

INTRODUCTION

According to World Bank data, almost half of the global population, or precisely 43 percent (2022), lives in rural regions (World Bank n.d.). Indeed, this statistic indicates a more salient shift in the processes of human development. For, according to UN statistics, 2011 marked the year in which more people in the world resided in urban areas than in rural areas (UN 2011), the first time this balance of social demographic distribution had occurred in recorded human history.

One consequence of this demographic and technological shift has been an intensifying need for national and regional (local or municipal) governments to formulate policies and implement practices for the systematic and strategic management of both industrial and household waste. These practices are needed to maintain social order and safeguard public health and should be done evenly, equitably, and consistently in urban, suburban, and rural areas.

The focus of this study is the role that municipal governments can play in the management of solid household waste in rural communities in Japan. The study draws on data gathered during a series of field research visits to Setouchi City, a municipal conglomeration of village communities located in Okayama Prefecture in Western Japan.

Specifically, this study highlights how government policies and practices designed to facilitate and encourage the active citizen participation of rural communities in Japan can serve to safeguard and maintain public health—an overarching strategic objective of solid waste management (SWM) policies and practices.

As this study demonstrates, citizen participation (CP) improves service quality and can serve to create and improve measures of public value. Additionally, facilitating and encouraging CP in SWM processes can serve to both safeguard public health and strengthen the democratic legitimacy of municipal government.

Specifically, this article addresses the following questions:

- How can we describe contexts in researching the role of CP in SWM in Japan?
- Drawing on previous international research into CP contexts in SWM, what appears to be salient patterns of CP in contexts of the formulation and implementation of policies and practices of SWM generally, and specifically in the case of one rural government setting: Setouchi City in Western Japan?

Before proceeding to offer answers to these questions, we should emphasize that this article is informed by an analysis of empirical data gathered during a series of field research visits to Setouchi City. The research is ongoing and, as explained in the conclusion of this article, is designed to address research questions that are more generalizable to other settings for research into SMW and the potential impact of CP improving the effectiveness of solid waste management and administration. As we demonstrate in the case study, these settings can be further examined to assess the extent to which public management and administration in both rural and urban regions can serve public policy objectives such as generating “public value” and strategic objectives such as safeguarding public health.

As is standard in case study research, the settings can be described and compared across national and regional borders and between specific rural and urban regions. Indeed, this article is part of a larger research project being conducted by the lead author in his role as a researcher at Kwansei Gakuin University in Japan and where his chosen contexts for comparison are CP and the generation of public value in processes of SWM in rural regions of Japan and Bangladesh.

LITERATURE REVIEW

In a seminal work about public sector management, Flynn and Asqure (2017, 1) explain how definitions of *public* (i.e., in contrast to *private*) sectors as contexts for research into business and management activities became clarified as a consequence of how national economies undertook reconstruction after World War II—referred to in Japan as The Pacific War of 1931–1945 (Walker 2015, 240). According to Flynn and Asqure, how national assets, such as natural mineral resources, along with services, such as education and municipal waste management, “are owned and governed has an impact on decisions about asset acquisition, disposal and use” (2017, 2). Correspondingly, in the context of this study, is the extent to which governance at the national or local/rural levels of decision-making regarding the management of municipal waste is maintained as a public sector responsibility or as a private sector activity, or, as we illustrate later, a combination of both.

During post-war reconstruction, lawmakers in the United States and the United Kingdom contemplated national governmental policies regarding established industries such as coal mining, steel making, and public transportation. The policies set out by national (in the United Kingdom) or federal (in the United States) governments would guide the policies and practices of regional or local governments in sectors such as the provision of education and sectors for business management defined by the provision of public health and sanitation.

As stated earlier, this article is one output from a larger research project designed to test possible correlations between CP in contexts of SWM to achieve public policy objectives such as generating “public value” and public management strategy objectives such as safeguarding and, through the generation of public value, improving levels of public health.

Context: CP Research

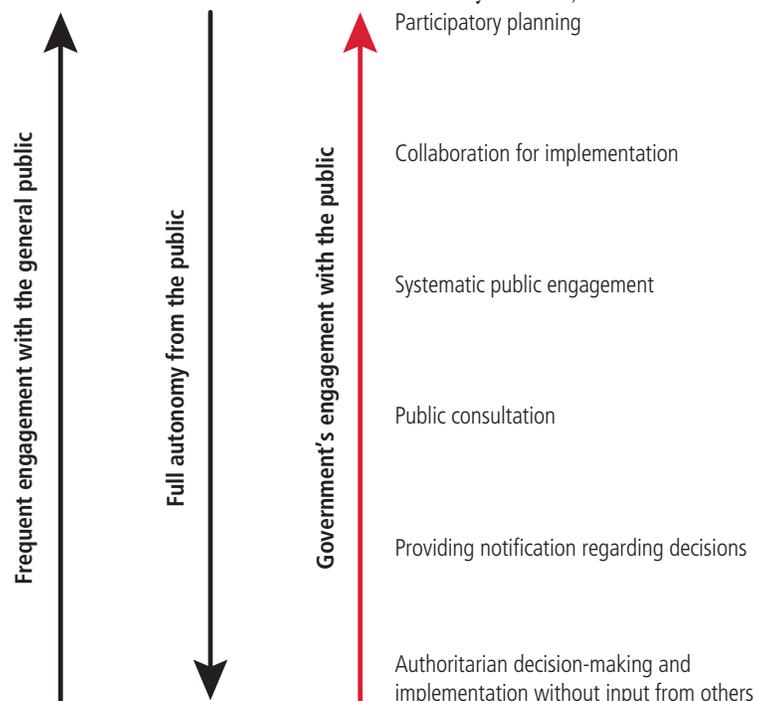
Citizens have long been actively overseeing the implementation of government programs in their local communities. Consequently, researchers have extensively investigated various aspects of CP, creating a substantial body of literature. However, the existing literature on citizen involvement in the public sector and SWM in Japan does not extensively discuss the impact of “required” CP on decision-making processes that contribute to creating public value. There is a scarcity of research in Japan that specifically examines public engagement, particularly in English publications (Lee et al. 2013, 33).

Abas et al. (2023, 1) analyzed 69 articles on government and local authority planning. They identified three distinct forms of public engagement: (1) access to information, (2) consultation, and (3) active participation. Public involvement in the government or local authority’s decision-making process on planning and agenda is essential and substantial. Without systematic management, it can lead to public demonstrations, negative perceptions of the government, and the collapse of national or local plans.

In their study, Kurkela et al. (2023, 132–33) conducted interviews with 14 key actors employed by the local government of Helsinki, Finland. They identified three essential factors contributing to influential CP: organizational structures, organizational culture, and sufficient resources. Additionally, the study highlighted the importance of effective management in enabling CP. The findings emphasized the significance of perceiving citizen involvement as a matter of governance and as an integral component of the administration that necessitates deliberate management endeavors.

The CP spectrum shown in Figure 1 describes the possibilities of participation. According to Mostert (2003), participation refers to the active involvement

FIGURE 1. Range of Public Involvement (Adapted from Gurtoo 2015 and Pretty 1995.)



of non-governmental entities in the process of making decisions. Non-governmental actors encompass many entities such as individual citizens, private enterprises, public interest groups, economic interest groups, and social groupings, for example, women and elderly individuals.

Theoretically, classical democratic theory trusts that the people who will be affected by choices make them in the democratic system (Pateman 1970). However, citizens' access to the process is only sometimes open, and complaints should be taken more seriously and treated equally (Lukes 1974). Gaventa (1982) argues that political, social, and economic conditions influenced access to the process. According to Peelle (1991), the interpretation of public participation varies from personal or institutional objectives, inspirations, and principles.

Different stakeholders like public sectors such as local government (Hari 2020; Niyati 2015, 54), government (Shekdar 2009), Households (Sujauddin, Huda, and Hoque 2008), Citizens (Hari 2020; Tajkir 2024, 307), international government, private sector, non-governmental organization, ministries (Chandrappa and Bhusan 2012; Guerrero, Maas, and Hogland 2013; Kundell and Ruffer 2002) responsibilities in SWM activities are described by various researchers. However, Damanhuri and Padmi (2010) describe how the public sector engages citizens in SWM. The central government facilitates CP by providing legal safeguards, financial support, and knowledge dissemination. The local government is promoting waste management and collaboration with other industries and urging citizens to recycle waste.

Researchers have seen public participation in governance through different approaches. The government aims to enhance public services to achieve its political objectives, while citizens are motivated by their desire to make a social impact (Crook and Manor 1998; OECD 2013; Rakodi 2003). This ensures a more sustainable and effective form of governance in the long term (Deichmann and Lall 2007; Few, Brown, and Tompkins 2007; Kim 2010; O'Leary, Van Slyke, and Kim 2010). Additionally, the concept of pluralism, which combines diverse perspectives, is crucial for ensuring sustainability in practice (Crook and Manor 1998; Kikuchi 2010).

Context: CP Research in Japan

In Japan, public engagement is commonly understood as a form of volunteerism and a significant societal endeavor (Gurtoo 2015, 10). Based on the National Survey on Lifestyle Preferences conducted by the Economic Planning Agency of Japan in 2000, 37 percent of the older population expressed a strong desire to engage in volunteer work if given the opportunity. The manifestation of collective action, as demonstrated by proactive volunteers in Japan, is apparent throughout all phases of pre-planning and implementation (Lee et al. 2008).

Mori et al. (2008) examined strategies to promote greater engagement in voluntary endeavors in Japan and explored the underlying factors that drive individuals to join. The researchers postulated that the availability of opportunities correlates with increased engagement rates, and this hypothesis was subsequently validated. In 2015, Gurtoo found that participation opportunities had significant positive effects on participation and voluntary action and these were linked to several different kinds of participation opportunities.

The city government of Kitakyushu has established various volunteer activities to provide advice and assistance to citizens in their endeavors, encompassing new plans, programs, and even systems, and finally, over 98 percent of allocated garbage bags are utilized, demonstrating high compliance and collaboration with the approved plans, program, and system (Alam 2016, 269–74). Voluntary recycling activities under the “Tokyo Slim” program were introduced by the Tokyo Metropolitan Government in 1989 to address the pressing issue of waste disposal. Ten years after the commencement of the campaign there was a notable rise in the annual recycling volume in the 23 wards of Tokyo, increasing from 300,000 to about 1 million tons (Sorensen and Okata 2011).

Nakano (2005) and Kida (2013) found that a more aged population in a city is positively related to higher voluntarism rates. As for personal demographics, Kida found that people with higher education, who own their house, have a higher income, and have at least two days off per week participated in public activities more than others. Mori et al. (2008) developed a model to represent the personality traits that influence an individual’s active engagement in public participation. The researchers identified the concept of *opportunity for participation* as a crucial factor, alongside having ample free time and a strong inclination toward public service.

Kaji (2012) records the initial endeavor at public participation dating back to the 1930s and emphasizes the importance of public involvement in addressing local and public concerns in the Toyama prefecture, Japan. In the mid-1960s, residents opposed the mining corporation and initiated a lawsuit regarding cadmium contamination in the nearby mines. They emerged victorious in 1972. This instance represents the inaugural occurrence of public involvement in Japan, wherein local inhabitants, external experts, and local specialists actively collaborated to address and resolve a public problem about environmental pollution. The case concluded with the corporation signing a pollution control agreement.

Gurtoo (2015) draws on Cooray (2013) to mention formal structures of CP at the Japanese city council level by setting up a public committee for discussion and decision on a specific issue. Citizens can sit through city council meetings. Also, the city council’s annual “town week” meetings are held at the local community center to discuss their plan and past achievements where the citizen can attend and raise their voice. This council makes local decisions and includes citizens from diverse backgrounds, such as academia, police, medicine, industry, and entrepreneurs. The Local Decentralisation Promotion Committee (1995–2001) recommended many local governance and public participation systems, and decentralization began with the Omnibus Decentralisation Law in July 1999 (revised in 2001).

Howard (1999) conducted a study on forest resources in Japan and discovered that the professional elite primarily decided on forest management goals. Additionally, cultural barriers limited widespread participation in forest management. Nevertheless, the government demonstrated a proactive approach by openly discussing its resource management plans with the public. Additionally, they successfully utilized citizen’s financial contributions to establish forest plantations, thereby enhancing the well-being of the forest. Reed (2008) and Kamo (1997) have also discovered that the local government’s efforts and impromptu actions were stimulated by the local political parties before the new structures were implemented.

Sakurai et al. (2015) evaluated an urban conservation program in Yokohama, Japan's second-largest city. The authors surveyed residents about their willingness to participate in five conservation efforts. The poll showed that hiring locals for community-based management was difficult. Participation was linked to enthusiasm for conservation, which improved resident social relationships. Participation in conservation was driven by the belief that the metropolitan region lacked "green" habitat characteristics like gardens and other plantings, and tied to a sense of duty to protect the environment. Younger people were more engaged than older people. Sakurai et al. highlight the importance of social relationships in conservation efforts and the need for social and aesthetic benefits from conservation measures to increase engagement.

Over 100,000 individuals gathered data on biodiversity availability and distribution in the Third National Survey of the Natural Environment (Environment Agency 1989). Independent volunteers are a crucial component in collecting and strategically developing environmental data for official purposes. Urban districts were systematically grouped to cultivate and maintain trees (Tanaka 2014). Shingematsu (1991) observed that youth groups and firm personnel maintain public-owned plantations, while suburban youth contribute to the establishment of forests.

Lee et al. (2008) investigated the factors that influence the involvement of Japanese older adults in voluntary labor, as well as why some individuals choose not to participate. From Tokyo, 593 participants aged between 60 and 74 provided feedback. The study authors identified lack of time and limited accessibility or lack of information as the primary reasons for nonparticipation, as reported by most respondents. Most participants were women, individuals with superior health, and those who had been in the neighborhood for a longer duration.

Broadbent (1988) conducted a comprehensive investigation of the Oita prefecture and its city through open-ended interviews and analysis of information from government records and surveys. The primary obstacles to the main public involvement project arise from the local, conservative political parties and their supporters. Kida (2013) emphasizes the need for extensive CP, a space currently lacking in most towns. Her analysis of Oita City reveals that the local assembly's opaque proceedings hinder citizens from actively participating in government affairs.

Context: SWM Research in Japan

Hari (2020) states that SWM in Japan encompasses waste collection, processing, recycling, and minimization. This responsibility falls not only on local governments but also requires collaborative efforts from local businesses. Additionally, direct involvement from resident and citizen groups is crucial in developing tailored and localized solutions. These solutions include establishing local rules and regulations, educational initiatives, raising awareness, and implementing technological advancements.

The concept of public participation has several intricacies. The task of engaging various stakeholders and managing their competing interests presents a significant practical problem (Atoda and Fukushima 2000; Treby and Clark 2004) and requires systematic and rigorous scientific analysis like development

roadways rely on both socioeconomic analysis and technological feasibility studies (Coleman 1985; Mahmoud and Arima 2011; Nakano 2005). Few, Brown, and Tompkins (2007) and Kim (2010) emphasize the importance of including the relevant stakeholders, some of whom may be difficult to access. Furthermore, the equilibrium between formalization and the necessity for debates might give rise to hindrances such as the intended timeframe, increased burden for personnel, and the demand for extra expenditures (Fletcher et al. 2009; Kim 2010; Tanaka 2005).

The Japanese government prioritized the development of waste management to enhance public health. The Ministry of Environment (MoE) in Japan indicated that in the 1970s there was a focus on environmental protection, but in the 2000s, the emphasis shifted toward developing a sustainable material-cycle society. The issue of “public health” emerged in the early 1950s in the aftermath of the war and continues to persist (MoE 2005, 5–6; MoE 2014, 3).

Ie is a Japanese phrase that translates to “household.” The term can have two distinct meanings: it can either denote a tangible dwelling or be used to describe a family’s ancestral heritage. It is commonly employed as the conventional family arrangement. An *ie* is a physical entity that encompasses a property comprising a residence, rice fields, and vegetable gardens, as well as a designated area inside the nearby cemetery (Shimizu 1987).

The Japanese Constitution grants significant administrative autonomy to prefectures and municipalities, as outlined in statutes such as the Local Autonomy Law (1946) along with the Public Comment Procedure, 1999. Local government strategies should be developed through conversations with local citizens, rather than relying on central government (Mahmoud and Arima 2011; OECD 2013). Public participation in decision-making can increase responsibility, performance, and democracy, and reduce the influence of powerful lobbying groups and private sector or commercial interests (Avritzer 2002; Crook and Manor 1998; Drèze and Sen 2002; Li, Ng, and Skitmore 2012; Rakodi 2003; Wang 2001). Over the past decade, Japanese citizens have become more involved in policy-making and development decisions, including environmental protection, infrastructure planning, public health and education management, community development, and asset management (Nakano 2005; Tanaka 2014).

The prevailing opinion nowadays is that citizens should actively participate in the development of innovative concepts within the public sector (Basanta et al. 2015). Emerging paradigms in government, such as *open government* (Lathrop and Ruma 2010) and *new public governance* (Osborne 2006), citizens are perceived not solely as customers, but also as valuable collaborators in the formulation of public policy. The Japanese concept of *kaizen*—a concept now applied globally across settings for business and public sector management to denote efforts to achieve “continuous improvement” of performance—is applied in settings for public management and administration to enhance the quality of services and ensure citizen happiness (Tajkir 2018, 111). To illustrate, the Saitama City office in Japan successfully implemented this management strategy to enhance the quality of their services (Loeffler 2017).

Ensuring public health through the systematic and effective management of municipal solid waste is a challenge shared by public sector managers universally. Thus, applying policies and practices guided by a *kaizen* mentality in con-

texts of the management of municipal solid waste can inform new approaches to public governance in Japan and elsewhere in the world (Podgaiskyte 2014).

The emergence of a post-war public sector in Japan was markedly influenced by the occupation of the country by the United States and allied forces from 1945 to 1952. During this period, Japanese government policies at the national level were directed toward the reconstruction of infrastructure and the reestablishment of a nationwide manufacturing base. As an economic policy, much of what Japanese industry produced was directed toward reinvigorating consumer demand for goods such as domestic appliances (washing machines, refrigerators, televisions, and so on): consumer goods which, along with automobiles, became the bedrock of Japanese exports during the period which became known as Japan's economic and demographic "bubble" years of the 1970s and 1980s.

The resources generated and revenues received by local governments across Japan during this period of economic "boom" also formed the foundation upon which current policies and practices, technologies, and approaches toward the management of household waste became formulated and embedded in Japanese social and political thinking and action.

However, we should note how the sustained and highly debt-funded growth that remains (for now) a durable source of strength for growing the Japanese economy can serve to deflect the attention of researchers of public sector and business management in Japan away from major challenges of environmental pollution and, accordingly, of policies and practices of municipal waste management. To illustrate, and in response to the cases of severe environmental pollution and human suffering from the 1970s onwards, Walker (2015, 261) concludes darkly how: "In the name of the post-war economic recovery, which preoccupied Japanese politics for decades, the nation appeared willing to poison its most vulnerable people and environments."

SWM in Japan

Japan has experienced substantial economic changes over the past five decades that have had a major effect on SWM in the country. As per the Ministry of the Environment in Japan, the overall quantity of garbage produced in Japan has experienced substantial growth during the past five decades (Agamuthu and Babel 2023, 1709). In the 1960s, Japan faced severe environmental pollution due to insufficient dumping sites and dangerous emissions from SWM facilities and because of the huge production and consumption of goods at that time (MoE 2014, 4). During the 1960s and 1970s, Japan mostly relied on landfilling as their waste management strategy, with waste being commonly disposed of in open places (MoE 2012, 27). Japan's garbage production surged from over 28 million tons in 1970 to about 41 million tons in 2020 (Hiratsuka-Sasaki and Kojima 2020). However, per capita waste generation decreased from 1.22 kg/day to 0.94 kg/day in 2019 (Saitoh et al. 2022). Agamuthu and Babel (2023, 1709–10) delineate the Japanese tendency to prioritize waste reduction/recycling and technological advancements in waste management.

In 1970, the government took action by enacting the Basic Law for Environmental Pollution Control. This legislation had the objective of minimizing waste production and encouraging recycling to improve public health (Honma

and Hu 2021). Japanese municipalities bear legal responsibility for SWM. Since the Meiji Restoration period, municipalities have assumed the responsibility of managing solid waste at the household level as part of the public sector (CLAIR 2022, 15–6). In the Waste Management and Public Cleansing Act in 1971, Article 6 mandated municipalities to formulate waste management strategies and encourage recycling (Tanaka 2014).

Mottainai

Here it is relevant to invoke the Japanese term *mottainai*. This concept can be translated into English as “wasteful” or “undeserving.” Japanese citizens are socialized into observing and practicing the *avoidance* of being “wasteful” from early school years. To illustrate, schoolchildren in Japan routinely clean and tidy their classrooms. Japanese tourists and fans in sports stadia worldwide are renowned for tidying up and taking home items of personal waste after visiting a venue or event. On Japan’s streets, and in both urban and rural settings, it is difficult to find a public waste disposal facility.

The principle of *mottainai* merged as a guiding ethos that curbed wasteful practices and fostered the advancement of technologies aimed at reuse, recycling, and efficient utilization through heat recovery (MoE 2012, 1). Japan prioritized enhancing its waste management infrastructure and adopting innovative technology throughout the 1980s and 1990s. An important advancement occurred in the late 1980s with the implementation of the 3Rs (reduce, reuse, and recycle) (MoE 2005, 1) and Japan’s Extended Producer Responsibility (EPR) system (Yamaguchi). The implementation of this legislation resulted in a substantial surge in recycling rates in Japan, as manufacturers commenced crafting more user-friendly packaging and allocating resources toward recycling infrastructure (Ogushi and Kandlikar 2007).

Japan’s national and local (municipal) governments have implemented a range of strategies that encompass heightened awareness, collaboration among different entities, information sharing, technology research, and development, as well as numerous initiatives for developing a sustainable material-cycle society (MoE 2005, 5–6). Japan redirected its attention toward the establishment of a circular economy and the advancement of renewable energy sources (Herrador et al. 2022). The government implemented the Basic Law for the Promotion of the Recycling-Oriented Society in 2001, with the aim of waste reduction and the enhancement of recycling efforts (Hara and Yabar 2012). The post-war period and the beginning of the SWM focused on public health improvement, but gradually pollution problems and living environment protection and the establishment of a sound material-cycle society came forward. The new laws become necessary for achieving the targets and goals of society. Municipalities are responsible for supervising the organized gathering of materials.

Japan has demonstrated ongoing advancements in waste management, with a special focus on plastic garbage. In 2018, to diminish plastic waste and encourage the adoption of sustainable plastic practices (Ono, Hewage, and Visvanathan 2023), Japan pioneered sophisticated recycling technologies, like chemical recycling of plastic waste (Kuan et al. 2022, 761). Japan has primarily concentrated on minimizing waste production, encouraging recycling, and advancing technological innovations in waste management during the last fifty

years (Japan International Cooperation Agency 2022, 11). Japan's efforts have established it as a leader in waste management and have successfully reduced the environmental impact of waste (MoE 2014, 1).

Citizen Participation

One key theoretical concept informing the design of our observation scheduled during the gathering of field research data in a rural community in Setouchi City in Western Japan is “citizen participation.” In general terms, CP can be conceptualized as a process whereby private persons and, individually, any person of accepted legal (citizen) and social (status in a community) standing is invited (as a government policy) and enabled (as a public management practice) to participate actively in the implementation of government policy.

According to Cogan and Sharpe (1986), the origins of CP as a social and political activity can be traced back to the proto-democratic institutions of ancient Greece. Cogan and Sharpe describe a more recent iteration of CP in the “Great Society” programs initiated in the mid-1960s under the presidency of Lyndon Johnson in the United States—an initiative that served to both institutionalize the practice in public management and establish CP as a topic of interest to researchers in public sector management internationally.

Japan's municipal SWM has incorporated CP from the very beginning. Historically, this effort is referred to as the “War against Waste.” The example of inhabitants in Tokyo's Koto Ward uniting to combat environmental pollution carries various complex implications.

Amid Japan's period of fast economic expansion, Tokyo encountered the degradation of the environment in the vicinity of landfills. This occurred due to a significant accumulation of garbage disposed in landfills without undergoing appropriate treatment. The waste accumulation was a consequence of delays in constructing waste incineration facilities, which were hindered by objections from local citizens. The situation was most grave in the Koto Ward, as it received the majority of rubbish produced in all 23 wards of Tokyo. The residents in the Koto Ward experienced significant degradation of their living environment due to noxious odors and infestations of flies and mosquitoes originating from the dumps. Additionally, waste trucks further exacerbated the situation by depositing waste along residential roadways in the ward. In light of these conditions, the Koto Ward passed a resolution during a ward assembly meeting to express their opposition to taking rubbish from other wards. In contrast to a movement against the establishment of a waste incineration facility in the Sugunami Ward, the people of the Koto Ward obstructed the shipment of rubbish from the Sugunami Ward (MoE 2014, 7).

These advancements were extensively covered by newspapers and televised news broadcasts. Experiencing a profound feeling of urgency regarding these advancements, the Tokyo Metropolitan governor proclaimed a “War against Waste” in September 1971, asserting that the imminent garbage predicament posed a threat to the lives of Tokyo's inhabitants. The governor announced that the metropolitan government will enforce efficient waste management strategies, such as encouraging the establishment of waste processing facilities and landfills. The execution of these measures led to an eventual resolution. The War against Waste has increased public consciousness of waste as a significant

concern in everyday existence. Consequently, individuals acknowledged the significance of collaboration between government entities and citizens to advance trash management. Consequently, measures were taken to foster the establishment of waste management facilities that are environmentally sustainable (MoE 2014, 7; Siniawer 2018).

Citizen Participation in Japan: Volunteering

In the case of Japan, we can draw on the observation made by an eminent Japanese sociologist, Yoshio Sugimoto, who notes how the English term *volunteer* gained currency in public discourse in Japan “immediately after the Great Hanshin-Awaji Earthquake that devastated the Western Japanese city of Kobe and its environs in 1995” (Sugimoto 2014, 306). A similar citizen response was seen in response to the Great Tohoku.

The scale of this disaster along with its ongoing implications for the natural environment continues to infuse controversy at the geopolitical level in the East Asia region. To illustrate, the Japanese government’s 2023 decision to begin disposing of waste from the stricken Fukushima nuclear generation plant into the Pacific Ocean prompted the government of the People’s Republic of China (PRC) to ban the import of all seafood products from Japan.

According to Sugimoto, the scale and organization of volunteering activities in the aftermath of the Fukushima disaster gave rise to many influential forms of organized citizen actions in Japan. These include non-governmental organizations (NGOs) and nonprofit organizations (NPOs). As we detail later, of direct relevance to our research focus on CP in SWM is what Sugimoto terms the *rise of resident movements*. Sugimoto invokes the aforementioned tensions arising between the structures and strategies of economic growth in Japan with the threats perceived by associations of residents to their local eco-systems, the health of their community members, and/or the *negative* public value that might accrue to their local assets as a result of business-led exploitation of natural resources.

Recent research into the CP phenomenon as observed in Japan helps us distinguish more sharply between what sociologists such as Sugimoto describe as traditions of “volunteering” and what public management researchers might choose to term “citizen participation.” To illustrate, Gurtoo (2015) offers a detailed review of “citizen participation in governmental decision-making” in Japan. She alerts non-Japanese researchers of CP to take into consideration contextual factors such as traditions of Confucianist thinking in Japan such as respect for social hierarchy (which, in the contexts of management and public governance, tends to be male-dominated) and social order, which as a distinctive signifier in Japanese culture is commonly expressed as “harmony” or *wa* (Jackson 2020).

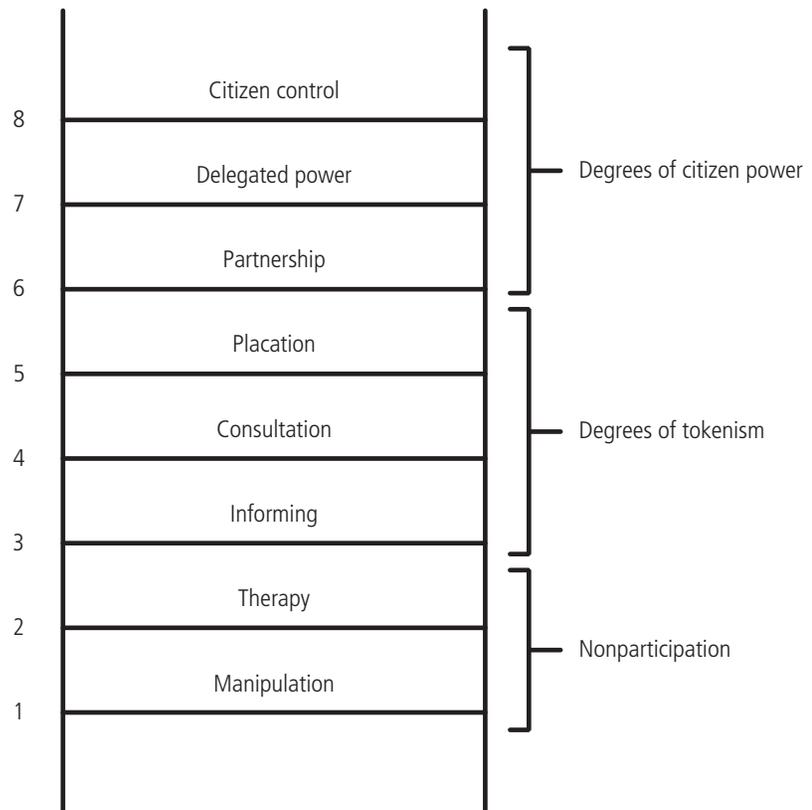
Theoretical Framework: The Ladder of Citizen Participation

In research methodology terms, it is important to emphasize how patterns of CP can be observed, described, recorded as data over time, and thereafter analyzed and compared across settings. Thus, the key theoretical framework informing the design of our analysis of data gathered from repeated fieldwork observations in Setouchi City is the so-called “ladder of citizen participation.”

Visualizing stages (“rungs”), degrees, and relative intensities of CP as a “ladder” was first proposed by Sherry Arnstein in 1969. This theoretical framework describes, explains, and predicts observed patterns of CP from a generalizable base. This theory is a highly cited and significant model within the realm of democratic public engagement (Organizing Engagement n.d.). Indeed, the Ladder of Citizen Participation Theory has emerged as the prevailing theoretical framework for understanding and analyzing citizen participation at the organizational level (Gaber 2019; Mapuva 2015; McQuaid 2010; Mostert 2003; Pollak 1985; Thapa et al. 2015), and waste management issues (Kofi et al. 2023; Morrissey 1992; Shukor et al. 2011; Stasiukynas et al. 2020). Arnstein talks about how citizens are denied their power by public officials and organizations and how people can gain more control, power, and agency.

With the ladder conceptualization, Arnstein guided researchers toward describing a hierarchy of observed or, from a public sector policy and practice perspective, potential patterns of facilitated or induced CP (Parker 2003). As illustrated in Figure 2, Arnstein’s ladder comprises CP. The first level is nonparticipation, which includes manipulation and therapy. The second level is degrees of tokenism incorporating informing, consultation, and placation. Finally, the last

FIGURE 2. Arnstein Ladder (1969) (From Arnstein, Sherry R. 1969. “A Ladder of Citizen Participation.” *Journal of the American Planning Association* 35, no. 4, 216–24. Copyright © 1969 American Planning Association, Chicago, IL, reprinted by permission of Informa UK Limited, trading as Taylor & Francis Group, www.tandfonline.com on behalf of American Planning Association, Chicago, IL.)



level is degrees of citizen power, which includes partnership, delegated power, and citizen control. Figure 2 describes the degree of CP in defined settings for empirical research.

As Figure 2 illustrates, Arnstein identifies eight distinct categories of CP. Each step or category represents the level of influence citizens have in shaping the outcomes of government policies and practices. For example, the ladder of CP identifies the bottom levels or rungs as (1) *manipulation* and (2) *therapy*. These two rungs delineate degrees of “nonparticipation.” Some individuals have devised this as a replacement for authentic engagement. Their primary aim is not to facilitate individuals’ involvement in the creation or implementation of programs, but rather to empower those in positions of authority to “cure” or “educate” the participants. At this stage, the task of participation is to garner public endorsement through the use of public relations. *Manipulation* covers organizing meetings with citizen advisory committees, or establishing such committees in a community; serves as evidence of genuine public engagement in a project that has not even been deliberated with these individuals. Individuals often lack awareness and eagerly provide their signatures for programs that are perceived as “noble.”

The ladder of CP categorizes the level of tokenism into three rungs: (3) *informing*, (4) *consultation*, and (5) *placation*. The *informing* and *consultation* levels enable the underprivileged to receive information and express their opinions. When powerholders present them as the exclusive form of engagement, citizens may actually listen and have their voices acknowledged. Nevertheless, in these conditions, they do not possess the jurisdiction to ensure that the influential individuals will consider their recommendations. Without restructuring participation to these levels, there is a lack of follow-through, effectiveness, and therefore no guarantee of altering the existing state of affairs. Rung 5, *placation*, can be seen as an elevated form of tokenism, as it permits the have-nots to offer advice but still grants the powerholders the ultimate authority to make decisions.

The subsequent stage of CP entails “degrees of citizen power,” which encompass three levels: (6) *partnership*, (7) *delegated power*, and (8) *citizen control*. The level of citizen empowerment and, thus, space and incentives to *participate*—gradually increases as the degree of involvement in the democratic decision-making process increases. During the *partnership* stage (6), citizens have the opportunity to reach a level where they can negotiate and make compromises with established authorities: e.g., a mayoral representative of a local government. At the highest levels, persons who lack resources acquire the majority of decision-making positions or complete management authority.

RESEARCH DESIGN

As mentioned previously, Arnstein’s ladder of the CP model has guided the research designs of generations of social researchers. For example, Mostert (2003, 182–3) describes the different levels of CP with the lists of different methods based on Arnstein’s ladder (Arnstein 1969; Creighton 2000; Edelenbos 2000; IAP2 1969; Roberts 1995). Table 1 illustrates some of the refinements proposed from the findings of researchers in the field of CP. As can be seen in the table, additional dimensions of CP have been proposed (Borrini-Feyerabend

TABLE 1. Citizen Participation Levels and Variables Relevant to Empirical Research Design (Adapted from Mostert 2003, 183.)

Level of Participation	Possible Public Participation Methods
<p><i>1. Information</i></p> <p>The public gets/has access to information (not genuine citizen participation, but the basis for all forms of it)</p>	<p>i. Leaflets and brochures ii. Mailings iii. Use of the media: press releases, press conferences iv. Information centres v. Repositories (other than iv, e.g., libraries and city halls) vi. Travelling exhibitions vii. Information hotlines/contact persons viii. Open house ix. Field trips x. Briefings (at meetings of residents' associations, women's clubs, etc.) xi. Internet xii. Cultural events (e.g., street theater, especially for raising awareness)</p>
<p><i>2. Consultation</i></p> <p>The views of the public are sought</p>	<p>xiii. Reply forms xiv. Opportunity to comment in writing xv. Public hearings and meetings xvi. Interviews xvii. Opinion polls xviii. Stakeholder analysis xix. Gaming xx. Internet discussions xxi. Advisory commissions/boards, focus groups xxii. Non-binding referenda</p> <p>Methods iv, vi, vii, viii, ix, and x could be used for consultation too.</p>
<p><i>3. Discussion</i></p> <p>Real interaction takes place between the public and the government</p>	<p>xxiii. Small group meetings (workshops, charrettes, coffee meetings, round tables, study circles, brainstorm sessions, planning cells, citizen juries, etc.) xxiv. Large group meetings involving splitting up into smaller groups and/or rotation between front benches and back benches or between subgroups (e.g., working groups, Samoan circle, open space meetings, carousel)</p> <p>Methods viii, ix, x, xix, and xxi can be used too.</p>
<p><i>4. Co-designing</i></p> <p>The public takes an active part in developing policy or designing projects</p>	<p>Several of the meeting formats are mentioned under xxiii and xxiv.</p>
<p><i>5. Co-decision-making</i></p> <p>The public shares decision-making powers with the government</p>	<p>xxv. Negotiations, e.g., resulting in a "voluntary agreement" xxvi. Public representation in governing bodies xxvii. Corrective referenda and all binding referenda initiated by the government</p> <p>Some of the meeting formats mentioned under xxiii and xxiv may also be used.</p>
<p><i>6. Decision-making</i></p> <p>The public performs public tasks independently</p>	<p>xxviii. Water users' associations and other NGOs performing public functions xxix. Popular initiatives</p> <p>Some of the meeting formats mentioned under xxiii and xxiv.</p>

et al. 2000; Creighton 2000; Renn, Webler, and Wiedemann 1995; World Bank 1996). These include processes such as "social learning" that attempt to incorporate both the basic concept of Arnstein's "power dynamics" by highlighting various types of observed participation activity.

Arnstein's (1969) *A Ladder of Citizen Participation* served as the basis for the development of many indicators used to identify different forms of participation by citizens in specified geographical and/or public administration settings: e.g., in processes of household waste management in a rural area of Japan.

Case Study

To observe and interpret salient patterns of CP in contexts of SWM by municipal governments in rural Japan, we elected to develop a case study (as defined by Yin [2018]) of Setouchi City in Western Japan. In relation to CP, we should note that the Japanese term *shimin* refers generally to an individual person's

social status and identity as a citizen. Consequently, Setouchi, a collection of rural communities, can describe itself for public administration purposes as a “city” because its responsibilities are by law geared toward serving the citizens of these various rural communities collectively. The signifier “city” thus varies from its use in international settings for public management research where a city might be defined historically and/or by size of population and other demographic variables. For example, a “cathedral city” in the United Kingdom might be smaller in population than a “town” in other regions of the country.

Both quantitative and qualitative data were collected during a series of fieldwork visits from 2022 to 2024. The data generation methods were tested and validated by application of the ladder model in two pilot studies: one at a solid waste incineration facility in Takarazuka, a semi-rural suburb of Osaka in Western Japan; and one in the urban location of Osaka City.

As in the pilot studies, the data-gathering exercises in Setouchi City were augmented by video footage (e.g., of solid waste incineration techniques) and photographs (e.g., of waste recycling installations) taken by the researchers and documentation and other evidence provided on-site by senior officials, executives, and policymakers in Setouchi City Hall. The research is ongoing. To illustrate, in April 2024 Setouchi City government kindly offered to allow researchers access to a series of focus group discussions with representatives of citizen councils, resident associations, and volunteer organizations with a direct interest in the city’s SWM policies and practices.

The data from the fieldwork visits were analyzed from two overlapping yet distinct perspectives. The citizen perspective refers to the role of citizens and their involvement in SWM. This also demonstrates the extent of their potential involvement in this process. The second perspective is institutional, emphasizing the crucial function of institutions. What role does the organization play in managing solid waste for the population? Specifically, what opportunities does the institution offer for participating in SWM policy-making and practices by the citizens of Setouchi City?

Key Findings

Table 2 illustrates some of the key findings from the analysis of fieldwork data.

Findings from Questionnaire and Survey Interviews

A series of 23 surveys was carried out (Miles and Huberman 1984). From the entire sample, 20 participants were classified as citizens, and the remaining three were categorized as service providers. Out of the population, 55 percent were male. The participants consisted of individuals from diverse occupational backgrounds, such as students, educators, professionals, community activists, entrepreneurs, and homemakers. Some individuals withheld their age, occupation, and personal information. A majority of participants (55.5 percent) were aged between 41 and 54 years. During the process of conducting three interviews with service providers, the number of responses surpassed five. Nevertheless, for the purpose of analysis, every interview was regarded as an individual unit.

TABLE 2. Observed Patterns of CP in Processes of SWM in Setouchi City

Role of Citizens	Role of Municipalities
Citizens are responsible at the household level for waste preservation, sorting, and dropping at the designated waste collection center.	Municipalities are responsible for waste collection from the roadside collection center through the cleaning center and private companies.
Citizens sorted waste according to the city garbage plan.	The city office selected respective companies for specific waste, like PET bottles, cans, and paper, and introduced them to the citizen groups.
Citizens spent their money purchasing garbage bags and maintaining a timetable prescribed by the municipalities.	The city office provided a small subsidy to the local citizen group as support for different community work.
Citizens are collectively responsible as citizen groups for waste collection centers at the community level.	Municipalities are responsible for waste collection from those centers according to the garbage plan.
Citizens follow the city garbage rules and act accordingly.	The city office collected citizens' opinions before planning through the private consulting organization. The city office makes garbage plans for the city. The city office follows the central rules and regulations.
Citizens visited the cleaning center once a year and third grade elementary school students also visited the cleaning center as a part of their education.	The cleaning center welcomes them and describes the facilities of the cleaning center.
Citizens have direct communication with the city office and the cleaning center and complain and comment on the services both oral and written form	The city office takes action promptly against the complaint.
Citizens can attend the city office meetings, and town meetings at the community level, using apps and websites to get information and feedback.	The city office generates facilities for face-to-face meetings, creating and maintaining apps and websites for information dissemination and feedback.
Citizens participate in the specific city garbage reduction plan.	The city office analyzes the existing situation and creates a local plan for achieving the central target.
Citizens can collect information from printed materials like garbage calendars, garbage sorting instructions, and disposal leaflets.	The city office provides and prints materials like garbage calendars, garbage sorting instructions, and disposal leaflets to the citizens.
Citizens groups are enlisted through the city office.	The city office maintains a relationship with the citizen groups.

Household SWM Activities by the Citizens

Table 3 displays the primary data collected from interviews regarding the specific work or role that Japanese citizens do in household-level SWM.

Citizens mentioned that at the household level, they separated or segregated waste (95 percent), disposed of waste at the collection point (70 percent), maintained designated time and place for waste disposal (65 percent), used specifically designated bags for waste disposal (70 percent), and followed city rules and guidelines for waste disposal (45 percent). These activities are interrelated. Some activities vary from city to city, according to the city by-laws, for instance, the separation of like-type items, time-table for waste disposal, and use of specific garbage bags. However, this study finds homogeneity of SWM activities in Japan.

TABLE 3. Role of Citizens in SWM in Japan

Role of Citizens	Frequency	Percentage
Sorted or segregated waste at the household level	19	95
Disposed of waste at the collection point	14	70
Maintained designated time and place for waste disposal	13	65
Used specific garbage bags for waste disposal	14	70
Followed the city rules and guidelines for waste disposal	9	45

Citizens think that these activities “make it easier for garbage collectors to do their jobs” (CJP 16)¹ and during the SWM activities, “citizen responsibility is very primary level” (CJP 14). The overall SWM activities in Japan are set by, maintained by, and followed by the law. Peer pressure helps to create public value.

One of the citizen’s (CJP 17) observations is that “citizens are expected to follow the rules set forth in laws and ordinances. The finer, more subtle details depend on our values. This is very important in Japanese society. In other words, ‘Is the behavior appropriate?’ That is, Is it appropriate? and we must act within the bounds of what is reasonable. If you do anything outside of this range, you will be labeled an ‘outlaw’ by everyone.”

City officials in Setouchi think that “citizens cooperate with our government-led waste reduction and sorting schemes, reducing waste, recycling, sorting, converting organic waste into compost, and reducing consumption (e.g., avoiding food waste).” An expert opinion on discharging garbage was, “citizens should use designated material (mainly transparent plastic bag) and set out at designated place and time.”

Citizens were solicited for their perspectives on the advancement of SWM. Most citizens emphasize raising awareness of individual garbage separation and reducing the volume of garbage. The elderly and foreign citizens were identified by the respondents as the two distinct sectors that require attention to improve SWM. Citizens thought that “a social problem that has emerged in Japan is that the elderly become unable to separate garbage as their cognitive abilities decline, resulting in the accumulation of garbage at home” (CJP 15).

In many cases, citizens observe that foreign citizens do not follow the garbage separation rules properly. “Many university students live in the neighborhood. There are cases where garbage is not put out on the correct day of the week, such as before long holidays, and garbage is not separated properly, causing trouble with residents” (CJP 18).

“This is because the number of foreign residents has increased in recent years, the Japanese language proficiency of residents has varied, and there are a certain number of residents who cannot (or do not) understand announcements. In this respect too, there may be a problem with overly detailed classification” (CJP 14).

¹The coding methodology employed in this study identified individuals belonging to the same occupational group. Unique identifiers were assigned to each subject. This code ensured the anonymity of the interviewee. The codes were: CJP, citizen of Japan; SPJP, service provider of Japan.

Citizen Groups/Associations in SWM in Japan

The respondents' answers were accumulated and separated into four different types of statements. These statements were then coded as follows: citizen groups/associations are available; citizen groups/associations are not available; I don't know, and citizen groups/associations are available, but I don't have any communication. These data are presented in Table 4.

The presence of citizen groups/associations is mentioned by around 65 percent of respondents, whereas 10 percent of respondents expressed that there are no citizen group activities. On the other hand, few respondents (10 percent) acknowledge the availability of citizen groups but they do not have any communication. However, 15 percent of respondents do not know or have no idea about the citizen groups/associations.

Citizen Groups/Associations Activities and Management

In Japan, citizen groups or associations are commonly known by different names, such as resident associations and neighborhood associations. These social groups are enlisted through the city office and serve voluntarily. The fieldwork observed that 360 citizen groups are enlisted in Takarazuka City (SPJP 03) and several groups are active in Setouchi City areas (SPJP 02). These groups work closely with the city office on different issues; SWM is one of them. Citizens' and group members' opinions are accumulated and reflected in Figure 3. It helps to explain their activities regarding SWM at the community level. Citizen groups' activities are one kind of cumulative CP at the community level in Japan.

Setouchi City officials mentioned that "several citizen groups in the city collect used cloth and paper for reuse. These groups have taken it upon themselves to sort [what they collect] into waste and reusable material and then to reuse what they can." Takarazuka Clean Center officials also mentioned the presence of citizen groups in Takarazuka City. "There are around 390 citizen groups affiliated with the Takarazuka City Office. They also look after proper garbage dumping at the community level. Citizen groups promote group collection methods, which help reduce the volume of garbage and the cost of waste management."

Citizens express that a "citizen group is a voluntary organization that helps to clean the local community," (CJP2) but "they do not directly treat waste" (CJP1). These groups "work closely with the cleaning centers to provide recycled materials" (CJP20) and "dispose of oversized garbage" (CJP2). The city office and these groups coordinate with each other according to their need, but regularly once a year (SPJP3). In Setouchi City, several meetings and programs

TABLE 4. Availability of Citizen Groups/Associations in Japan

Citizen Statement	n	Percentage
Citizen groups/associations are available	13	65
Citizen groups/associations are not available	2	10
I don't know	3	15
Citizen groups/associations are available, but I don't have any communication	2	10

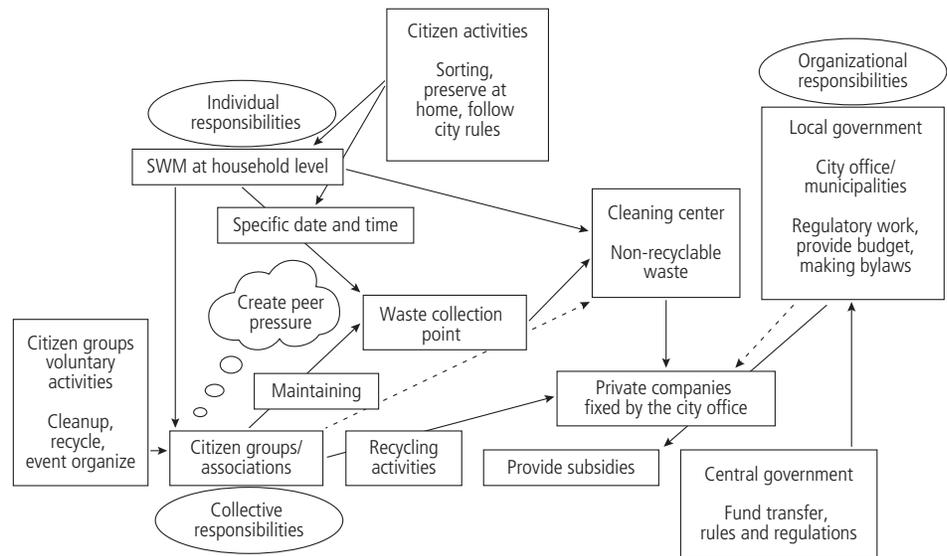
FIGURE 3. Activities of Citizen Groups

were organized to achieve the special city garbage plan (SPJP2). Citizen groups have communicated with the private companies selected by the cleaning center for recycling purposes. “When it comes to recyclable waste, the company which is chosen by the city office comes to collect it,” mentioned a citizen (CJP13). The city office provided a little subsidy for their support to arrange some social events, like mochi making, observing sakura, and so on (CJP14).

During the interviews, citizens mentioned that “residents pay a neighborhood association fee of several hundred yen per month for each unit” (CJP18), and “have a neighborhood membership fee of approximately 2,000 yen per household per year, which varies by neighborhood association” (CJP19). Citizen groups/associations have an executive team, comprising the chairman, vice-chairman, and annually rotating group heads. Annual general meetings are held once every year (CJP17). The association develops an annual budget that funds the maintenance of recycling facilities and the procurement of materials for community cleanup events. At regular monthly meetings, members report on their activities and exchange opinions (CJP20) (not so common for all citizen groups).

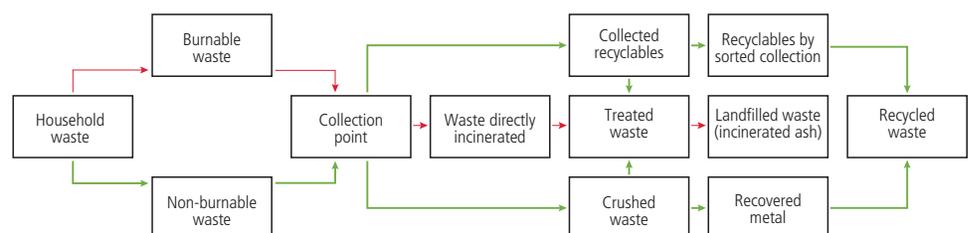
Household SWM Activities in the Rural Areas in Japan

From the fieldwork data, it is observed that the basic operations and activities are more or less the same due to the legal provisions. Experts in SWM opinion are “in the case of small cities/municipalities, they will make greater efforts to promote 3Rs.” However, Setouchi City officials expressed that, “in some areas (cities/towns/villages), they go house to house to collect the rubbish that households have placed in front of their homes. There are also slight differences in waste disposal regulations and plans as well in city treatment center capabilities, depending on the prefecture and city/town/village.” These differences are not

FIGURE 4. Household SWM Activities in Japan

operational differences. A classical example is observed in Osaka and Setouchi City for final garbage disposal. Mishima Incineration Plant in Osaka produces electricity from burnable wastes, but Setouchi City only incinerates waste for final disposal due to a lack of capacity. Figure 4 describes a typical household waste flow diagram in rural areas in Japan.

In Setouchi City, citizens sort their rubbish into the categories as outlined by the city, then dispose of it in the “garbage station” managed by their local residents’ association on the government-specified collection day. Figure 5 describes the general household waste flows in rural Japan. The waste is collected by private contractors commissioned by the city and taken to the Clean Center Kamome (CCK), the city’s waste disposal site. There are 14 sorting categories: burnable waste, drinks cans, plastic containers and packaging, PET bottles, glass food and drink bottles, hardware, used batteries, fluorescent light tubes, ceramics, miscellaneous glass, paper, burnable bulky waste, non-burnable bulky waste (including small household electrical appliances), and cloth. Besides disposing of waste at their local garbage station, citizens can also bring their household waste directly to the CCK. Burnable waste brought to CCK is incinerated. Ceramics and miscellaneous glass destined for landfill are handed off to a special disposal contractor. Rather than being disposed of as waste, other categories of rubbish are sent to recycling companies for processing into economically valuable materials.

FIGURE 5. General Household Waste Flows in Rural Japan

DISCUSSION

Applying Arnstein's ladder theory (Figure 2) and subsequent research-led developments based on it (Table 1), we examine CP in SWM. In the broader context, citizens in Japan are fully responsible for household-level SWM and drop-off to the collection point. In this way, the active engagement of CP by households is both socially expected and legally required. Consequently, and specific to our observations of CP in Setouchi City, the lowest rungs of the ladder, *manipulation* and *therapy*, appear to be not applicable: observed patterns from field research suggest a higher level or "rung" of CP. Stasiukynas et al. (2020) mention that a higher step does not mean better or more effective participation forms that meet the targets. The key elements of successful governance are civil engagement and active participation in decision-making (Bovaird and Löffler 2003).

From the field data informing the study of CP in Setouchi City, we can note how CP in SWM activities is ensured by law. The role of citizens in waste management in Japan is "to endeavor to reduce the amount of waste and to sort it so that it can be recycled and used again." They must also "dispose of waste responsibly and comply with waste reduction and sorting laws enacted by the state and other bodies." Article 2-4 of The Waste Collection and Processing Act (1970) mentioned correct waste disposal as a "Citizen responsibility." The prefecture is in charge of "industrial waste" management and municipalities are in charge of managing "general waste." Not only are several subsequent laws related to SWM enacted by the central government, each municipality has its own bylaws based on the Waste Management and Public Cleaning Act. As a result, each municipality decides on its own collection methods, etc. (e.g., garbage collection point, door-to-door collection, etc.); some municipalities have similarities, while others are completely different.

While citizens are allowed to voice their opinions through a questionnaire during the formulation of by-laws, there is no guarantee that their thoughts will be incorporated. According to the ladder, the fifth rung, *placation*, describes such participation as a degree of tokenism. At this stage, maybe all citizens are not technically sound and fit to provide actual contributions to the decision-making process, as in Japan's SWM.

Leaflets, garbage calendars, waste separation posters, and books for the citizens cover the one-sided information flow at the city level from the local government side. Field data mentioned that citizens are satisfied with the content of the information, which coincides with the ladder's *informing* level of participation. In Japan, technology, especially garbage-related apps and interactive websites, makes the information more vibrant than the print sources. Fieldwork observation reveals that it creates a feedback mechanism. However, this feedback is intended for citizens seeking services or information rather than involving them in decision-making.

Town meetings, opportunities for presence in the council meetings, direct application for seeking services, and public hearings are observed in the SWM process in Japan which highlights the fourth rung, *consultation*, on the ladder of participation. In Japan, city councils try to reduce waste volume as part of their central policy.

Examination of official documents and other information shared publicly with the researchers and with citizens of Setouchi City confirm that the city has

its own plan-specific targets for investments in SWM. In general, the policy is to reduce the volume of burnable waste from households and increase recycling activities. Several meetings, monitoring, and activities are found in the progress report of these activities. This planning and execution strategy covers the *placation* rung of the ladder theory. However, in Setouchi City the success rate of achievement is half of the target, which raises many questions about CP. According to Schlossberg and Shuford (2005), the interested persons or the stakeholders might be defined as a group or individuals that might influence the pursuance of the organization's goals, or whose influence might be exerted to reach goals.

Voluntary group activities are observed during the fieldwork in Japan in SWM in the name of citizen groups/associations, neighborhood associations, and residence associations/groups. These groups are affiliated with the city office—a kind of formal recognition from the government side. The city office provided a subsidy and had contact with the private sector recycling company through the city office in Japan. These voluntary citizen groups are responsible for setting up the local waste collection centers and maintaining them as well. They have an active role in the recycling process. These activities indicate a “partnership” between citizens and local government. Arnstein describes this level as “degrees of citizen power” and partnership is just the beginning of this stage. However, these voluntary activities are not as ideal, as Arnstein mentioned, but activities have proven a citizen-state relationship in Japan (Yun 2006). The Japanese voluntary activities (Lee et al. 2008; Kida 2013; Mori et al. 2008; Nakano 2005; Shingematsu 1991; Tanaka 2005) and different socio-cultural contexts (Andrew and Vries 2007; Faure 2001; Hill and Fujita 2000; Kim 2010; Mostert 2003; Wang and Tan 2006) can be defined as this unique contribution to Japanese style partnership in the context of the ladder theory.

The information provided by the city office for citizens regarding proper waste management (sorting, disposing of, and recycling) can be considered as a part of educating citizens. The cleaning center visiting facilities become a hands-on training facility for the citizens from the government side. On the other side, citizens spent their personal money (purchasing garbage bags and other items for disposal), time, and effort (following specific manners and schedules), and acted as volunteers indicating a strong sense of belongingness in the SWM activities in Japan. Applying a penalty is rare for illegal dumping, although there is a provision by law. However, peer pressure and social motivation are used as correction measures. In contrast to ladder theory, it is more than the *partnership* level, but not actually *delegated power*.

Applying the Arnstein (1969) typology and ladder model of CP, the capacity for CP in Setouchi City is close to the upper level. The active participation of citizens and the creation of participation opportunities with the help of the central law and policy may create a favorable environment for improving SWM activities. CP started in Japan (like many other countries) through a legal basis, but different initiatives from the local government make a space for the citizens in SWM. Japanese social culture makes citizens participate in different dimensions. This active participation of different stakeholders increases the chance of more effective SWM activities in both rural and urban regions and municipalities across Japan.

CONCLUSIONS AND PROSPECTS FOR FUTURE RESEARCH

As stated in the introduction, this article has been guided by explicit reference to two research questions:

- How can we describe contexts for researching the role of CP in SWM in Japan?
- Drawing on previous international research into CP in contexts of SWM, what are salient patterns of CP in the context of the formulation and implementation of policies and practices of SWM generally, and specifically in the case of one rural government setting: Setouchi City in western Japan?

This article's contextualization, presentation, and discussion of findings from an interim analysis of field research data in Setouchi City guides readers toward answers to the above questions.

As mentioned in the introduction, this article is one outcome of a much larger and ongoing research project. Questions guiding this ongoing research include:

- To what extent might local government policies and practices designed to facilitate CP in SWM policies and practices serve effectively to safeguard public health in rural communities in Japan?
- To what extent might local government policies and practices designed to facilitate CP in SWM policies and practices serve effectively to improve measures of public value?

Consequently, our research effort is ongoing and, ultimately, is designed to address research questions such as those above that are generalizable to other settings for research into SMW and the potential of CP to improve the effectiveness of SWM. For example, research into effectively achieving public policy objectives such as generating “public value” and strategic objectives such as safeguarding public health, nationally and in defined municipalities in rural regions of Japan and, for immediate comparison, Bangladesh.

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Review of Business is published twice a year.
ISSN: 0034-6454

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